AN INVESTIGATION INTO THE DOMESTIC AND INTERNATIONAL TRADE OF WILDLIFE FOR MEAT AND MEDICINE IN SOUTHEAST ASIA

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For the wild and beautiful creatures in my life

This thesis is the result of my own work, except where indicated and acknowledged in the text. No part has been submitted for any other degree at any other university.

Title photograph: An Asiatic Black Bear cub for sale in Lao PDR, 2016.

ABSTRACT

Global biodiversity is being ravaged by the commercial utilisation of wild plants and animals. In recent years this commercial trade has dramatically escalated. Once a species is targeted, trade-driven demands can rapidly diminish wild populations. In Southeast Asia, the potent combination of rising population, disposable wealth, popular demand and easy access to natural resources has had a drastic impact on the region's mega rich biodiversity, propelling over-exploitation and illicit trade. This makes it a crucial field of study. In this critical appraisal, I present my research on a leading driver of species decline – the trading of species for meat and medicine predominantly in the Southeast Asian region from 2015-2021. My primary objective has been to augment existing knowledge of species utilised for these purposes and discover ways in which to minimise negative trade-driven impacts. My work has encompassed analysis of 15 years' worth of seizure and CITES trade data, 60 days of market surveys, and 90 days of online markets surveys. It has also encompassed reviews of wildlife laws and policies as they pertain to species protection and utilisation. Using these methods, I have provided data on the trade of 18 species in eight countries involving over 1000 bears + unquantified parts and derivatives; over 45, 000 pangolins involving live animals, scales and meat; and other less prominent species i.e., serow – 1015 parts and derivatives, saiga antelope – unquantified quantities of horn shavings and powders, porcupines – 454 animals + 445 bezoars, pig-nosed turtles – 52, 373 live animals, and leopards – 83 animals. I have also reported on key trade hotspots and trafficking routes; legislative loopholes, enforcement strengths and weaknesses; and recommendations to reduce or disrupt over-exploitation and illegal trade. These publications provide vital insight into the meat and medicine trade in Southeast Asia. They serve as a foundation and resource for future trade work and research by conservation organisations, government agencies, independent scholars and other relevant stakeholders. The results have been used to support species threat assessments, conservation action plans and law enforcement. Perhaps most importantly the knowledge marshalled in this study can be utilised to educate and raise critical awareness among the general public whose insatiable appetite for these particular products fuels this extremely aggressive and lucrative commerce in wildlife.

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ABBREVIATIONS

CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
COVID-19	Coronavirus
EIA	Environmental Investigation Agency
FCPMDAM	Federation of Chinese Physicians and Medicine Dealers Association of Malaysia
IUCN	International Union for Conservation of Nature
IWT	Illegal Wildlife Trade
LEMIS	Law Enforcement Management Information System
NGO	Non-governmental Organisation
PDR	People's Democratic Republic (in reference to Lao)
SEA	Southeast Asia
SIPP	Sistem Informasi Penelusuran Pekara
TCM	Traditional Chinese Medicine
UNODC	The United Nations Office on Drugs and Crime
USAID	The United States Agency for International Development
WCS	Wildlife Conservation Society
WFFT	Wildlife Friends Foundation Thailand
WJC	Wildlife Justice Commission
WWF	World Wide Fund for Nature

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1 INTRODUCTION

1.1 Background on Wildlife Trade

Wild plants and animals are harvested around the globe for a variety of purposes, but most notably for commercial trade. This has come to be among the greatest threats to biodiversity, human health and economic security. According to Morton et al. (2021), an estimated 62% of birds, mammals and reptiles in trade show a decline in abundance. The trade in wildlife revolves around the demand for food, medicines, pets, entertainment, trophies, jewellery, clothing, luxury goods, ornamental items, charms or talismans and these demands have resulted in a multibillion-dollar wildlife trade industry (TRAFFIC, 2008; WAP, 2020). Based on the World Wildlife Trade Report released in November 2022, from 2011 - 2020, over 1.26 billion plants and 82 million animals and an additional 279 million kg of wildlife products were recorded in international trade (CITES Secretariat, 2022). These volumes however only cover species listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) that are traded internationally. It does not include domestic or illegal wildlife trade volumes. Discourse on the issue of unsustainable and illegal wildlife trade has intensified in recent years as we face a global biodiversity extinction crisis ('t Sas-Rolfes et al., 2019). While there are numerous factors (e.g., deforestation, habitat loss and degradation) contributing to the extinction of species, Fukushima et al. (2020) reveals the pervasiveness of the global wildlife trade which encompasses species from almost all marine and terrestrial realms and habitats. It further highlights just how little we know about wildlife trade including which species are being targeted, for what purpose or to what extent.

Southeast Asia has a highly diverse range of habitats and ecosystems, making it exceptionally rich in biodiversity including endemic and range-restricted species. Globally, it is a significant region for species conservation as it hosts six of the world's 25 biodiversity hotspots that contain 20% of the planet's vertebrate and plant species (Hughes, 2017). It is also one of the most densely populated hotspots in the world with an estimated population of over 675 million, many of whom still depend on wildlife for subsistence (TRAFFIC, 2008; UN, 2019). Rising population, economic growth, disposable wealth, ongoing demand for and easy accessibility to natural resources have resulted in severe consequences for wildlife with the greatest number of species threatened with extinction found in Southeast Asia (Duckworth et al., 2012). Over the years exploitation for commercial trade has steadily become the leading threat to biodiversity in the region (Krishnasamy and Zavagli, 2020). Currently, Southeast Asia is a key source and consumer of wildlife globally, the consequences of which have been species extinctions or extirpations from parts of their range, with many more being pushed in that direction (Lee et al., 2005; Shepherd and Ibarrondo, 2005; Corlett, 2007, Nijman, 2010). Illegal wildlife trade (IWT) is particularly pervasive in the region (TRAFFIC, 2008; Nijman, 2010; Duckworth et al., 2012; Eaton et al., 2015; Krishnasamy and Zavagli, 2020). Poor enforcement action, weak laws, as well as the lack of prosecution and judicial law enforcement have been cited as major reasons for the continuing exploitation, trade and decline of species in Southeast Asia (Nijman, 2010). Weak border controls and high corruption levels have intensified the threat to wildlife.

While there have been many important conservation initiatives and developments in the region over the years to counter illegal and unsustainable wildlife trade such as improved wildlife trade policies and legislation, outright bans of wildlife markets, strengthened regional and international partnerships aimed at tackling cross-border smuggling (Krishnasamy and Zavagli, 2020; Narang and Watson, 2020; USAID, 2021) the problem persists due to the growing global demand for wildlife.

Despite the emergence of COVID-19 raising concerns regarding the threat from zoonotic diseases, wildlife markets continue to operate across the region with impunity. The high economic value of wildlife trade has meant that legal and illegal markets flourish alongside each other (Phelps et al., 2016; Wong, 2019; UNODC, 2020). Corruption and the increasing involvement of organised crime syndicates make it even harder to distinguish legal from illegal trade, impeding conservation efforts and the legal and sustainable use of wildlife resources. Further exacerbating the issue is captive breeding of wildlife, as such facilities are arguably of little conservation value with wild-caught animals known to be laundered and trafficked through them. This practice further stimulates demand and trade in highly threatened species (Brooks et al., 2010; Four Paws, 2020; WFFT, 2020).

This critical appraisal focusses on species traded for meat and traditional medicine in Southeast Asia. This has become a significant threat to species yet, research around this subject in the region has been limited.

1.2 Traditional Medicine Trade

A centuries-old practice, the use of wildlife in traditional medicine is widespread around the globe and remains deeply rooted in modern day culture and lifestyle (Alves et al., 2009; Feng et al., 2009; Nijman and Bergin, 2017; Gbogbo and Daniels, 2019). Wild plants and animals are a crucial resource in a variety of traditional medicinal remedies that range from general health benefits and a common cold to liver ailments and cancer (Costa-Neto, 2005). It has been estimated that 80% of the world's population relies on wildlife-based traditional medicinal remedies (Lee et al., 2014). This is particularly evident in developing countries as traditional medicine is often more affordable than modern medicine and in remote areas it can be the only form of medicine available (Sofowora, 1996; Soewu et al., 2012; Alves and Rosa, 2013). However, commercialisation of the industry in a globalised world has also made traditional medicine mainstream, regardless of actual efficacy. Such a development has triggered overexploitation of a vast and varied range of species and undermined the value and reputation of the industry/practice (Lee et al., 2014; Alvarado Martínez and Martínez, 2018; Peng and Chen, 2021).

In Southeast Asia, traditional medicine is an integral form of alternative medicine that is used for disease prevention and treatment as well as for general health maintenance (Davis et al., 2019; Liu, 2021). Herbal treatments, consisting of wild plants or animals or a mixture of both, are believed to have many healing properties (Nijman, 2005; Goodrich et al., 2015; Cheung et al., 2021). Such beliefs are driving species declines across the globe (Nowell, 2000; Brooks et al., 2010; Lee et al., 2014; Milliken and Shaw, 2012; Nijman et al., 2017; Alvarado Martínez and Martínez, 2018; Shepherd et al., 2020). Traditional Chinese medicine (TCM) in particular is a multibillion-dollar industry and China's controversial 'Belt and Road Initiative', which covers over 100 countries, includes specific goals to expand the TCM market (Hinsley et al., 2020; EIA, 2021). This is likely to stimulate demand further and heighten existing threats to a myriad of species consumed for this purpose. The consequences of the spread of TCM on species can already be witnessed throughout Southeast Asia (Livingstone et al., 2018; Wong, 2019; Krishnasamy and Zavagli, 2020; EIA, 2021).

1.3 Wild Meat Trade

Wild meat consumption is prevalent in many parts of the world. Trade of wild meat on a commercial scale has caused excessive and illegal hunting of species to meet local and international market demands, threatening biodiversity, food and livelihood security (Fa et al., 2002; Milner-Gulland and

Bennett, 2003a; Lee et al., 2014; Gluszek et al., 2021). In rural communities, wild meat can be the staple source of sustenance and income (Nooren and Claridge, 2001; Scheffers et al., 2012; Fa et al., 2015; Martine et al., 2020). In many urban markets, a wild meat industry thrives due to a demand for exotic or luxury food (Nasi et al., 2011; Chaves et al., 2019; Fa et al., 2019; El Bizri et al., 2020; Gluszek et al., 2021). Growing affluent societies in parts of the world advertise their high status by purchasing expensive wild meats, the price of which is often determined by the rarity of a species and its wild origins (Drury, 2011; Shairp et al., 2016; D'Cruze et al., 2021; Gluszek et al., 2021). Some studies also show there is a preference for wild meat due to the perception that it is healthier than farmed livestock or because it offers more variety than domesticated meats (Chaves et al., 2019; Pruvot et al., 2019). In essence, there are many factors that drive the hunting of wildlife for consumption and this has contributed to species declines (Corlett, 2007; Brooks et al., 2010; Lindsey et al., 2013). Increasing demand due to a constantly rising global population magnifies the threat posed by the wild meat consumption (Corlett, 2007; Mayor et al., 2021; Fa et al., 2022). In Africa and South America, the wild meat trade has been well studied and shown to be extensive in both rural and urban environments (Fa et al., 2015; Coad et al., 2019; Martin et al., 2020; Mayor et al., 2021; Fa et al., 2022). They also reveal concerning and unsustainable offtake levels attributed to growing human populations and affluence. Major et al. (2021) reported an increasing trade of wild meat in Iquitos, Peru at a rate of 6.4 t/year from 1973 to 2018. Approximately six million tons of wild meat are exported from the Congo and Amazon Basins annually (Fa et al., 2003). While consumer demand for wild meat is high, trade is poorly monitored or regulated, making it a low-risk activity for consumers, poachers and traders alike (Milner-Gulland and Bennet, 2003; Nasi et al., 2011; D'Cruze et al., 2021; Mayor et al., 2021).

Research on species traded for meat in Asia, particularly Southeast Asia (SEA), is limited and sporadic (Milner-Gulland and Bennett, 2003; McEvoy et al., 2019; Ingram et al., 2021; Fa et al., 2022). Nevertheless hunting of wildlife in the region is intense and extensive driven by an escalating demand for wild meat among other reasons (Harrison et al., 2015; McEvoy et al., 2019). Ingram et al. (2021)'s recent evaluation of wild meat research and management over an 18-year period (2002-2020) has further highlighted the poor implementation of conservation and mitigation measures recommended to address the unsustainable harvesting of species, especially evident in the Asia-Pacific region.

1.4 Aim of Research

Various objectives govern this research. Its overarching aim is to investigate, monitor and assess the meat and medicine trade of species. There is a dearth of studies in this field in Southeast Asia. Hence, my study is intended to help fill a marked gap in data on species of conservation concern, in particular bears and pangolins, so that relevant enforcement agencies, conservation organisations and other stakeholders may understand and mitigate the considerable threats posed by this trade.

I also wish to raise the profile of lesser-known species threatened by trade, such as porcupines, leopards, serows and turtles, to draw the necessary resources for their protection and ensure effective monitoring.

By identifying necessary mitigation measures, this research also serves to undergird current conservation efforts.

Another major objective is to raise awareness among key players in the field with regard to a range of issues related to poaching and unsustainable and illegal trade of wildlife. Conservation organisations,

enforcement agencies and the general public urgently need to be alerted to current dangers confronting these species.

Legislative reviews conducted provide essential insights into areas requiring attention and reform in order to protect wildlife.

1.5 Publications Included in this Research Programme

This critical appraisal includes research published between May 2015 and April 2021. I present these in three categories: (1) bears (2) pangolins and (3) lesser-known species in trade. It encompasses specific funded research published as TRAFFIC reports or in the TRAFFIC Bulletin (the only publication solely dedicated to wildlife trade issues). TRAFFIC reports/bulletin papers undergo a rigorous peer-review process prior to being published. My non-TRAFFIC related work was published in peer-reviewed journals. Since the research programme covered various countries in Southeast Asia, it involved collaboration with local counterparts. Hence, many of my papers have multiple co-authors (colleagues, local consultants, organisations, etc) who have contributed through field surveys, data collection in local languages and technical expertise.

The proportion and type of work I undertook is explained below for the co-authored/multi-authored publications under five key categories: (1) initiation of study (2) project management (3) data collection (4) analysis and (5) writing. For each category, I give initials for the authors in order of importance of contribution. All publications are provided in the Annexes (A) attached to this document.

(1) Bears

A1. Or, O.C., Lau, C.F. and Gomez, L. 2017. Recent reports of seizures and poaching of sun bears in Malaysia. International Bear News 26 (2): 17-18.
Initiation of study: LG. Project management: LG. Data collection: OOC, LG, CFL. Analysis: OOC, LG. Writing of paper: LG, OOC, CFL

A2. Livingstone, E., Gomez, L. and Bouhuys, J. 2018. A review of bear farming and bear trade in Lao PDR. Global Ecology and Conservation 13 (2018) e00380. DOI: 10.1016/j.gecco.2018.e00380.
Initiation of study: Donor request. Project management: LG. Data collection: LG, JB. Analysis: EL. Writing of paper: EL, LG

A3. Gomez, L. and Shepherd, C.R. 2018. Trade in bears in Lao PDR with observations from market surveys and seizure data. Global Ecology and Conservation 15 (2018) e00415. DOI: 10.1016/j.gecco.2018.e00415.
Initiation of study: LG. Project management: LG. Data collection: LG. Analysis: LG, CRS. Writing of paper: LG, CRS

A4. Gomez, L. 2019. An update on the bear bile trade in Peninsular Malaysia. TRAFFIC, Petaling Jaya, Malaysia.
Initiation of study: LG. Project management: LG. Data collection: local consultant. Analysis: LG. Writing of paper: LG

A5. Gomez, L. and Shepherd, C.R. 2019. Bearly on the radar: an analysis of bear seizure data in Indonesia. European Journal of Wildlife Research (2019) 65:89. DOI: 10.1007/s10344-019-1323-1.

Initiation of study: LG. Project management: LG. Data collection: LG, CRS. Analysis: LG. Writing of paper: LG, CRS

A6. Gomez, L., Shepherd, C.R. and Morgan, J. 2019. The online trade of Sun Bears in Indonesia. TRAFFIC Bulletin 31(2): 67-71.

Initiation of study: LG. Project management: LG. Data collection: JM. Analysis: LG. Writing of paper: LG, JM, CRS

A7. Gomez, L., Shepherd, C.R. and Khoo, M.S. 2020. The illegal bear bile trade in Sabah and Sarawak. Endangered Species Research 41: 279–287. DOI: 10.3354/esr01028.

Initiation of study: LG. Project management: LG. Data collection: KMS. Analysis: LG. Writing of paper: LG, CRS

A8. Shepherd, C.R., Kufnerová, J., Cajthaml, T., Frouzová, J. and Gomez, L. 2020. Bear trade in the Czech Republic: An analysis of legal and illegal international trade from 2005 to 2020. European Journal of Wildlife Research (2020) 66:92. DOI: https://doi.org/10.1007/s10344-020-01425-7.

Initiation of study: CRS. Project management: CRS. Data collection: JK, TC, FJ, LG, CRS. Analysis: LG, CRS. Writing of paper: CRS, LG

A9. Gomez, L., Wright, B., Joseph, T. and Shepherd, C.R. 2021. An analysis of the illegal bear trade in India. Global Ecology and Conservation e01552.

Initiation of study: LG. Project management: LG. Data collection: LG, TJ. Analysis: LG. Writing of paper: LG. Recommendations/review: CRS, BW

(2) Pangolins

A10. Gomez, L., Leupen, B.T.C. and Tian, K.H. 2016. The trade of African pangolins to Asia: a brief case study of pangolin shipments from Nigeria. TRAFFIC Bulletin 28(1):3–5.

Initiation of study: LG. Project management: LG. Data collection: TKH. Analysis: LG, BTCL. Writing of paper: LG, BTCL

A11. Gomez, L., Leupen, B.T.C., Heinrich, S. 2016. Observations of the illegal pangolin trade in Lao PDR, 2016. TRAFFIC Southeast Asia Regional Office, Petaling Jaya, Selangor, Malaysia.

Initiation of study: LG. Project management: LG. Data collection: LG, BTCL. Analysis: LG, BTCL, SH. Writing of paper: LG, BTCL

A12. Gomez, L., Leupen, B.T.C., Krishnasamy, K. and Heinrich, S. 2017. Scaly nexus: mapping Indonesian pangolin seizures (2010-2015). TRAFFIC, Petaling Jaya, Malaysia.

Initiation of study: LG. Project management: LG. Data collection: LG, BTCL. Analysis: LG, BTLC, SH. Writing of paper: LG, BTCL, KK

A13. Gomez, L. and Sy, E. 2018. Illegal pangolin trade in the Philippines. TRAFFIC Bulletin 20(1): 37-39.

Initiation of study: LG. Project management: LG. Data collection: LG, ES. Analysis: LG. Writing of paper: LG, ES

(3) Lesser-known Species in Trade

A14. Leupen, B.T.C., Gomez, L. and Shepherd, C.R. 2017. Recent observations of the illegal trade in serows in Lao PDR. TRAFFIC Bulletin 29: 37–40.
Initiation of study: CRS. Project management: BTCL. Data collection: BTCL, LG, CRS. Analysis: BTCL, LG, CRS. Writing of paper: BTCL, LG, CRS

A15. Gomez, L. and Krishnasamy, K. 2019. A rapid assessment of the trade in Saiga Antelope horn in Peninsular Malaysia. TRAFFIC Bulletin 31(1): 35-38.
Initiation of study: LG. Project management: LG. Data analysis: LG, KK. Writing of paper: LG, KK

A16. Heinrich, S., Toomes, A. and Gomez, L. 2020. Valuable stones: The trade in porcupine bezoars. Global Ecology and Conservation 24 (2020) e01204.
Initiation of study: SH. Project management: SH. Data collection: AT. Analysis: SH. Writing of paper: SH, AT, LG (personal observations from market surveys of traditional medicine shops in Malaysia). Legislative interpretation/review: LG

A17. Shepherd, C.R., Gomez, L. and Nijman, V. 2020. Illegal wildlife trade, seizures and prosecutions: a 7.5-year analysis of trade in pig-nosed turtles *Carettochelys insculpta* in and from Indonesia. Global Ecology and Conservation 24 (2020) e01249.
Initiation of study: CRS. Project management: CRS. Data collection: LG, CRS, VN. Analysis: LG, VN. Writing of paper: LG, CRS, VN

A18. Gomez, L. 2021. The illegal hunting and exploitation of porcupines for meat and medicine in Indonesia. Nature Conservation 43: 109-122 (2021).
Initiation of study: LG. Project management: LG. Data collection: local consultant. Analysis: LG. Writing of paper: LG

A19. Gomez, L. and Shepherd, C.R. 2021. The illegal exploitation of the Javan Leopard (Panthera pardus melas) and Sunda Clouded Leopard (Neofelis diardi) in Indonesia. Nature Conservation 43: 25–39 (2021). DOI: 10.3897/natureconservation.43.59399.
Initiation of study: LG. Project management: LG. Data collection: LG, CRS. Analysis: LG. Writing of paper: LG. Recommendations/review: CRS

2 METHODS

2.1 Study Area

Much of my work on wildlife traded for meat and medicine has been based in Southeast Asia, which lies just below China, to the east of India and to the north of Australia. It is composed of 11 countries: Brunei, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor-Leste and Vietnam (**Figure 1**), each with their own unique mix of languages, cultures and traditions. I have undertaken studies in all these countries (some more extensively than others e.g., Indonesia, Lao PDR, Malaysia) barring Brunei and Timor-Leste. This has encompassed legislative reviews, market surveys, online surveys, seizure data analysis, trade data analysis, which I describe in more detail below. For my work on bears, I have begun to include countries outside Southeast Asia (e.g., Czech Republic, India, Hong Kong, Australia, New Zealand, Europe). I have appended two papers on the bear trade in the Czech Republic and India as these countries have illegal trade links to Southeast Asia.

Figure 1 A map of Southeast Asia and the countries that fall within this region as well as population data and density. Source of population data: UN, 2019

2.2 Study Species

2.2.1 Bears

There are eight extant species of bears (Order: Carnivora, Family: Ursidae) in the world, six of which are found in Asia (**Table 1**). Poaching for the illegal wildlife trade is now considered the leading threat to Asian bear species, in particular, the Asiatic black bear (*Ursus thibetanus*), brown bear (*Ursus arctos*), sloth bear (*Melursus ursinus*) and sun bear (*Helarctos melayanus*). Bears are harvested for their gall bladder and bile, coveted in traditional Asian medicines. Their meat and paws are considered delicacies and their body parts (e.g., skins, skulls, claws, teeth) prized as trophies or talismans. Live bears are captured for the pet trade, bear bile extracting facilities (otherwise known as bear farms) and wildlife entertainment industries (e.g., exhibitions, performances, bear baiting). These demands are causing bear declines throughout Asia.

Table 1 The threat status and protection status of the eight bear species found globally and their native range

Species	IUCN Red List Status	CITES Appendix Listing	National Status	Range
American Black Bear *(Ursus americanus)*	Least Concern	II	Managed by individual states and provinces	Canada, Mexico, United States
Asiatic Black Bear *(Ursus thibetanus)*	Vulnerable	I	Protected	Asia
Brown Bear *(Ursus arctos)*	Least Concern	II (except populations in Bhutan, China, Mexico and Mongolia, which are included in Appendix I)	Managed by individual states and provinces	Asia, Europe, North America
Giant Panda *(Ailuropoda melanoleuca)*	Vulnerable	I	Protected	China
Sloth Bear *(Melursus ursinus)*	Vulnerable	I	Protected	India, Nepal, Sri Lanka
Spectacled Bear *(Tremarctos ornatus)*	Vulnerable	I	Protected	South America (restricted to tropical Andes)
Sun Bear (*Helarctos malayanus)*	Vulnerable	I	Protected	Asia
Polar Bear (*Ursus maritimus)*	Vulnerable	II	Managed by individual states and provinces	Canada, Greenland, Norway, Russia, US (Alaska)

2.2.2 Pangolins

Pangolins are mammals of the order Pholidota and family Manidae. There are only eight species of pangolins in the world (**Table 2**); four in Asia and the other four in Africa, the only two continents where pangolins survive although it is fast becoming a precarious existence as they are one of the most heavily trafficked mammals in the illegal wildlife trade (Newton et al., 2008; Challender and Waterman, 2017). They are exploited mainly for food and medicine across their range (Wu and Ma, 2007; Zhang and Yin, 2014; Mohapatra et al., 2015; Nijman, 2015; Shairp et al., 2016). Pangolins are considered unique for being the only mammals on earth that have scales. These scales cover the upper side of its body, from the tip of its head to the end of its tail, interlinking and overlapping into a concrete armour. Demand for these scales in Asia is currently the main threat to pangolins, both in Asia and Africa (Challender and Hywood, 2012; Xu et al., 2016). Pangolins only reach sexual maturity between the ages of five and seven and have a slow reproductive rate. This makes them particularly susceptible to the destructive effects of overharvesting and indiscriminate poaching (Lim and Ng, 2008). These impacts are already evidenced in Asia where pangolins have rapidly disappeared and been locally extirpated in parts of range. This has caused a notable shift in trade from Asian species to African species (Challender and Hywood, 2012; Challender et al., 2016; Gomez et al., 2016a; Heinrich et al., 2016).

Table 2 The threat status and protection status of the eight pangolins species found globally and their native range

Species	IUCN Red List Status	CITES Appendix Listing	National Status	Range
Chinese Pangolin *(Manis pentadactyla)*	Critically Endangered	I	Protected	Bhutan, China, India, Lao PDR, Myanmar, Nepal, Taiwan, Thailand, Vietnam
Indian Pangolin *(Manis crassicaudata)*	Endangered	I	Protected	South Asia
Philippine Pangolin *(Manis culionensis)*	Critically Endangered	I	Protected	Philippines (endemic to Palawan Islands)
Sunda Pangolin *(Manis javanica)*	Critically Endangered	I	Protected	Southeast Asia
Black-bellied Pangolin *(Phataginus tetradactyla)*	Vulnerable	I	Protected (hunting is permitted in some range states)	West and Central Africa
White-bellied Pangolin *(Phataginus tricuspis)*	Endangered	I	Protected (hunting is permitted in some range states)	West Africa
Giant Ground Pangolin (*Smutsia gigantea)*	Endangered	I	Protected (hunting is permitted in some range states)	West and Central Africa
Temminck's Pangolin (*Smutsia temminckii)*	Vulnerable	I	Protected (hunting is permitted in some range states)	Africa

2.2.3 Lesser-known Species in Trade

Many wild animals and plants are harvested and traded locally for a variety of reasons, but this rarely gets documented. These species are traded under the radar i.e., undetected and unregulated and are defined here as lesser-known species in trade. Since the illegal wildlife trade has become a leading cause of species decline in the region, the dearth of information on 'lesser-known' species in trade is cause for concern. They are overshadowed by high profile or flagship species such as tigers, rhinos, elephants that tend to attract greater attention in terms of conservation efforts and resources. Without adequate protection, there is a very real possibility they are being silently extinguished. Without adequate trade data, strategies to counter the perils to lesser-known species in trade are poorly informed or absent altogether.

Ongoing monitoring of markets, seizures and trade data provide a great deal of information on the diversity of species found in trade. Over the years, I have come across a myriad of species being utilised for meat and medicinal purposes in Southeast Asia. I have documented some of this trade particularly in relation to species in need of greater conservation attention (**Table 3**).

Table 3 The threat status and protection status of the lesser-known species utilised for the meat and medicine trade in Southeast Asia that I have documented from 2015 - 2021, including their native range and what they are used for

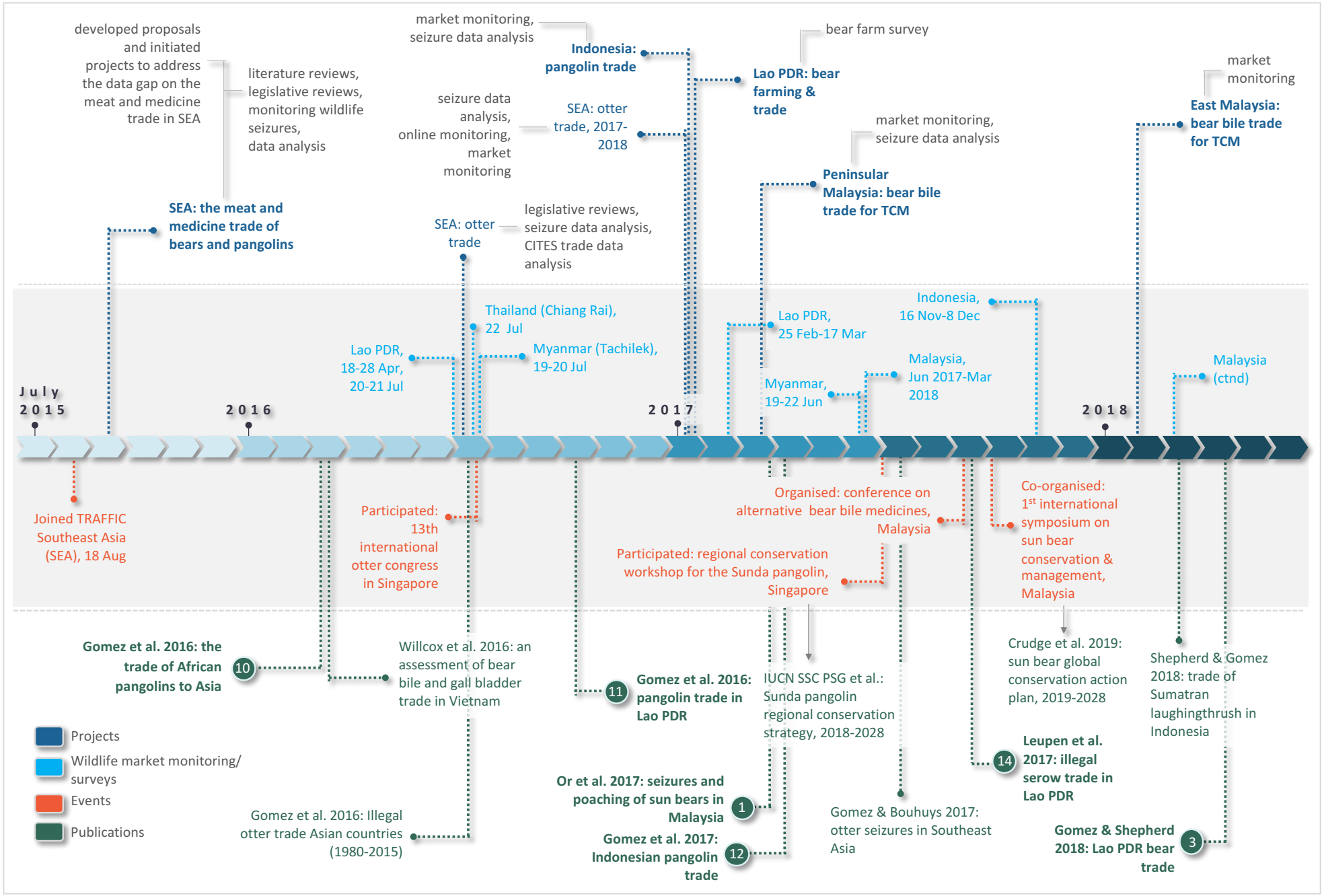
Species	IUCN Red List Status	CITES Appendix Listing	National Status	Range	Purpose/Use
Javan leopard *(Panthera pardus melas)*	Endangered	I	Protected	Endemic to the island of Java (Indonesia)	- Trophies/ornaments - enhance male strength and virility - treat foot and mouth disease, heart disease, asthma and other ailments
Sunda clouded leopard *(Neofilis diardi)*	Vulnerable	I	Protected	Endemic to the island of Borneo (Brunei, Indonesia and Malaysia) and Sumatra (Indonesia)	
Porcupine Species (Indonesia, Malaysia, Singapore)					
Asiatic brush-tailed porcupine (*Atherurus macrourus)*	Least Concern	Not listed	Protected	Asia	- alternative protein source - aphrodisiac - treat asthma, cancer, fever and other ailments - ornaments/charms
Long-tailed porcupine (*Trichys fasciculata)*	Least Concern	Not listed	Protected (except in Indonesia)	Brunei, Peninsular Malaysia, Sumatra (Indonesia), Borneo	
Malayan porcupine *(Hystrix brachyura)*	Least Concern	Not listed	Protected (except in Indonesia)	Asia	
Sumatran porcupine (*H. sumatrae)*	Least Concern	Not listed	Not protected	Endemic to the island of Sumatra (Indonesia)	
Sunda porcupine *(H. javanica)*	Least Concern	Not listed	Protected	Endemic to Java, Bali, Sumbawa, Flores, Lombok, Madura and Tonahdjampea	
Thick-spined porcupine (*H.crassispinis)*	Least Concern	Not listed	Protected (except in Indonesia)	Endemic to Borneo	
Saiga antelope *(Saiga tatarica)*	Critically Endangered	II	Protected (though hunting is permitted in some range states for local consumption)	Kazakhstan, Mongolia, Russia, Uzbekistan	- horns are promoted as having a 'cooling effect' and used to treat fevers
Chinese serow *(Capricornis sumatraensis milneedwardsii)*	Vulnerable	I	Protected	China, Southeast Asia	- treat bone fractures - alternative protein source - trophies/ornaments
Pig-nosed turtle *(Carettochelys insculpta)*	Critically Endangered	I	Protected	Philippines (endemic to Palawan Islands)	- exotic meat trade - pet trade

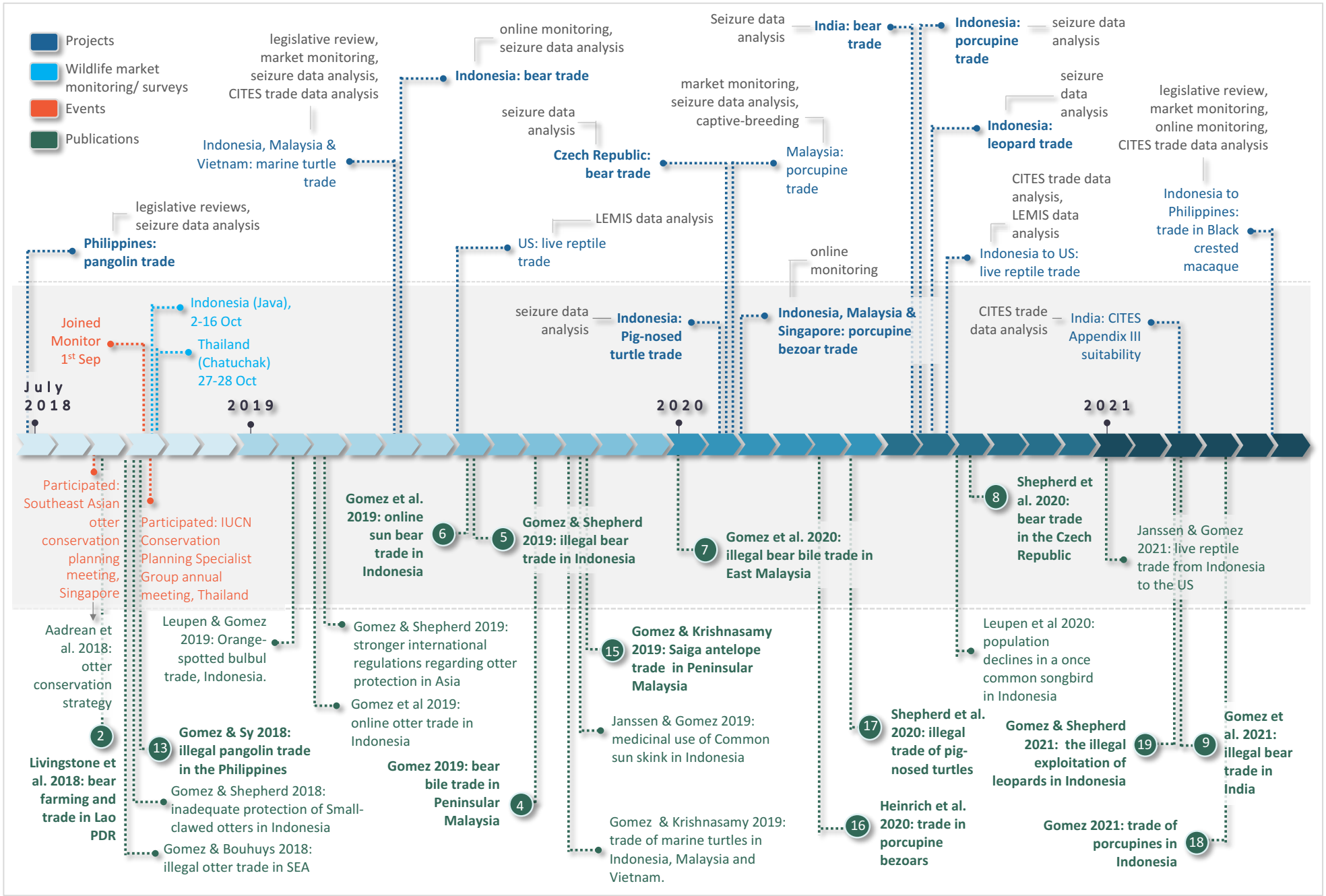
2.3 Study Timeline

My research on wildlife trade began in August 2015 when I became a programme officer at TRAFFIC, the wildlife trade monitoring network established by World Wide Fund for Nature (WWF) and the International Union for Conservation of Nature (IUCN) (refer CV in Annex B). I served the Southeast Asian branch and was under the coaching of Dr Chris R. Shepherd who was regional director of TRAFFIC Southeast Asia at the time. In 2018, I left TRAFFIC and joined Dr Shepherd and two other like-minded individuals to establish the Monitor Conservation Research Society (hereinafter referred to as Monitor). We currently focus on lesser-known species impacted by wildlife trade.

Initially I worked on the meat and medicine trade as it related to bears and pangolins. I gradually extended my focus by including other species used for meat and medicine such as serows, Saiga Antelopes and porcupines. During this period, I also explored the commercial exploitation of various other species including otters, songbirds and reptiles for the pet trade; marine turtles for the meat and souvenir trade; tigers, rhinos and elephants for illegal markets in East Asia; captive-bred lions for traditional medicine, trophies and tourism.

This critical appraisal covers research completed between 2015 and April 2021 with a focus on wildlife traded for meat and medicine. **Figure 2** (below) is a timeline of my practical experience from August 2015 to April 2021. It encompasses projects and scope of work undertaken during this time. These are described in more detail in the sections on methods and discussion. Bold and numbered items indicate publications included in this research programme in the order listed in the Annexes.


developed proposals and initiated projects to address the data gap on the meat and medicine trade in SEA
literature reviews, legislative reviews, monitoring wildlife seizures, data analysis
SEA: the meat and medicine trade of bears and pangolins
market monitoring, seizure data analysis
Indonesia: pangolin trade
seizure data analysis, online monitoring, market monitoring
SEA: otter trade, 2017-2018
SEA: otter trade
legislative reviews, seizure data analysis, CITES trade data analysis
bear farm survey
Lao PDR: bear farming & trade
market monitoring, seizure data analysis
Peninsular Malaysia: bear bile trade for TCM
market monitoring
East Malaysia: bear bile trade for TCM
July 2015
2016
2017
2018
Joined TRAFFIC Southeast Asia (SEA), 18 Aug
Lao PDR, 18-28 Apr, 20-21 Jul
Thailand (Chiang Rai), 22 Jul
Myanmar (Tachilek), 19-20 Jul
Lao PDR, 25 Feb-17 Mar
Myanmar, 19-22 Jun
Malaysia, Jun 2017-Mar 2018
Indonesia, 16 Nov-8 Dec
Malaysia (ctnd)
Participated: 13th international otter congress in Singapore
Organised: conference on alternative bear bile medicines, Malaysia
Participated: regional conservation workshop for the Sunda pangolin, Singapore
Co-organised: 1st international symposium on sun bear conservation & management, Malaysia
Gomez et al. 2016: the trade of African pangolins to Asia
10
Willcox et al. 2016: an assessment of bear bile and gall bladder trade in Vietnam
11
Gomez et al. 2016: pangolin trade in Lao PDR
IUCN SSC PSG et al.: Sunda pangolin regional conservation strategy, 2018-2028
Crudge et al. 2019: sun bear global conservation action plan, 2019-2028
Shepherd & Gomez 2018: trade of Sumatran laughingthrush in Indonesia
Projects
Wildlife market monitoring/ surveys
Events
Publications
Gomez et al. 2016: Illegal otter trade Asian countries (1980-2015)
Or et al. 2017: seizures and poaching of sun bears in Malaysia
1
Gomez et al. 2017: Indonesian pangolin trade
12
Gomez & Bouhuys 2017: otter seizures in Southeast Asia
14
Leupen et al. 2017: illegal serow trade in Lao PDR
Gomez & Shepherd 2018: Lao PDR bear trade
3


Projects
Wildlife market monitoring/ surveys
Events
Publications
July 2018
2019
2020
2021
Joined Monitor 1st Sep
Indonesia (Java), 2-16 Oct
Thailand (Chatuchak) 27-28 Oct
legislative reviews, seizure data analysis
Philippines: pangolin trade
legislative review, market monitoring, seizure data analysis, CITES trade data analysis
Indonesia, Malaysia & Vietnam: marine turtle trade
online monitoring, seizure data analysis
Indonesia: bear trade
LEMIS data analysis
US: live reptile trade
seizure data analysis
Czech Republic: bear trade
market monitoring, seizure data analysis, captive-breeding
Malaysia: porcupine trade
seizure data analysis
India: bear trade
Indonesia: porcupine trade
seizure data analysis
seizure data analysis
Indonesia: leopard trade
CITES trade data analysis, LEMIS data analysis
Indonesia to US: live reptile trade
legislative review, market monitoring, online monitoring, CITES trade data analysis
Indonesia to Philippines: trade in Black crested macaque
seizure data analysis
Indonesia: Pig-nosed turtle trade
online monitoring
Indonesia, Malaysia & Singapore: porcupine bezoar trade
CITES trade data analysis
India: CITES Appendix III suitability
Participated: Southeast Asian otter conservation planning meeting, Singapore
Participated: IUCN Conservation Planning Specialist Group annual meeting, Thailand
Aadrean et al. 2018: otter conservation strategy
2
Livingstone et al. 2018: bear farming and trade in Lao PDR
13
Gomez & Sy 2018: illegal pangolin trade in the Philippines
Gomez & Shepherd 2018: inadequate protection of Small-clawed otters in Indonesia
Gomez & Bouhuys 2018: illegal otter trade in SEA
Leupen & Gomez 2019: Orange-spotted bulbul trade, Indonesia.
Gomez & Shepherd 2019: stronger international regulations regarding otter protection in Asia
Gomez et al 2019: online otter trade in Indonesia
Gomez et al. 2019: online sun bear trade in Indonesia
6
5
Gomez & Shepherd 2019: illegal bear trade in Indonesia
4
Gomez 2019: bear bile trade in Peninsular Malaysia
15
Gomez & Krishnasamy 2019: Saiga antelope trade in Peninsular Malaysia
Janssen & Gomez 2019: medicinal use of Common sun skink in Indonesia
Gomez & Krishnasamy 2019: trade of marine turtles in Indonesia, Malaysia and Vietnam.
7
Gomez et al. 2020: illegal bear bile trade in East Malaysia
16
Heinrich et al. 2020: trade in porcupine bezoars
17
Shepherd et al. 2020: illegal trade of pig-nosed turtles
8
Shepherd et al. 2020: bear trade in the Czech Republic
Leupen et al 2020: population declines in a once common songbird in Indonesia
Janssen & Gomez 2021: live reptile trade from Indonesia to the US
19
Gomez & Shepherd 2021: the illegal exploitation of leopards in Indonesia
9
Gomez et al. 2021: illegal bear trade in India
18
Gomez 2021: trade of porcupines in Indonesia

2.4 Study Methods

2.4.1 Literature Review

My main source of information on wildlife trade was first the TRAFFIC library which has a vast collection of TRAFFIC reports and bulletins (these feature trade-specific research by experts in this field of study worldwide), unpublished reports and field notes. NGOs (e.g., the Environmental Investigation Agency (EIA), Wildlife Justice Commission (WJC), Wildlife Conservation Society (WCS), WWF), international conventions/institutions (e.g., CITES, IUCN), government agencies (e.g., USAID, UNODC, INTERPOL) as well as conference proceedings and papers were also informative sources of information. I used Google, Google Scholar, Scihub, Researchgate and online library databases to search for news, media and journal articles on wildlife trade issues and species-specific information. A snowball approach was then used from literature and articles recovered to identify additional relevant sources of information. I mainly did searches in English and Malay and relied on co-authors to provide relevant local context within the region.

2.4.2 Legislative Review

Domestic trade of species is regulated by national wildlife legislation, policies and guidelines that specify whether protected species can be caught, killed, kept, possessed, cared for, transported or traded. I only focused on terrestrial wildlife regulations. Some Southeast Asian countries have far more comprehensive and efficient legislation than others. I have spent tremendous amount of time analysing these laws to understand the protection status of species being studied, the legality of wildlife trade activities, the effectiveness of laws in regulating and preventing illegal trade, and the effectiveness of penalties or punishments for an offence. I then recommended reforms and improvements to enhance species protection.

The international trade of species is governed by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which is an 'agreement between governments to ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species'. CITES subjects international trade in specimens of selected species to certain trade controls. All import, export and re-export of species covered by the Convention is authorised through a licensing system. Since it entered into force in 1975, the Convention has been adopted by 184 Parties (as of October 2021) and regulates international trade in over 38,000 species. These species are listed in three Appendices according to the degree of protection they need. CITES Trade data were extracted from the CITES Trade Database (trade.cites.org) and downloaded into Microsoft Excel for analysis. This database is freely accessible and holds all records of import, export and re-export of CITES-listed species as reported by Parties to the CITES Secretariat.

2.4.3 Data Collection and Analysis

A quantitative approach was taken to monitor and investigate specific wildlife trade issues in the region, in line with TRAFFIC Southeast Asia standard protocols (Lee et al., 2015; Chng and Eaton, 2016; Nijman et al., 2017; Fernandes et al., 2022; Woolloff et al., 2022). The various methods of data collection and justification for their use are described in the following sections. Considering the aims of this research, much of the analysis involved simple descriptive statistics and interpretation to ensure our findings were clear, concise and understandable to reach our target audience in Southeast Asia – government authorities and agencies, media, public, traditional medicine practitioners and retailers, and other relevant stakeholders.

Trade Data

Monitoring and analysis of wildlife seizures can reveal much about the illegal nature of wildlife trade covering such aspects as new species in trade; species of conservation concern; trends over time; trafficking routes; poaching/trade hotspots; source, transit and destination countries; commodities in trade; uses of species; and enforcement levels (Rosen and Smith, 2010; Burgess et al., 2014; Chng, 2014; Stoner et al., 2016; Petrossian et al., 2016; Siriwat and Nijman, 2018). It is also a useful approach to document evidence and highlight the conservation needs of lesser-known species in trade.

For general monitoring of wildlife seizures, I used Google alerts with regard to species of interest. For specific investigation of project/country/species, data were extracted from various sources, including TRAFFIC publications, Customs, police, CITES, and media reports, grey literature and records from other non-governmental organizations (NGOs). Enquiries were also sent to enforcement agencies, CITES Management Authorities, local NGOs and consultants in order to obtain seizure data not publicly reported or only reported in local languages. In Indonesia, there is a government website known as Sistem Informasi Penelusuran Pekara (SIPP; Court Tracking Information System), which is an open access information database of the courts for each district in the country. It records wildlife crimes such as seizures, arrests and prosecution outcomes. A valuable resource, I often used it, with the help of a local consultant fluent in the Indonesian language, to assess enforcement efforts and prosecution rates. Data were collated into Microsoft Excel for analysis. From seizures, where available, information on date of seizure, commodity (i.e., live, dead, parts), quantities of each commodity seized, location of seizures and trafficking routes, suspects arrested and prosecution outcomes is extracted and analysed. I also used the seizure data to map important trade hotspots and routes using Microsoft Excel and Power Point.

Using seizure data has certain limitations due to the covert nature of illegal wildlife trade. Its true extent is unlikely to be reflected by this data alone. It is also inherently biased because of a range of factors including varying levels of law enforcement; different reporting and recording practices of both law enforcement and media; variability in non-governmental organisation (NGO) behaviour and advocacy; different levels of corruption; language biases in each region, country and province, and thus has to be interpreted with caution. Nevertheless, it is still a useful approach to gain an understanding of IWT. When combined with other data sources, such as market or online surveys, it can provide a good indication of trade-driven threats to species.

Market Surveys

Market surveys are another tool employed to determine and monitor species in trade and the effects that trade may have on a species (Harris et al., 2015), particularly appropriate in Southeast Asia where wildlife markets and retail outlets are still a prevalent route through which wild animals and plants reach consumers (TRAFFIC, 2008). TRAFFIC SEA and Monitor have conducted many market surveys across Southeast Asia and I used their standard survey protocols for all my field work (e.g., Shepherd and Nijman, 2008; Shepherd, 2010; Chng and Eaton, 2016). These surveys consisted of visits to fresh/wet markets, wildlife pet markets, traditional medicine stores and street stalls, malls, hotel shops, tourist markets and shops, etc – places where wildlife products may be found. To survey species traded for traditional Chinese medicine, I engaged a local consultant, who fits the profile of a consumer and was able to speak the language, to undertake the surveys. These sites were generally open to the public and easily accessible. Sites visited were either based on previous research experience conducted, e.g., by TRAFFIC, or more opportunistic in nature, whereby wildlife trade locations were found through observations or casual conversations with locals. All wildlife parts and

products openly displayed for sale were recorded. Informal conservations were also had with sellers where possible to gather data on use, demand, origin and price. Data were collated into Microsoft Excel for analysis. I have conducted market surveys in Indonesia, Lao PDR, Myanmar and Thailand (**Table 4; Plates 1 - 2**). It was during these market surveys that I began to understand the nature of wildlife trade and the expanse of it that presents a threat to species. I also found these surveys to be the best way to learn identification of species, their parts and derivatives in trade.

To survey bear farms in Lao PDR, I worked with a wildlife consultant and a local guide on a scheduled road trip throughout the country. We visited the main provincial towns likely to have bear bile extraction facilities, based on past research (Livingstone and Shepherd, 2014). Contacting local NGOs (WCS in Vientiane and Free the Bears in Luang Prabang) and members of the local community (at markets, TCM stalls, restaurants, bus stations, tourist agencies, hotels and villages), we made enquiries regarding other possible locations. In three areas (Paksan, Phonsavan and Sekong) we met up with government staff from the Department of Agriculture and Forestry for the same purpose. Wherever we encountered bears in captivity, we noted their condition, number, origin, uses, prices and turnover rates.

This method of data collection has limitations. These include having to work on the assumption that traders provide accurate information and wildlife products observed are genuine. It is also assumed that processed wildlife products for sale, like bear bile medicines in the form of powder, pills or flakes, contain genuine bear parts as claimed. This is because testing cannot be done in the field as wildlife products are not purchased so as to avoid perpetuating market demands. In addition, the growing awareness of wildlife trade issues in recent times has further complicated the issue by driving illegal aspects of the trade underground. Open availability of protected species is less blatant than it once was. Thus, future market surveys will require the use of more covert investigative methods.

Online Surveys

Over the last decade the sale of wildlife is moving away from physical markets to online platforms due to the low risk of detection, global reach and anonymity they provide (Derraik and Phillips, 2010; IFAW, 2011; Lavorgna, 2014; Harrison et al., 2016). This presents several challenges for enforcement and regulatory authorities. These platforms drastically lower logistic barriers for sellers and provides buyers easy access to both legal and illegal markets. Even niche products are easier to find than ever before (Lavorgna, 2014). Exacerbating the issue is the speed with which illegal transactions can be conducted, leaving only a small window of time for enforcers to act (Lavorgna 2014, Yu and Jia 2015, Siriwat and Nijman 2018). Therefore, surveillance of online platforms has become essential.

Following the monitoring protocols adopted by TRAFFIC (e.g., Krishnasamy and Stoner, 2016; Xiau et al., 2017; Kitade, 2017), I used online surveys to specifically look at the trade of bears, otters, porcupines, songbirds and primates in the region. This encompassed a search of e-commerce websites (e.g., Alibaba, Carousell, Lazada, Shopee) and social media (e.g., Facebook, Instagram) for advertisements or sales listings of the species being studied using a combination of key words related to the species, their parts, products, and derivatives. Searches were conducted in English and local languages over a fixed period of time specified for each project (**Table 4**). Online wildlife trade inevitably differs between the Southeast Asian countries. I engaged local wildlife trade experts to help with local language searches and translations. These consultants are included as co-authors in my papers. Examining available information, we extracted from advertisements, types of wildlife products, we listed seller locations, species involved, types of commodities (live animals or their parts

– skin, skull, teeth, claws, etc), quantities offered for sale, age of animal on sale, source of wildlife offered and prices. Data were collated into Microsoft Excel for analysis. No personal data about the sellers was ever collected and no interaction with sellers took place. Care was also taken to omit products that were obviously fake or likely parts of other animals.

Table 4 Details on the methods used for each of the publications included in this Critical Appraisal and the quantities of wildlife parts and products observed in trade in each study

Publication	Methodology	Observations and volumes of wildlife commodities in trade
(1) Bears		
Or, O.C., Lau, C.F. and Gomez, L. 2017. Recent reports of seizures and poaching of sun bears in Malaysia. International Bear News 26 (2): 17-18.	Analysis of seizure data and poaching data, 2015-2017	Obtained 7 seizures amounting to 10 sun bears (carcases) and 1 live bear. 371 snares were removed Belum-Temengor Forest Reserve – found a sun bear carcass in at least 1 snare, while another 3 snares, had signs indicating bears had been caught but had either escaped or been removed by poachers.
Livingstone, E., Gomez, L. and Bouhuys, J. 2018. A review of bear farming and bear trade in Lao PDR. Global Ecology and Conservation 13 (2018)	20 days in the field searching for bear farms	Recorded 7 bear farms holding a minimum of 116 Asiatic black bears. A further 14 wild Asiatic black bear cubs were found illegally held by private individuals.
Gomez, L. and Shepherd, C.R. 2018. Trade in bears in Lao PDR with observations from market surveys and seizure data. Global Ecology and Conservation 15 (2018)	20 days of surveys of markets/outlets selling wildlife parts and products, analysis of seizure data, and legislative review	56% of locations surveyed were selling bear parts and derivatives mostly for traditional medicine and trophy/ornamental purposes. Items and quantities recorded: packages of powder – 566, bottles of fat/ grease – 82, bottles of pills – 74, raw gall bladders – 35, bottles of wine – 17, teeth – 120, claws – 11, skins – 2 and a jaw – 1. There were 51 bear seizures estimated to amount to a minimum of 173 bears. Seizure data involved mostly live bears – 55 followed by paws – 149, gall bladders – 80, and derivatives – 49 items.
Gomez, L. 2019. An update on the bear bile trade in Peninsular Malaysia. TRAFFIC, Petaling Jaya, Malaysia	Survey of traditional Chinese medicine (TCM) shops in Peninsular Malaysia	318 TCM shops surveyed, of which 221 were found selling bear bile products. The majority were selling pills (88%) followed by gall bladder (7%), vials (3%), powder (1%), capsules and ointments (1%).
Gomez, L. and Shepherd, C.R. 2019. Bearly on the radar: an analysis of bear seizure data in Indonesia. European Journal of Wildlife Research (2019)	Analysis of seizure data, 2011-2018, and legislative review	Obtained 71 seizures representing an estimated minimum of 254 sun bears. Commodities and quantities seized: live bears – 61, claws – 1388, bones – 268, canines – 241, paws – 91, gall bladders – 35, skulls – 6, skins – 5, dead bears – 5, body part (unspecified) – 35, stuffed – 8.

Gomez, L., Shepherd, C.R. and Morgan, J. 2019. The online trade of Sun Bears in Indonesia. TRAFFIC Bulletin 31(2): 67-71.	3-month survey of Facebook Groups with survey effort of 4 hours/ week	Recorded 158 advertisements. Commodities and quantities for sale: live bears – 47, claws – 140, teeth – 86, skull – 1, stuffed – 3.
Gomez, L., Shepherd, C.R. and Khoo, M.S. 2020. The illegal bear bile trade in Sabah and Sarawak. Endangered Species Research 41: 279–287	Survey of traditional Chinese medicine (TCM) shops in Sabah and Sarawak	128 TCM shops surveyed, of which 25% were found selling bear parts and products. Commodities and quantities for sale: gall bladders – 79, shredded gall bladder in vials – 1, bear bile wine – 1, and bear bile pills although quantity could not be determined.
Shepherd, C.R., Kufnerová, J., Cajthaml, T., Frouzová, J. and Gomez, L. 2020. Bear trade in the Czech Republic: An analysis of legal and illegal international trade from 2005 to 2020. European Journal of Wildlife Research (2020) 66:92	Analysis of seizure data and CITES trade data, 2005-2020	Obtained 36 seizures totalling 346 items. Commodities and quantity seized: live bears – 2, claws – 1, teeth – 2, skins – 15, skull – 9, stuffed – 2, bear bile medicines – 310, gall bladder – 2, bear bile in vodka – 1. Obtained 221 CITES trade records relating to imports of bears, their parts and derivatives to the Czech Republic which consisted of: whole bears and their parts (bones, claws, feet, genitalia, meat, skins and skulls) totalling 639 items (importer reported quantities) and 1018 items + 92.7 kg of meat (exporter reported quantities); live bears – 15 (importer reported quantities) to 16 (exporter reported quantities) animals; and derivatives – 0.15 L + 2.75 kg.
Gomez, L., Wright, B., Joseph, T. and Shepherd, C.R. 2021. An analysis of the illegal bear trade in India. Global Ecology and Conservation e01552	Analysis of seizure data, 2009 – 2019 and legislative review	Obtained 149 poaching and seizure incidents amounting to a minimum of 264 bears. Commodities and quantities seized: bones – 2, canines – 2, claws – 27, fat – 2kg, gall bladder – 129, live – 26, meat – 26kg, paws – 5, skins – 15, skulls – 2.
2. Pangolins		
Gomez, L., Leupen, B.T.C. and Tian, K.H. 2016. The trade of African pangolins to Asia: a brief case study of pangolin shipments from Nigeria. TRAFFIC Bulletin 28(1):3–5	Analysis of seizure data, 2011 – 2015	Obtained 9 seizures totalling 6,715 kg of scales and 3000 kg of meat.
Gomez, L., Leupen, B.T.C., Heinrich, S. 2016. Observations of the illegal pangolin trade in Lao PDR, 2016. TRAFFIC	10 days of surveys of markets/outlets selling wildlife parts and products and analysis of seizure data, 2010-2015	Recorded 2734 pieces of pangolin scales openly for sale. Obtained 43 seizures amounting to an estimated 5678 pangolins. Commodities and quantities seized: live - 61 kg + 1679 whole animals, dead - 75 kg + 534 whole animals and scales – 2,368 kg.

Southeast Asia Regional Office, Petaling Jaya, Selangor, Malaysia		
Gomez, L., Leupen, B.T.C., Krishnasamy, K. and Heinrich, S. 2017. Scaly nexus: mapping Indonesian pangolin seizures (2010-2015). TRAFFIC, Petaling Jaya, Malaysia.	Analysis of seizure data, 2010-2015	Obtained 111 seizures totally an estimated 35,632 pangolins. Commodities and quantities seized: live – 6200 kg + 1540 whole animals, dead – 23,566 kg + 2681 whole animals, individuals (live/dead) – 4788, meat – 23,969.45 kg, scales – 5,218.57 kg + 146 pieces, skins – 189.
Gomez, L. and Sy, E. 2018. Illegal pangolin trade in the Philippines. TRAFFIC Bulletin 20(1): 37-39.	Analysis of seizure data, 2001 – 2017 and legislative review	Obtained 39 seizures totalling an estimated 3,537 pangolins.
3. Lesser-known species in trade		
Leupen, B.T.C., Gomez, L. and Shepherd, C.R. 2017. Recent observations of the illegal trade in serows in Lao PDR. TRAFFIC Bulletin 29: 37–40	10 days of surveys of markets/outlets selling wildlife parts and products	Recorded serow items in 59 shops totalling 1015 individual items. Commodities and quantities for sale: ointments – 740 bottles, horns – 134, gall bladders – 56, frontlets – 28, skeletal items (bones, joints, jaws, skulls, hooves, etc) – 21, and meat – 2 kg.
Gomez, L. and Krishnasamy, K. 2019. A rapid assessment of the trade in Saiga Antelope horn in Peninsular Malaysia. TRAFFIC Bulletin 31(1): 35-38	Survey of traditional Chinese medicine (TCM) shops in Peninsular Malaysia, analysis of CITES Trade data and legislative review	228 TCM outlets surveyed with 154 found with saiga antelope products. Commodities for sale: horns (whole), shavings, powders, powders mixed with pearl powder capsules, bottled Saiga water and bottled Saiga tea. Quantities were not available.
Heinrich, S., Toomes, A. and Gomez, L. 2020. Valuable stones: The trade in porcupine bezoars. Global Ecology and Conservation 24 (2020) e01204	3-month survey of 11 e-commerce websites with survey effort of 7 hours/ week, and legislative review	Recorded 121 posts and a total of 443 bezoars for sale.
Shepherd, C.R., Gomez, L. and Nijman, V. 2020. Illegal wildlife trade, seizures and prosecutions: a 7.5-	Analysis of seizure data, 2013-2020, legislative and prosecution review	Obtained 26 seizures totalling 52,374 live animals.

year analysis of trade in pig-nosed turtles *Carettochelys insculpta* in and from Indonesia. Global Ecology and Conservation 24 (2020) e01249.		
Gomez, L. 2021. The illegal hunting and exploitation of porcupines for meat and medicine in Indonesia. Nature Conservation 43: 109-122 (2021).	Analysis of seizure data, 2013 – 2020 and legislative review	Obtained 39 seizures totalling an estimated 454 porcupines. Commodities and quantities seized: live – 429, dead – 19, bezoars – 2, meat – 26 skewers, quills – 236, internal organs – 1.
Gomez, L. and Shepherd, C.R. 2021. The illegal exploitation of the Javan Leopard (Panthera pardus melas) and Sunda Clouded Leopard (Neofelis diardi) in Indonesia. Nature Conservation 43: 25–39 (2021)	Analysis of seizure data, 2011 – 2019 and legislative review	Obtained 41 seizures totalling 83 animals. Commodities and quantities seized: canines – 30, claws – 26, dead – 6, live – 23, paws – 2, skins – 31, skulls – 13, stuffed – 10.

2.5 Ethics

This critical appraisal is based on work I have done during my employment with TRAFFIC and Monitor. As such, the research procedures I have used were in accordance with the ethical standards/protocols used by both organisations and were sanctioned prior to the studies being undertaken (refer Annex C). Considering the nature of wildlife trade investigations conducted by these organisations, both overt and covert methods are a crucial means of providing evidence needed to support enforcement action. As such, research protocols are designed and reviewed prior to project commencement to ensure integrity and quality of the research, to ensure health and safety of researchers and to ensure that confidential information is handled with care (e.g., password protected and accessible to only a few people dealing with law enforcement, public identities are withheld from publications, etc).

Plate 1

A wet market in Luang Prabang, Lao PDR, April 2016

Pangolin scales for sale at a medicine stall in Lao PDR, April 2016

Wildlife parts including bear canines and serow horns for sale in Lao PDR, April 2016

Type of bear bile product for sale in Lao PDR, April 2016

Wildlife parts for sale at a Tachilek market stall, Myanmar, July 2016

Serow horn for sale at a Tachilek market stall, Myanmar, July 2016

Plate 2

Bear bile extraction facility in Lao PDR, March 2017

Asiatic black bear cubs for sale in Lao PDR, March 2017

Malayan porcupine for sale in a wildlife market in Indonesia, October 2018

Tokay gecko is one of the most hunted species for meat and medicine trade in Asia. These were for sale in an Indonesian wildlife market, October 2018

Bats are eaten as a medicinal remedy for asthma. Commonly found for sale in wildlife markets in Indonesia, October 2018

Small-clawed otter in Java, Indonesia, November 2017. Otter skins are sometimes used in traditional medicine in parts of Asia

3 DISCUSSION

In this section I present and discuss the findings of my research which I have grouped into three categories as per my publication list i.e., bears, pangolins and lesser-known species in trade. These publications were aimed at complementing and adding on to the existing and limited research on the trade of wildlife for meat and medicine in Southeast Asia. It provided a useful baseline that enabled me to further wildlife trade investigations and research in the region. Each study highlighted potential conservation concerns for the species being traded and included measures that might alleviate this threat. It is intended that this work be used by relevant enforcement agencies, policy makers, conservation organisations and other stakeholders to mitigate the threats of illegal trade through increased levels of effective enforcement, improved legislative frameworks and policies and enhanced species protection. It is also intended that this work can be used to raise general awareness on the poaching and illicit use of wildlife for meat and medicine; and provide a baseline that strategic demand reduction interventions can build upon.

3.1 Bears

Asian bear species are largely protected throughout their range from hunting and trade. They are also listed in Appendix I of the Convention on International trade in Endangered Species of Wild Fauna and Flora (CITES) which generally prohibits commercial international trade. In spite of this, bears continue to be illegally sourced from the wild to supply a demand for meat and parts consumed for their medicinal value. Initial accounts of the traditional medicine trade of bears in Asia were undertaken by Mills and Servheen (1991) and Mills et al. (1995). They provided an overview of the scope of the trade and its drivers, spurring further research into the poaching and trade of bears throughout the region (see: Meijaard, 1999; Pereira, 2002; Williamson, 2007; Shepherd and Nijman, 2008; Dutton et al., 2011; Foley et al., 2011; Kikuchi, 2012; Sathyakumar et al., 2012; Burgess et al., 2014). Burgess et al. (2014) focused on bear-related seizures in 17 countries/territories in Asia between 2000 and 2011, showcasing Southeast Asia's prominent role in the illegal bear trade and the significance of trade-driven impacts on Asian bear species. This called for further country specific investigations of the bear trade in the region that would provide robust trade data to support stronger enforcement levels and raise awareness. The body of work below reflects these efforts. They reveal the unrelenting threat traditional medicine presents to bear species across the region. Asian bear species are assessed as Vulnerable by the IUCN Red List (**Table 1**). Considering their threat status, if consumption of bear parts continues unabated, it will very likely lead to the extinction of some bear species in the wild. This is already evident in parts of Asia e.g., China, Singapore, Vietnam (Scotson et al., 2017). There have been important conservation actions to tackle the illegal trade of bears in the region. This includes the development of the first regional conservation action plan dedicated solely to sun bears (Crudge et al., 2019). There has been a commitment from governments to end commercial farming of bears for their bile in parts of Asia e.g., Vietnam, South Korea (Livingstone et al., 2018). Effort to understand consumer behaviour is progressing (Davis et al., 2016; 2019; 2020) which can be used to support the development of strategic demand reduction interventions. Nevertheless, as the body of work below reveal, such efforts are currently being undermined by weak enforcement and legislation.

Malaysia is a stronghold of the sun bear, its only native bear species. Monitoring this species revealed the poaching and harvesting of sun bears for food and medicine (Or et al., 2017). This is a threat that has persisted due to the medicinal value placed on bear parts (see: Mills and Servheen, 1991; Meijaard, 1999; Pereira et al., 2002; Foley et al., 2011; Burgess et al., 2014; Krishnasamy and Shepherd, 2014; Lee et al., 2015). To mitigate the use of bear parts in traditional medicine, I began working with the Federation of Chinese Physicians and Medicine Dealers Association of Malaysia (FCPMDAM) to raise awareness among their practitioners regarding the existing laws that prohibit the use of protected species. This included highlighting herbal alternatives to bear bile medicines and other endangered species used in TCM as well as encouraging practitioners to source for products responsibly by using only legal wildlife resources. To assess the impacts of these initiatives, further surveys of TCM outlets were undertaken (Gomez, 2019; Gomez et al., 2020). In Peninsular Malaysia little change was observed in the availability and types (e.g., bear bile pills, powder, ointment, gall bladders) of products sold in the market when compared with previous surveys undertaken (Gomez, 2019). Yet there were fewer TCM retailers who claimed to be selling bear gall bladders or pure bear bile pills. Similarly, in East Malaysia (i.e., the states of Sabah and Sarawak), there were fewer TCM outlets offering bear parts and products in comparison to numbers reported in previous studies (Gomez et al., 2020). But bear gall bladder continued to be the main commodity for sale in these two states and investigations revealed that the indigenous communities were responsible for the sourcing of bear parts found in trade. Engagement with the TCM community appears to have made an impact on one front: most if not all retailers were aware that sun bear is a protected species and any trade in parts or derivatives is prohibited by law. What remained unclear was whether the illegal trade in bears and their parts had decreased or whether retailers had become more adept at circumventing the law. This provided a strong case for continued and vigilant monitoring of the TCM trade to ensure it is practiced within the confines of the law. These studies also highlighted a need to assess the degree to which consumers knowingly or unwittingly contributed to demand. More detailed evidence-based research is vital to understand consumer behaviour better and determine behaviour change approaches to reduce demand for bear bile products. Sarawak has the weakest law in Malaysia governing the protection of sun bears. Legislative improvements were first proposed to the Sarawak government in 1997 (Krishnasamy and Shepherd 2014). More than 20 years have since passed but the law has remained the same. These studies reinforced a requisite for a stronger law that empowers enforcement authorities and judiciary in taking affirmative action against poachers and illegal wildlife traders; and assists NGOs (e.g., TRAFFIC and Monitor) in lobbying to get bears upgraded to the list of fully protected species. This will afford the species protection from hunting under the law and allow for stricter penalties and fines.

Indonesia is regarded as another stronghold for sun bears. Yet they are frequently caught in snares either set deliberately for bears or for other high-valued species such as tigers (*Panthera tigris sumatrae)* (Shepherd and Magnus, 2004). Although the density of wild bear populations has not been well ascertained in Indonesia (Tumbelaka and Fredriksson, 2006), the illegal bear trade, habitat loss and destruction have been described as leading causes of sun bear declines (Meijard, 1999; Kurniawan and Nursahid, 2002; Tumbelaka and Fredriksson, 2006; Scotson et al., 2017). Studies targeting the illegal bear trade in Indonesia are limited (Meijard, 1999; Kurniawan and Nursahid, 2002; Crudge et al., 2019). I attempted to fill this data gap through seizure data analysis (covering 2011 -2018) and online surveys (2018/2019) (Gomez et al., 2019; Gomez and Shepherd, 2019). This work revealed an ongoing threat from illegal trade. This included a local demand for sun bear parts such as claws, teeth, skin, skull or stuffed whole specimens, prized as either trophies, charms or souvenirs corroborating previous studies (see Meijard, 1999; Kurniawan and Nursahid, 2002). We found evidence of the trade

in live cubs as pets. Evidence also emerged of the targeted poaching of bears for international markets in violation of CITES regulations. Fundamental flaws in wildlife laws and enforcement were discovered. For example, while numerous seizures were made over the period of study, arrest, prosecution and conviction rates were extremely low. Local law enforcement and army personnel were implicated in at least two seizures, indicating the underlying levels of corruption involved. The availability of bears for sale online raised attention to the loopholes in Indonesia's wildlife legislation whereby it is not a criminal offence to openly advertise illegal products, only the sale of such products was illegal. Further, the law only permits authorities to take enforcement action against persons in possession of protected species or physically involved in illegal transactions, a loophole online traders took full advantage of. This work provided grounds for further investigations into the illegal bear trade in Indonesia that is intended to draw continued attention to this threat and catalyse implementation of conservation interventions.

Lao People's Democratic Republic (PDR) has surfaced as a major hub of international illegal wildlife trade in Southeast Asia (Duckworth et al., 1999; Anon, 2015; EIA, 2015; Anon, 2016). Illegal and unsustainable wildlife trade has led to the depletion of a diversity of taxa such as cats, deer, pangolins, birds, snakes, freshwater turtles and even insects across the country (Nooren and Claridge, 2001; Phanthavong, 2008; Coudrat et al., 2012; Som and Cottet, 2015). Since it has the weakest laws and enforcement effort in Southeast Asia, criminal networks exploit this weakness with foreign-run wildlife markets operating illegally but openly, especially along its borders and Special Economic Zones. Home to two species of bears, Asiatic black bears and sun bears, Lao PDR was listed as one of the top four countries in Asia as a key source and consumer of live bears, their parts and derivatives (Foley et al., 2011; Burgess et al., 2014). Through seizure data analysis and market surveys, we found the trade in bear parts and derivatives to be prolific in large parts of the country (Gomez and Shepherd, 2018). The variety of commodities openly in trade was also much greater than previously reported by Foley et al. (2011). There were far more parts and derivatives openly for sale than ascertained through seizure analysis, which reinforced the reality of significant weaknesses in law enforcement. The international trafficking of bears and their parts to and from Lao PDR was also evident and involved China, Myanmar, New Zealand, the US and Vietnam, with the connection between Lao PDR and the US presenting a new trade link. Although bears are protected under the law, trade was open, widespread and unabated across Lao PDR revealing a lack of fear of enforcement. The large number of confiscations involving live bears, presumably captured to restock bear bile extraction facilities, provided much needed support for the closure of all bear bile extraction facilities in the region (IUCN: 2016, 2012).

Bile, taken from the gallbladders of bears, has been used in traditional medicine in East Asia for more than a thousand years as treatment for a wide range of inflammatory and degenerative ailments (Feng et al., 2009; Li et al., 2016). The practice of keeping bears captive for live bile extraction, commonly known as "bear farming", began in the 1980s (Mills and Servheen, 1991; Feng et al., 2009). It has since expanded throughout Asia, particularly China (Servheen et al., 1999; WAP, 2020). Bear farms have long been an issue of contention as they are commercial enterprises with little conservation value. Most of them do not breed bears. They are predominantly bear bile extracting facilities. Wild bears are captured to replenish stock (Livingstone and Shepherd, 2016). This practice has stimulated the establishment of illegal farms and the laundering of wild-caught bears, their parts and derivatives (Banca, 2016; Wilcox et al., 2016; WAP, 2020). Some of the highest bear population declines have been in countries with a history of bear farming for example South Korea (Jeong et al., 2011) and Vietnam (Crudge et al., 2016; Garshelis and Steinmetz, 2016). In 2012, bear farming came under

international scrutiny when the IUCN Resolution WCC-2012-Rec-139-EN to phase out the industry in most bile-producing countries (excepting China[1]) and launch an investigation into its impact on wild bear populations in China (IUCN: 2016, 2012) was passed. Current trends indicate that the bear farming industry is shrinking in some countries and increasing in others. Vietnam is a major consumer of bears and their parts and derivatives (Foley et al., 2011; Burgess et al., 2014; Wilcox et al., 2016). This has radically depleted its native bears, the Asiatic black bear and sun bear (Crudge et al., 2016) and stimulated the trafficking of bears from neighbouring countries into Vietnam (Foley et al., 2011; Livingstone et al., 2018; Gomez and Shepherd, 2019). Since 2005 Vietnam has taken steps to protect its bears including listing both bears as protected species which prohibits their exploitation and use for commercial purposes, including hunting, trading, advertising, transport and slaughter. But the implementation and enforcement of laws and policies has been neglected (Wilcox et al., 2015; Crudge et al., 2018; Davis et al., 2019). Crudge et al. (2018) found that 95% of bear farmers interviewed admitted to regularly extracting bile, 51% admitted to killing bears when closing their farms and only 5% reported having ever been issued fines. Vietnamese-owned bear farms have established in neighbouring Lao PDR presumably to circumvent restrictions in trading and advertising bear bile in Vietnam (Livingstone et al., 2018). A status review of bear farms in Lao PDR showed that northern facilities owned by ethnic Chinese had expanded since 2012 while central and southern facilities owned by Vietnamese or locals had downsized or closed (Livingstone et al., 2018). The closure of Vietnamese owned facilities was attributed to the success of public awareness campaigns to discourage bear bile consumption (ENV, 2015) and the creation of bear rescue centres throughout Vietnam in response to a government-led enforcement on the ban in trading or advertising of bear bile. Nevertheless, the industry has been propped up by Chinese nationals who operated with impunity within Special and Specific Economic Zones that cater to a Chinese market as the Lao government's efforts to enforce laws and protect wildlife were highly inadequate. Closing the facilities in the north will require political will and decisive law enforcement by the local government.

India has four bear species - Asiatic black bears, brown bears, sloth bears and sun bears. The main threat to bears in India is habitat loss, degradation and fragmentation due to rapid development throughout the country. Loss of suitable habitat has exacerbated retaliatory killings due to human-bear conflict (Sethy and Chauhan, 2011; Sathyakumar et al., 2012). Bear cubs, predominantly sloth bears, are also captured to be trained as dancing/performing bears. But this practice has decreased as a threat in recent years due to government curbs (D'Cruze et al., 2011). The extent of the illegal trade in bears in India as well as efforts to counter this trade have been poorly documented (Sethy and Chauhan, 2011). To address the data gap seizure and poaching data from 2009 to 2019 was analysed, providing the first detailed account of the illegal bear trade in India (Gomez et al., 2021). Trade and poaching hotspots were mapped to support enforcement efforts. The data revealed that bears were mostly being trafficked for traditional medicine use and to a lesser extent as trophies. A steady rise in poaching incidents were observed over the study period mainly involving sloth bears. Human-bear conflict rather than trade is generally believed to be the root cause of bear poaching in India. However, the demand for bear parts indicated that wildlife poachers are likely exploiting conflict situations to procure bear parts for trade. This study showed that despite being a strictly protected

[1]China has the biggest and largest number of bear farms in Asia (estimated to be holding over 20,000 captive bears on 68 licensed farms and a further 2,000 bears on illegal farms). Its legal bear bile industry is reportedly worth USD1bil (WAP 2020). Excess production of bile has resulted in farms and pharmaceutical companies fabricating different types of products to stimulate and drive consumption (WAP 2020).

species in India, there is still a threat to bears from illegal trade. It exposed improvements required in enforcement capacity and resources in relation to crimes involving bears. While there have been some arrests, these were confined to local poachers and mid-level traders. Little effort was dedicated to intelligence gathering or sustained investigation on actual buyers, end consumers, illegal cross-border trade, and the higher levels of the poaching and trafficking syndicate(s). In this respect, greater effort has been made for high profile species like tigers and more recently pangolins and suggests this can be applied to bear conservation in India. But growing levels of human-bear conflict has rendered bears a considerable threat in India and perhaps this has overshadowed their conservation needs.

The Czech Republic was not previously known to have an active trade in bears. In 2019, the Czech Environmental Inspectorate as the CITES enforcement focal point of the Czech Republic provided Monitor with bear seizure data covering the period January 2005 to February 2020. This data included associated prosecution records, details of individuals arrested/prosecuted, volumes and origins of shipments seized. An analysis of it disclosed a great deal of information about the legal and illegal trade of bears within and through the Czech Republic (Shepherd et al., 2020). There was an active trade in bear trophies originating from Canada, Russia and the US. Trophy hunting is legal in all three countries, but it is accompanied by poaching. It was unclear why trophies that can be legally exported were instead smuggled out of these countries, but possible reasons include illegal harvest, poaching for illegal trade, invalid/ lack of hunting permits, avoidance of permits fees or import duties as well as ignorance of legal requirements. Irrespective of the reasons, it raised valid concerns regarding the negative impact of trophy hunting on species conservation. Bear bile medicines were also being smuggled in from Vietnam and, to a lesser extent, mainland China and Hong Kong. The Czech Republic has a relatively large Vietnamese community, so it is not surprising there is some demand for their traditional medicines. The trafficking of bear bile medicines from Vietnam to the Czech Republic is strictly prohibited and violates CITES regulations. This illegal trade also undermines Vietnam's efforts to shut down bear farming and curb illegal trade. These threats are amplified, given that these market demands likely exist across the rest of Europe where a significant Asian community is resident. Our study drew attention to the global nature of the illegal bear trade and enabled us to initiate further research into the bear trade in Europe and non-bear range countries (e.g., Australia, New Zealand – Cassey et al., 2021).

3.2 Pangolins

TRAFFIC SEA was one of the first organisations to expose the threat posed by trade to Asian pangolin populations (Pantel and Chin, 2009). At the time, they were a relatively unknown species and trade-related research on pangolins in the region was limited. To address this data gap I began monitoring and collecting pangolin seizure data in Southeast Asian countries and commenced mapping trade hotspots and trafficking routes. Country specific accounts below reflect some of this effort. Trade data were used to develop the strategic regional conservation action plan for the Sunda pangolin (*Manis javanica*) (see IUCN SSC Pangolin Specialist Group et al., 2018) and the national conservation action plan for the Philippine pangolin (*Manis culionensis*) (see Palawan Council for Sustainable Development Staff et al., 2020). The data provided grounds to update the IUCN threat assessment for both species (Challender et al., 2019; Schoppe et al., 2019). It also supported a global assessment on the illicit trade in pangolins including mapping key trade routes and transportation modes (see Heinrich et al., 2016). At least 159 unique international trades routes were used in a six-year period reinforcing the highly mobile nature of smuggling networks. The link between Nigeria and Asia stood out at the time as a significant trade route in the trafficking of African pangolins to Asia that had not been previously examined. Using Nigeria as a case study, the importance of further research into shifting trends in the

international pangolin trade was raised (Gomez et al., 2016a). Since then, there has been a growing number of intelligence-led investigations into the illegal trade of pangolin scales out of Africa, showing Nigeria's central role in the trafficking trade chain (EIA, 2020; USAID, 2020; WJC, 2020). Trade data highlighting the international trafficking of pangolins supported the IUCN Pangolin Specialist Group's proposal to uplist all eight pangolin species to CITES Appendix I, the highest protection level governing the international trade of species. Pangolins were listed in CITES Appendix II in 1995 to regulate international trade in the species. But continued concerning trade levels in the four Asian pangolin species resulted in the establishment of a zero annual export quota for commercial trade for these species in 2000 effectively prohibiting any trade. This failed to prevent the trafficking of Asian pangolin species and also saw the rise in trade of African pangolins. The proposal was accepted at the CITES Conference of the Parties meeting in September 2016, prohibiting international commercial trade in all pangolin species. Nevertheless, the work below highlight that more extensive and effective protection measures and enforcement effort will be necessary if pangolins are to be saved from extinction.

Observing that Lao PDR was involved in the trafficking of pangolin scales from Nigeria, I researched further into pangolin trade dynamics in the country, which had not been documented up to this point. Lao PDR is a range country for two pangolin species, the Sunda pangolin and the Chinese pangolin (*Manis pentadactyla*). Strategically located next to China, Myanmar, Thailand and Vietnam, Lao PDR serves as an important transit hub for these countries, all of which have an active wildlife trade profile. Analysing market survey and pangolin seizure data (2010 – 2015) revealed that the pangolin trade within Lao PDR appeared to be mainly focused on a Chinese clientele (Gomez et al., 2016b). In the Boten province, shop owners and employees were predominantly of Chinese ethnicity and prices were often given in Chinese Yuan (CNY). In the provinces of Luang Prabang and Vientiane, pangolin products were mostly found in popular tourist hotspots. This study also demonstrated the country's role as a transit location for the movement of pangolins from other parts of Asia and Africa into China and Vietnam. Pangolin scales were openly traded alongside other illicit wildlife products, such as rhino horn shavings, helmeted hornbill casques, tiger teeth, elephant ivory and bear teeth, gall bladders and claws, without apparent fear of repercussion, exposing Lao PDR's poor enforcement of wildlife laws. It also raised attention to the various weaknesses and loopholes in Lao PDR's wildlife laws - violations are vaguely described and penalties designated are extremely low. This data has been used by NGOs (e.g., TRAFFIC) to lobby for much needed improvements to Lao PDR's legislative framework. The study also provided practical measures that can be used by enforcement authorities to mitigate the illegal trade of pangolins to and through Lao PDR.

Indonesia is home to one species of pangolin, the Sunda pangolin, which can be found in Kalimantan, Sumatra, Java and adjacent Indonesian Islands (Challender et al., 2014). Indonesia's involvement in the international pangolin trade dates back to at least the 20th century. There are records of large shipments of scales from Java to China from as early as 1925 (Semiadi et al., 2009; Nijman, 2015). During the 1990s, trade in pangolins out of Indonesia mostly involved their skins which were used to make leather products such as bags, wallets and other accessories (Sopyan, 2008). In the early 2000s, the trade in skins was replaced by the more profitable international trade in pangolin scales. This presented a need to better understand the country's role in the regional and international pangolin trade, as Indonesia and Malaysia were believed to be the remaining strongholds for the Sunda pangolin in Southeast Asia. An analysis of seizure data (2010-2015) and local intel exposed Indonesia as an important source country for pangolins in trade (Gomez et al., 2018b). Evidence of professional and industrial-scale hunting for the purposes of commercial international trade was discovered. Trade

hotspots and trafficking routes were mapped to support enforcement. Six main countries/territories were linked to the trafficking of pangolins from Indonesia - China (mainland China and Hong Kong), Lao PDR, Malaysia, Philippines, the US and Vietnam. One seizure record indicated for the first time, Indonesia's role as a transit country in the trafficking of African pangolin scales further supporting the diverse routes used by organised crime groups. This work stressed the need for enhanced enforcement capacity to improve intelligence led investigations into the cross-border trade of pangolins, as well as multi-agency collaboration at national and international levels to tackle the organized criminal networks involved in smuggling pangolins across Indonesia's border.

The Philippines is home to one species of pangolin, the Philippine or Palawan pangolin, so named because of its restricted range on Palawan and adjacent islands (Gaubert and Antunes, 2005; Lagrada et al., 2014). Pangolin populations on these islands are being depleted due to hunting and international trade according to one preliminary study i.e., Schoppe and Cruz (2009). To gain an understanding of current trade dynamics involving the Philippine pangolin, seizures data (2001-2017) and anecdotal observations of trade in the country were analysed (Gomez and Sy, 2018). It revealed that much of this trade was local in nature and involved pangolin meat and scales. Several seizures implicated foreign nationals from mainland China and Taiwan residing in the Philippines. Whether this trade feeds a local market catering to visitors and/or foreign nationals residing in the country or an international market could not be confirmed at the time, revealing an aspect of trade that needed investigating. Following up on this study, Sy and Krishnasamy (2020) revealed a surge in pangolin seizure incidents in the Philippines between 2018 and 2019 and a significant increase in the quantity of pangolins seized (from 740 pangolins seized between 2000-2017 to 6,894 seized between 2018-2019). Both these studies were used to assess the threat status of the Philippine pangolin. In December 2019, the IUCN Red List of Threatened Species re-assessed this species as Critically Endangered with the primary threat attributed to poaching and illegal trade, both for domestic and international purposes (Schoppe et al., 2019).

3.3 Lesser-known Species in Trade

Leopards

Leopards (*Panthera pardus)* (Order: Carnivora, Family: Felidae) have a wide habitat range and distribution across Africa and Asia (Stein et at., 2020). Yet populations are declining, having been reduced to isolated pockets or extirpated from large parts of their historical range (Jacobson et al., 2016; Stein et al., 2020). Population declines are mainly attributed to habitat loss and fragmentation, illegal wildlife trade, prey base decline and trophy hunting (Jacobson et al., 2016). Human-leopard conflict is also a significant problem in some parts of the region (e.g., India, Indonesia) and in some cases leopards killed in these situations do end up in illegal trade though the extent of this has not been extensively examined (CITES, 2019). These threats have resulted in leopards being assessed as Vulnerable on a global scale by the IUCN Red List of Threatened Species but there are also several Asian subspecies that are assessed as Endangered and Critically Endangered due to significant deterioration of wild populations in recent years (Laguardia et al., 2017; Stein et al., 2020; Vitekere et al., 2021). Indonesia is home to two leopard species (**Table 3**). The Javan leopard (*P. p. melas*) is regarded as one of the most threatened subspecies of leopard (Wibisono et al., 2018) and among the most threatened of all big cats. It is endemic to the island of Java in Indonesia. Deforestation and habitat conversion have depleted wild populations and greatly reduced the species range. Their habitat is now fragmented and limited to isolated pockets of forested areas around the island

(Wibisono et al., 2018; Stein et al., 2020). According to Wilting et al. (2016), only five percent of the island is habitable for the species. The Sunda clouded leopard (*Neofilis diardi*) is only found in Borneo and Sumatra, Indonesia. Wilting et al. (2011) further separated populations of Sunda clouded leopard on Borneo and those on Sumatra into two distinct subspecies - the Bornean clouded leopard (*N. d. borneensis*) and the Sumatran clouded leopard (*N. d. diardi*). Populations are reported to be declining across their range predominantly due to forest loss and degradation (Hearn et al., 2015). They are also poached in some areas (Hearn et al., 2016). While monitoring bear seizure data in Indonesia, I found that leopards were frequently seized along with bears. Data on the illegal trade of both leopard species is limited (Partasasmita et al., 2016). Building on this through in depth analysis of seizure data, a substantial illegal trade in both species mainly for their body parts and skin was discovered (Gomez and Shepherd, 2021). Locally, almost every part of the leopard is used in traditional medicine (Partasasmita et al., 2016). The data also revealed previously undocumented illegal exploitation of both species for the exotic pet trade, feeding local and international market demands. Human-leopard conflict in Indonesia is reportedly on the rise due to increasing fragmentation and loss of suitable habitat as well as depleting prey base (Partasasmita et al., 2016; Gunawan et al., 2017; Wibisono et al., 2018). This study raised doubts about the genuine nature of some conflict situations, revealing the possibility that loopholes in the law were being exploited to harvest these protected species for trade. Illegal exploitation of wildlife for trade has been persistently raised as a key threat to Indonesia's biodiversity, particularly when it involves rare, endemic and restricted range species (Nijman and Stoner 2014; Janssen and Shepherd 2018). This study reinforced this threat and served to draw conservation attention for the Javan leopard and Sunda clouded leopard particularly significant because of their threatened status in the wild. It has also since inspired a wider investigation into the trade of leopards across Asia.

Porcupines

Porcupines (Order: Rodentia, Family: Hystricidae) are among the most frequently encountered animals in surveyed markets across Asia. Their meat is consumed as an alternative and important source of protein in parts of their range and their quills are used for decorative purposes. In traditional Chinese medicine there is a particularly high demand for porcupine bezoar (non–digestible food material that forms a stone like mass in the gut of an animal) due to the perception that it has many healing properties (Brown, 2015; Lee et al., 2015; Tan et al., 2019). Chung et al. (2016) concluded that the high demand for porcupine bezoar may be one of the main reasons for the overhunting and decline of the Malayan porcupine (*Hystrix brachyura*) in Singapore and throughout its range. The procurement of genuine bezoars is considered difficult and rare as not all porcupines have them – hundreds to thousands are killed to obtain a just few bezoars (Gomez and Khoo, in prep). The commercial exploitation of porcupines for traditional medicine was particularly evident during our investigations into the bear bile trade in Malaysia. A need to identify the source of these bezoars spurred further investigation into porcupine trade in the region as studies in Southeast Asia show porcupines are in decline due to habitat loss and conversion as well as poaching (Brooks et al., 2010; Chung et al., 2016; Salviana et al., 2017; Farida et al., 2018; McEvoy et al., 2019; Loke et al., 2020). Most Southeast Asian porcupine species are assessed as Least Concern by the IUCN Red List of Threatened Species (Aplin, 2016; Cassolar, 2016; Molur, 2016; Lunde et al., 2016). However, these assessments provide no population density details in any range state. Furthermore, there is no listing of major threats to the species or details on use and trade, owing to the fact that trade-driven impacts have not been examined in detail or documented.

Several studies in Indonesia, Malaysia and Singapore have since been undertaken to fill current data gaps on what species of porcupine are being utilised, the source of porcupines in trade and the extent porcupines are used for meat and medicine (**Table 3**). It is intended that a deeper understanding of such trade dynamics can be used by government agencies, conservation organisations and other relevant stakeholders to sustainably manage the trade in porcupines and ensure wild populations remain secure. Heinrich et al. (2020) was the first study to scrutinise the online trade of porcupine bezoars in Indonesia, Malaysia and Singapore. Approximately 680 - 1332 bezoars were observed for sale. This study raised concerns regarding the source and legality of much of this trade as porcupines are protected to varying degrees in each country. It further highlighted the complications in determining the source country of species in trade which hinder enforcement efforts to monitor uptake and trade levels. It uncovered evidence on the international nature of the trade involving porcupines which occurs with little to no regulation in place. Indonesia was seen to be a significant source country. With the exception of the Malayan porcupine, which has a wide range throughout much of Asia, the remaining four species in Indonesia have a more restricted range (including three island endemics: the Sumatran porcupine (*H. sumatrae*), the Sunda porcupine (*H. javanica*) and the thick-spined porcupine (*H. crassispinis*), placing them at higher risk from unsustainable hunting and unregulated trade. This led to further research on the porcupine trade in Indonesia through an analysis of seizure data (Gomez, 2021). What clearly emerged from this study was that porcupines were being illegally hunted and exploited throughout their range in Indonesia, a situation facilitated by poor enforcement and legislative weaknesses. For instance, the inadequate regulation of harvest quotas is an issue that has been raised countless times in respect of Indonesian species in trade and is seen as a deliberate impediment to species conservation (Gomez and Bouhuys, 2018; Janssen and Chng, 2018; Armstrong and Chng, 2020; Latinne et al., 2020; Janssen and Gomez, 2021). This work on porcupines provided further evidence of this and demonstrated Indonesia's lack of political will in combatting the exploitation of wildlife of high commercial value. It also drew attention to the need to assess porcupine distribution and density to determine their conservation status and understand trade driven impacts. Raised awareness on the unregulated trade of porcupines that is occurring enabled us to procure more support to investigate the TCM trade of bezoars and captive-breeding of porcupines in Malaysia (Gomez and Khoo, in prep).

Saiga antelope

The saiga antelope (*Saiga tatarica*) (Order: Artiodactyla, Family: Bovidae) has been severely impacted by the traditional Chinese medicine trade (Milner-Gulland et al., 2001; Mallon, 2008; Doughty et al., 2019; Roberts et al., 2021). Its horn is in high demand in Asia and is used to treat fevers, liver ailments and epilepsy (Zang, 1990; Li et al., 2007). Only males carry horns and overhunting them has led to a skewed sex ratio and reproductive collapse, further contributing to population declines (Milner-Gulland et al., 2003b). Historically, hunting and trade of saiga antelope were legally allowed in parts of its range, however, the increasing demand for horns in Asia caused drastic population declines. In 1995 the species was listed in Appendix II of CITES to regulate international commercial trade in its parts and derivatives. A proposal to transfer the saiga antelope from Appendix II to Appendix I of CITES, which would have banned trade for primarily commercial purposes, was presented at the 18th meeting of the Conference of the Parties in Geneva in 2019 but was not adopted. Instead, the CITES Parties accepted an amended proposal that retained saiga on Appendix II subject to a zero-export quota for wild specimens traded for commercial purposes (Milner-Gulland et al. 2020). Continued declines also led to hunting bans in all range states (Theng et al., 2017). Despite this, illegally sourced horns continue to enter the market (EIA 2019; Van Uhm 2019; WWF 2020). Today, only five fragmented populations exist: one in Kalmykia, Russia (~5000-6000 individuals), three in Kazakhstan

(~154,600) and one in western Mongolia (~5000 individuals) (IUCN SSC Antelope Specialist Group, 2018). Populations in China and Ukraine are considered extinct. Migrating populations have declined in Uzbekistan and are no longer seen in Turkmenistan. Since 2002, the species has been listed as Critically Endangered.

Market surveys in Peninsular Malaysia in 2018 found saiga horn to be one of the most common medicinal products observed in trade. Only one study on the saiga horn trade in Malaysia has been published (von Meibom et al., 2010). To provide a current account on trade dynamics, market survey data and CITES trade data relating to saiga antelope were analysed (Gomez and Krishnasamy, 2019). This study revealed an active trade in horns and derivatives throughout the country. While trade is permitted (if from stockpiles of horns and derivatives harvested before the adoption of the zero quota or before the species was listed on CITES), it was unclear what proportion of the trade was occurring in accordance with regulations, or otherwise, or indeed whether the products were always genuine. The discrepancies in trade data and the lack of information on stockpiles has made it impossible to ascertain current legal stocks permitted for trade. This supported a case being made by NGOs (see EIA, 2019) for more comprehensive reporting of stocks to prevent laundering of illegally obtained horns. It also underscored a need for more accurate information on consumption patterns which would provide better insights into current demand and help guide awareness raising and demand reduction-related activities.

Serow

One group of species in Southeast Asia that few people have heard of is the serow (*Capricornis* spp) (Order: Artiodactyla, Family: Bovidae). Based on recent taxonomy reassessments, the IUCN Red List of Threatened Species recognises four species of serow: the Japanese serow (*Capricornis crispus*) restricted to Japan; the red serow (*C. rubidus*) restricted to Myanmar, India and southwest China; the Formosan serow (*C. swinhoei*) restricted to Taiwan; and the mainland serow (*C. sumatraensis*) which includes the following subspecies – (*C. s. sumatraensis*) found in Indonesia, Malaysia and Thailand, (*C. s. mildneedwardsii)* found in Cambodia, China, Lao PDR, Myanmar, Thailand and Vietnam, and (*C. s. thar*) found in the Himalayan range (Phan et al., 2020). Serows are threatened by widespread poaching and illegal trade almost everywhere they occur, yet surprisingly little attention has been given to their plight and conservation needs. Perhaps this is because specific trade-related research involving serows is extremely limited. They are mainly hunted for their meat and for their parts (including horns, bones, feet, blood, teeth, innards) which are used in traditional medicines (Duckworth et al., 2008a, Duckworth et al., 2008b, Duckworth and Than Zaw, 2008). Surveys of wildlife markets in Southeast Asia show that serows are one of region's most utilised group of species, despite being totally protected across their range (unpublished data). This revealed to be also true in Lao PDR during market surveys in 2016 (Leupen et al., 2017). The Chinese serow (*C. s. mildneedwardsii)* is the only naturally occurring species of serow in Lao PDR. In nearly every traditional medicine shop surveyed, serow parts and products were identified and amongst the most encountered wildlife in traditional based medicines. This encompassed ointments, gall bladders, horns, skins and skeletal remains (bones, joints, jaws, skull). Serow meat were observed for sale on two occasions. Their horns were also discovered for sale in seven jewellery shops. Despite being a protected species, trade was open and blatant, pointing to weak law enforcement. While vendors were generally aware such trade was illegal, they did not fear prosecution. According to a local policeman, illegal wildlife trade was not a priority for local law enforcement partly because wild meat and trade in wildlife products is a much-needed source of nutrition and/or income for the rural population. This highlighted the importance of local community engagement in preventing illegal trade and supported other studies proposing

similar interventions for species conservation in region (Challender and MacMillan 2014; Harrison et al., 2015; Hubschle and Shearing 2018; D'Cruze et al., 2018; Roe and Booker, 2019). This work provided the necessary grounds to gain further resources to investigate the trade of serows in other parts of Southeast Asia (see Shepherd et al., 2022a; Shepherd et al., 2022b). It also supported the IUCN Red List threat assessments for the red serow (see Shepherd, 2022) and the mainland serow (see Phan et al., 2020).

Pig-nosed turtle

Tortoises and freshwater turtles are among the most heavily traded groups of species in the world. Millions are traded annually to supply demand for meat, use in traditional medicines and pets (Standford et al., 2020). The pig-nosed turtle *(Carettochelys insculpta)* (Order: Testudines, Family: Carettochelyidae) is one such species. It is found only in New Guinea and northernmost Australia. Burgess and Lilley (2014) provided the first comprehensive overview of the harvesting and trade in this species. It revealed that egg and turtle harvesting for local consumption and the international pet trade was one of the biggest threats to this species. In 2017, the pig-nosed turtle was reassessed as Endangered on the IUCN Red List of Threatened Species from a previous assessment of Vulnerable in 2000 (Eisemberg et al., 2018). Populations are in decline due to unsustainable exploitation to meet international demand for pets and food. If this threat is not urgently curtailed, the species could be elevated to the status of Critically Endangered (Eisemberg et al., 2011; Eisemberg et al., 2018). Building upon the work of Burgess and Lilley (2014), an analysis of seizure data from 2013 to 2020 was undertaken to determine current trafficking levels (Shepherd et al., 2020). It revealed a significant level of international trade in pig-nosed turtles originating from Indonesia, and indicated little has been done to mitigate this threat. Law enforcement was found to be particularly ineffective. Though pig-nosed turtles are fully protected in Indonesia, only nine of the 26 seizures were successfully prosecuted and never to the full extent afforded under the law governing wildlife protection. Trade in and trafficking of pig-nosed turtles also violated Indonesia's Fisheries and Customs Acts, a legal instrument that crucially provides for significantly higher penalties and fines but was not utilised to prosecute perpetrators. The Indonesian CITES Management Authority approved the export of 5,415 pig-nosed turtles, 95% of which were declared wild-caught, in direct contravention of its own wildlife laws. This study once again exposed the lack of political will in Indonesia to address illegal trade in species of high commercial value. It also exposed the importance of using all legal instruments available to strengthen the prosecution of wildlife crimes.

A wildlife market in Java, Indonesia, 2018

4 CONCLUSION

A substantial body of research is reflected in the collection of published papers appended. They augment knowledge related to the domestic and international trade of wildlife for meat and medicine in Southeast Asia. Crucial factors affecting bears, pangolins and several other species across the region were scrutinised (including key trade hotspots, trafficking routes, legislative loopholes and weaknesses and enforcement effectiveness).

The research on bears is especially extensive. It highlights the uncertain future facing wild populations in Asia as they continue to be poached and killed for illegal trade. Indonesia and Malaysia, considered Sun Bear strongholds, were revealed to have noteworthy consumer markets for bears, their parts and derivatives. Lao PDR was found to have a significant illegal trade in bears and its bear bile/farming industry was predominantly supported by Chinese consumers/tourists. Rising poaching levels, attributed to illegal trade and human-bear conflict, were documented in India. My research exposes the international reach of trade-driven demands – medicines, meat, body parts, and trophies – which extends beyond well-known consumer countries such as China and Vietnam and beyond bear range countries.

The papers on pangolins show the relentless trafficking of Asian pangolins across Southeast Asia. China and Vietnam were reinforced as key end-use destinations. Lao PDR, Malaysia, Singapore and Thailand were revealed as important transit countries and Indonesia as a source country in the illicit trade chain. The Philippines was seen to have an active trade in pangolin meat catering to a local market and potentially international market. My research also brings to light Nigeria's role as an export point in the shipment of African pangolin scales to China and Lao PDR, and the increasing quantities of African pangolin scales seized in Asia.

I draw attention to Lao PDR's significance as an illegal wildlife trade hub that is exploited by neighbouring countries due to weak laws and ineffective enforcement. Chinese tourist/investors hold significant influence over wildlife trade activities in Lao PDR including the establishment of hotspots, like Boten and the Golden Triangle, that perpetuate the illicit trade in wildlife.

I underscore the risk to lesser-known species in trade such as porcupines, leopards and serows from exploitation as not only was trade widespread but occurred with little to no regulation. Human-wildlife conflicts are shown to warrant greater scrutiny and regulation as these situations are often exploited by wildlife traffickers to procure animals for trade as evident in the case of bears, leopards and porcupines.

My research conclusions identify improved policy and legislative reforms as well as support species threat assessments, conservation action plans and law enforcement. They also provide a valuable foundation for future work in the field.

Wildlife trade is extremely fluid in nature, constantly evolving and adapting to market conditions, trends and forces. Alert, sustained monitoring is required to keep abreast of its ever-changing dynamics, trade-driven demands and impacts. In particular, more focused research on less charismatic species in trade and non-CITES listed species is warranted to address the current imbalance in allocated conservation efforts and resources.

The COVID-19 pandemic has brought international attention to the huge risk wildlife trade can pose through the possible transmission of zoonotic diseases and the urgent need for deliberate measures to address this danger. These include reducing our reliance on natural resources for sustenance. Consequently, more study of local communities and their role in the illicit sourcing of wildlife for meat and medicine is paramount. Engagement with local communities, especially those that live near wildlife, through education, awareness programmes, capacity-building exercises and exploration of alternative livelihood solutions has proven significant in complementing enforcement efforts (Challender and MacMillan, 2014; Hubschle and Shearing, 2018; Roe and Booker, 2019). Such initiatives already have had some measure of success in parts of Asia. These involve indigenous communities in Kinabatangan Sabah (Ancrenaz et al., 2007), local communities in India and Nepal (Pathak, 2006) and traditional herding communities in China (Foggin, 2018).

There is also a need for more evidence-based research on consumer patterns, motivations and concerns in order to develop demand-reduction strategies and influence consumer behaviour (Thomas-Walters et al., 2021). This was identified as a priority conservation action for bears and pangolins to mitigate the use of these species for meat and medicine. Some progress is being made on this front by NGOs in the region – several studies have been undertaken to understand consumer behaviour and beliefs regarding the traditional medicine use of bears in Cambodia, Lao PDR, Myanmer and Vietnam (Davis et al., 2016; 2019; 2020). For other species - elephant, pangolin, rhino and tiger - social and behaviour change campaigns in China and Thailand were found to have increased the acknowledgement of the social unacceptability of consuming these species and their products, and a decreased desire to do so in the future (USAID, 2021). This offers hope in the possibility that targeted demand-reduction strategies could complement enforcement efforts to reduce the illegal and unsustainable exploitation of wildlife in the region.

Lamentably in Southeast Asia combatting wildlife crime is still treated as a low priority. The time is ripe for a fundamental reset in attitude. With the emergence of COVID-19, wildlife trade has been placed in the global spotlight. This charged attention has to translate into urgent collaborative action on the part of governments across the globe to ensure adequate resources (capacity, people, funds) are channelled towards tackling wildlife trade issues and the monumental species conservation crisis confronting our planet. Without this, biodiversity may not recover.

REFERENCES

Anon (2015). Sin City: Illegal wildlife trade in Laos's Golden Triangle Special Economic Zone. EIA, March 2015. https://eia-international.org/wp-content/uploads/EIA-Sin-City-FINAL-med-res.pdf.

Anon (2016). Application of Article XIII in the Lao People's Democratic Republic. SC67 Doc. 12.1. CITES Sixty-seventh meeting of the Standing Committee Johannesburg (South Africa), 23 September 2016 (https://cites.org/sites/default/files/eng/com/sc/67/E-SC67-12-01.pdf).

Aplin, K. (2016). Hystrix javanica. The IUCN Red List of Threatened Species 2016: e.T10752A 22231749. https://doi.org/10.2305/IUCN.UK.2016-2.RLTS.T10752A22231749.en.

Alvarado Martínez, I. and Martínez, E.R. (2018). Trafficking of Totoaba Maw. In: Arroyo-Quiroz, I., Wyatt, T. (Eds.), Green Crime in Mexico. Springer International Publishing, Cham 149–170. https://doi.org/10.1007/978-3-319-75286-0_12.

Alves, R., Santana, G., Almeida, W., Léo Neto, N. and Vieira, W. (2009). Reptiles used for medicinal and magic religious purposes in Brazil. Applied Herpetology 6 (3): 257–274. https://doi.org/10.1163/157075409X432913.

Alves, R.R.N. and Rosa, I.L. (Eds.) (2013). Animals in Traditional Folk Medicine: Implications for Conservation. Springer Berlin Heidelberg, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-29026-8.

Alves, R.R.N., Vieira, W.L.S., Santana, G.G., Vieira, K.S. and Montenegro, P.F.G.P. (2013). Herpetofauna used in traditional folk medicine: conservation implications. In: Animals in Traditional Folk Medicine. Springer, pp. 109–133.

Ancrenaz, M., Dabek, L. and O'Neil, S. (2007). The costs of exclusion: recognising a role for local communities in biodiversity conservation. PLOS Biology 5(11): e289.

Armstrong, O.H. and Chng, S.C.L. (2020). Distancing the flock: Bird singing competitions fly online to avoid Covid–19. TRAFFIC Bulletin 32(2).

Baker, S.E., Cain, R., Van Kesteren, F., Zommers, Z.A., D'cruze, N. and Macdonald, D.W. (2013). Rough trade: animal welfare in the global wildlife trade. BioScience 63, 928–938.

BANCA (2016). The Bear Trade and the Bear Farms in Cross-border Regions in Eastern Myanmar. Yangon, Myanmar.

Brodie, J.F., Giordano, A.J., Zipkin, E.F., Bernard, H., Mohd-Azlan, J. and Ambu, L. (2015). Correlation and persistence of hunting and logging impacts on tropical rainforest mammals. Conservation Biology 29: 110–121.

Brooks, E.G.E., Roberton, S.I. and Bell, D.J. (2010). The conservation impact of commercial wildlife farming of porcupines in Vietnam. Biological Conservation 143, 2808–2814. https://doi.org/10.1016/j.biocon.2010.07.030.

Brown, V. (2015). Not a miracle cure. The Star Online. https://www.thestar.com.my/opinion/online-exclusive/behind-the-cage/2015/06/12/not-a-miracle-cure. Accessed: June 2020.

Burgess, E.A. and Lilley, R. (2014). Assessing the trade in Pig-nosed Turtles Carettochelys insculpta in Papua, Indonesia. TRAFFIC, Petaling Jaya, Selangor.

Burgess, E.A., Stoner, S.S. and Foley, K.E. (2014). Bring to bear: an analysis of seizures across Asia (2000 - 2011). TRAFFIC, Petaling Jaya, Selangor.

Cassey, P., Gomez, L., Heinrich, S., García-Díaz, P., Stoner, S., Shepherd, C.R. and Calver, M. (2021). Bearing all Down Under: the role of Australasian countries in the illegal bear trade. Pacific Conservation Biology.

Challender, D. and Hywood, L. (2012). African Pangolins: Under increased pressure from poaching and intercontinental trade. TRAFFIC Bulletin 24(2): 53–55.

Challender, D.W.S. and MacMillan, D.C. (2014). Poaching is more than an enforcement problem. Conservation Letters 7: 484–494.

Challender, D., Waterman, C. and Baillie, J.E.M. (2014). Scaling up Pangolin Conservation. IUCN SSC Pangolin Specialist Group Conservation Action Plan. Zoological Society of London, London, UK.

Challender, D., Baille, J., Waterman, C., Pietersen, D., Nash, H., Wicker, L., Parker, K., Thomson, P., Nguyen, T.V., Hywood, L. and Shepherd, C.R. (2016). On scaling up pangolin conservation. TRAFFIC Bulletin 28(1): 19–21.

Challender, D and Waterman, C. (2017). Implementation of CITES Decision 2 17.239 b) and 17.240 on Pangolins (Manis spp.). Prepared by IUCN for the CITES Secretariat. SC69 Doc.57 Annex 1.

Challender, D., Willcox, D.H.A., Panjang, E., Lim, N., Nash, H., Heinrich, S. and Chong, J. (2019). Manis javanica. The IUCN Red List of Threatened Species 2019: e.T12763A123584856. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T12763A123584856.en. Accessed on 22 December 2022.

Chaves, W.A., Monroe, M.C. and Sieving, K.E. (2019). Wild Meat Trade and Consumption in the Central Amazon, Brazil. Human Ecology 47, 733 - 746. https://doi.org/10.1007/s10745-019-00107-6.

Cheung, H., Mazerolle, L., Possingham, H.P. and Biggs, D. (2021). Rhino horn use by consumers of traditional Chinese medicine in China. Conservation Science and Practice 3, e365. https://doi.org/10.1111/csp2.365.

CITES Secretariat (2022). World Wildlife Trade Report 2022. Geneva, Switzerland.

Chng, S.C.L. (2014). Seizures of tortoises and freshwater turtles in Thailand 2008 – 2013. TRAFFIC, Petaling Jaya, Selangor, Malaysia.

Chng, S.C.L. and Eaton, J.A. (2016). In the market for extinction: Eastern and Central Java. TRAFFIC Southeast Asia, Petaling Jaya, Selangor.

Chung, Y., Lim, N., Shunari, M., Wang, D. and Chan, S. (2016). Records of the Malayan porcupine, Hystrix brachyura (Mammalia: Rodentia: Hystricidae) in Singapore. Nature in Singapore 9: 63 - 68.

Coad, L., Fa, J.E., Abernethy, K., van Vliet, N., Santamaria, C., Wilkie, D., El Bizri, H.R., Ingram, D.J., Cawthorn, D.M. and Nasi R. (2019). Towards a sustainable, participatory and inclusive wild meat sector. Bogor, Indonesia: CIFOR.

Coals, P., Moorhouse, T.P., D'Cruze, N.C., Macdonald, D.W. and Loveridge, A.J. (2020). Preferences for lion and tiger bone wines amongst the urban public in China and Vietnam. Journal for Nature Conservation 57: e125874. https://doi.org/10.1016/j.jnc.2020.125874.

Corlett, R.T. (2007). The Impact of Hunting on the Mammalian Fauna of Tropical Asian Forests. Biotropica 39, 292–303. https://doi.org/10.1111/j.1744-7429.2007.00271.x.

Costa-Neto, E. M. (2005). Animal-based medicines: biological prospection and the sustainable use of zootherapeutic resources. Anais da Academia Brasileira de ciências, 77, 33–43.

Coudrat, C.N.Z., Duckworth, J.W. and Timmins, R.J. (2012). Distribution and conservation status of the red-shanked douc (Pygathrix nemaeus) in Lao PDR: an update. Am. J. Primatol. 74, 874e889.

Crudge, B., Wilkinson, N.M., Do, V.T., Cao, T.D., Cao, T.T., Weegenaar, A., and Hunt, M. (2016). Status and distribution of bears in Vietnam, 2016. Tech Rep, Free the Bears/Animals Asia, Vietnam.

Crudge, B., Nguyen, T. and Cao, T. (2018). The challenges and conservation implications of bear bile farming in Viet Nam. Oryx 1–8.

Crudge, B., Lees, C., Hunt, M., Steinmetz, R., Fredriksson, G. and Garshelis, D. (Eds) (2019). Sun bears: global status review & conservation action plan, 2019−2028. IUCN SSC Bear Specialist Group/IUCN SSC Conservation Planning Specialist Group/Free the Bears/TRAFFIC.

Davis, E.O., Gaffi, L., Mussoni, G., Zaw, T. and Glikman, J.A. (2020). Insights into medicinal wildlife consumption and bear part use in Rakhine, Myanmar. Journal for Nature Conservation, 58. https://doi.org/10.1016/j.jnc.2020.125923.

Davis, E. O., Glikman, J. A., Crudge, B., Dang, V., Willemsen, M., Nguyen, T., O'Connor, D. and Bendixsen, T. (2019). Consumer demand and traditional medicine prescription of bear products in Vietnam. Biological Conservation 235: 119–127.

Davis, E.O., O'Connor, D., Crudge, B., Carignan, A., Glikman, J.A., Browne-Nuñez, C. and Hunt, M. (2016). Understanding public perceptions and motivations around bear part use: A study in northern Laos of attitudes of Chinese tourists and Lao PDR nationals. Biological conservation, 203: 282–289.

Davis, E.O., Veríssimo, D., Crudge, B., Lim, T., Roth, V. and Glikman, J.A. (2020). Insights for reducing the consumption of wildlife: The use of bear bile and gallbladder in Cambodia. People and Nature, 2(4): 950–963.

D'Cruze, N., Sarma, U.K., Mookerjee, A., Singh, B., Louis, J., Mahapatra, R.P., Jaiswal, V.P., Roy, T.K., Kumari, I., Menon, V. (2011). Dancing bears in India: a sloth bear status report. Ursus 22 (2), 99–105.

D'Cruze, N., Galarza, F. E. R., Broche, O., El Bizri, H. R., Megson, S., et al. (2021). Characterizing trade at the largest wildlife market of Amazonian Peru. Global Ecology and Conservation, 28, e01631.

D'Cruze, N., Singh, B., Mookerjee, A., Harrington, L. A. and Macdonald, D. W. (2018). A socio-economic survey of pangolin hunting in Assam, Northeast India. Nature Conservation, 30.

Debata, S., Swain, K.K., Sahu, H.K., Palei, H.S. (2016). Human-sloth bear conflict in human dominated landscape of northern Odisha, India. Ursus 27 (2), 90–98.

Derraik, J.G.B. and Phillips, S. (2010). Online trade poses a threat to biosecurity in New Zealand. Biological Invasions 12, 1477–1480. https://doi.org/10.1007/s10530-009-9595-0.

Doughty, H., Veríssimo, D., Tan, R. C. Q., Lee, J. S. H., Carrasco, L. R., Oliver, K. and Milner-Gulland, E. J. (2019). Saiga horn user characteristics, motivations, and purchasing behaviour in Singapore. PloS One 14(9), e0222038.

Drury, R. (2011). Hungry for success: Urban consumer demand for wild animal products in Vietnam. Conservation and Society 9, 247. https://doi.org/10.4103/0972-4923.86995.

Duckworth, J.W., Salter, R.E. and Khounboline, K. (Ed.) (1999). Wildlife in Lao PDR: 1999 status report. Vientiane: IUCN-The World Conservation Union/Wildlife Conservation Society/Centre for Protected Areas and Watershed Management. Vientiane, Lao PDR.

Duckworth, J.W., Steinmetz, R. and MacKinnon, J. (2008a). Capricornis sumatraensis. The IUCN Red List of Threatened Species 2008:e. T3812A10099434. http://dx.doi.org/10.2305/IUCN.UK.2008. RLTS.T3812A10099434.en.

Duckworth, J.W., Steinmetz, R. and Pattanavibool, A. (2008b). Capricornis milneedwardsii. The IUCN Red List of Threatened Species 2008:e. T3814A10101852. http://dx.doi.org/10.2305/IUCN.UK.2008. RLTS.T3814A10101852.en.

Duckworth, J.W. and Than Zaw (2008). Capricornis rubidus. The IUCN Red List of Threatened Species 2008: e.T3815A10102774. http:// dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T3815A10102774. en.

Duckworth, J., Batters, G., Belant, J., Bennett, E., Brunner, J., Burton, J., Challender, D., Cowling, V., Duplaix, N. and Harris, J. (2012). Why South-East Asia should be the world's priority for averting imminent species extinctions, and a call to join a developing cross-institutional programme to tackle this urgent issue. SAPI EN. S. Surveys Perspectives Integrating Environment and Society 5.2 (2012).

Dutton, A. J., Hepburn, C. and Macdonald, D. W. (2011). A stated preference investigation into the Chinese demand for farmed vs. wild bear bile. PloS One 6(7), e21243.

Eaton, J.A., Shepherd, C.R., Rheindt, F.E., Harris, J.B.C., van Balen, S., Wilcove, D.S. and Collar, N.J. (2015). Trade-driven extinctions and near-extinctions of avian taxa in Sundaic Indonesia. Forktail 31: 1–12.

EIA (2015). Sin city illegal wildlife trade in Laos' Golden Triangle Special Economic Zone. London, UK.

EIA (2020). Out of Africa: How West and Central Africa have become the epicentre of ivory and pangolin scale trafficking to Asia. https://eia-international.org/wp-content/uploads/Out-of-Africa-FINAL.pdf.

EIA (2021). Lethal remedy: how the promotion of some traditional Chinese medicine in Africa poses a major threat to endangered wildlife. Environmental Investigation Agency, UK.

Eisemberg, C.C., Rose, M., Yaru, B. and Georges, A. (2011). Demonstrating decline of an iconic species under sustained indigenous harvest - the Pig-nosed Turtle (Carettochelys insculpta) in Papua New Guinea. Biological Conservation 144(9), 2282–2288.

Eisemberg, C., van Dijk, P.P., Georges, A. and Amepou, Y. (2018). Carettochelys insculpta. The IUCN Red List of Threatened Species 2018: e.T3898A2884984. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T3898A2884984.en. Downloaded on 25 July 2020.

El Bizri, H.R., Morcatty, T.Q., Valsecchi, J., Mayor, P., Ribeiro, J.E., Vasconcelos Neto, C.F., Oliveira, J.S., Furtado, K.M., Ferreira, U.C., Miranda, C.F. and Silva, C.H. (2020). Urban wild meat consumption and trade in central Amazonia. Conservation Biology 34, 438–448. https://doi.org/10.1111/cobi.13420.

Ezekiel, A. (2018). Review of Marine Wildlife Protection Legislation in ASEAN. TRAFFIC, Petaling Jaya, Selangor.

Fa, J.E., Funk, S.M. and Nasi, R. (2022). Hunting wildlife in the tropics and subtropics. Cambridge University Press.

Fa, J.E., Juste, J., Burn, R.W. and Broad, G. (2002). Bushmeat consumption and preferences of two ethnic groups in Bioko Island, West Africa. Human Ecology 30, 397–416.

Fa, J.E., Olivero, J., Real, R., Farfán, M.A., Márquez, A.L., et al. (2015). Disentangling the relative effects of bushmeat availability on human nutrition in central Africa. Scientific reports 5(1), 1–8.

Fa, J.E., Peres, C.A. and Meeuwig, J. (2003). Bushmeat Exploitation in Tropical Forests: an Intercontinental Comparison. Conservation Biology, 16 (1): 232–237. https://doi.org/10.1046/j.1523-1739.2002.00275.x.

Fa, J.E., Wright, J.H., Funk, S.M., Márquez, A.L., Olivero, J., Farfán, M.Á., Guio, F., Mayet, L., Malekani, D., Louzolo, C.H. and Mwinyihali, R. (2019). Mapping the availability of bushmeat for consumption in Central African cities. Environmental Research Letters 14(9), p.094002.

Feng, Y., Siu, K., Wang, N., Ng, K.M., Tsao, S.W., Nagamatsu, T. and Tong, Y. (2009). Bear bile: dilemma of traditional medicinal use and animal protection. Journal of Ethnobiology and Ethnomedicine 5, 2. https://doi.org/10.1186/1746-4269-5-2.

Fernandes, M., Chopra, M., Gautam, A. and Badola, S. (2022). In deep water: India's sea cucumber in illegal wildlife trade. TRAFFIC India, New Delhi.

Foggin, J.M. (2018). Environmental conservation in the Tibetan Plateau Region: lessons for China's belt and road initiative in the mountains of Central Asia. Land 7: 52.

Foley, K.E., Stengel, C.J. and Shepherd, C.R. (2011). Pills, powders, vials and flakes: the bear bile trade in Asia. TRAFFIC Southeast Asia, Petaling Jaya, Selangor.

Four Paws (2020). Europe's second-class tigers: Revealing the out-of-control captive tiger numbers and commercial trade. https://media.4-paws.org/c/5/5/5/c555a6c3b7150e4bbcb672872796b28b7b2598d6/Report_Europes-second-class-tigers_EN_FP-2020.pdf.

Fukushima, C.S., Mammola, S. and Cardoso, P. (2020). Global wildlife trade permeates the Tree of Life. Biological Conservation 247, 108503. https://doi.org/10.1016/j.biocon.2020.108503.

Garshelis, D. and Steinmetz, R. (2016). Ursus thibetanus (Errata version published in 2017). The IUCN red list of threatened species 2016. Online at: e. T22824A114252336. https://doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22824A45034242.en. Accessed: August 2017.

Gaubert, P. and Antunes, A. (2005). Assessing the taxonomic status of the Palawan Pangolin Manis culionensis (Pholidota) using discrete morphological characters. Journal of Mammalogy 86(6):1068–1074, December 2005.

Gbogbo, F. and Daniels, J.K. (2019). Trade in wildlife for traditional medicine in Ghana: therapeutic values, zoonoses considerations, and implications for biodiversity conservation. Human Dimensions of Wildlife 24, 296–300. https://doi.org/10.1080/10871209.2019.1605637.

Gluszek, S., Viollaz, J., Mwinyihali, R., Wieland, M. and Gore, M.L. (2021). Using conservation criminology to understand the role of restaurants in the urban wild meat trade. Conservation Science and Practice 3.5 (2021). https://doi.org/10.1111/csp2.368.

Goodrich, J., Lynam, A., Miquelle, D., Wibisono, H., Kawanishi, K., et al. (2015). Panthera tigris. The IUCN Red List of Threatened Species 2015: e.T15955A50659951. https://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T15955A50659951.en. Downloaded 17 February 2021.

Gomez, L. (2019). An update on the bear bile trade in Peninsular Malaysia. TRAFFIC, Southeast Asia Regional Office, Petaling Jaya, Selangor.

Gomez, L. (2021). The illegal hunting and exploitation of porcupines for meat and medicine in Indonesia. Nature Conservation 43, 109.

Gomez, L. and Bouhuys, J. (2018). Illegal Otter Trade in Southeast Asia. TRAFFIC, Petaling Jaya, Malaysia.

Gomez, L. and Krishnasamy, K. (2019). A rapid assessment of the trade in Saiga Antelope horn in Peninsular Malaysia. TRAFFIC Bulletin 21(1): 35–38.

Gomez, L., Leupen, B.T.C. and Tian, K.H. (2016a). The trade of African pangolins to Asia: a brief case study of pangolin shipments from Nigeria. TRAFFIC Bulletin 28(1): 3–5.

Gomez, L., Leupen, B.T.C. and Heinrich, S. (2016b). Observation of the illegal pangolin trade in Lao PDR. TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia.

Gomez, L., Leupen, B.T.C., Krishnasamy, K. and Heinrich, S. (2017). Scaly nexus: Mapping Indonesian pangolin seizures (2010–2015). TRAFFIC, Southeast Asia Regional Office, Petaling Jaya Selangor.

Gomez, L. and Shepherd, C.R. (2018). Trade in bears in Lao PDR with observations from market surveys and seizure data. Global Ecology and Conservation 15, e00415. https://doi.org/10.1016/j.gecco.2018.e00415.

Gomez, L. and Shepherd, C.R. (2019). Bearly on the radar – an analysis of seizures of bears in Indonesia. European Journal of Wildlife Research 65 (6), 1–8. https://doi.org/10.1007/s10344-019-1323-1.

Gomez, L. and Shepherd, C. R. (2021). The illegal exploitation of the Javan Leopard (Panthera pardus melas) and Sunda Clouded Leopard (Neofelis diardi) in Indonesia. Nature Conservation 43, 25.

Gomez, L., Shepherd, C. and Khoo, M. (2020). Illegal trade of sun bear parts in the Malaysian states of Sabah and Sarawak. Endangered Species Research 41, 279–287. https://doi.org/10.3354/esr01028.

Gomez, L., Shepherd, C.R. and Morgan, J. (2019). Revealing the online trade of Sun Bears in Indonesia. TRAFFIC Bulletin, 31(2): 67.

Gomez, L. and Sy, E.Y. (2018). Illegal pangolin trade in the Philippines. TRAFFIC Bulletin 30(1): 37 - 39.

Gomez, L., Wright, B., Shepherd, C.R. and Joseph, T. (2021). An analysis of the illegal bear trade in India. Global Ecology and Conservation 27, e01552. https://doi.org/10.1016/j.gecco.2021.e01552.

Gunawan, H., Iskandar, S., Sihombing, V.S. and Wienanto, R. (2017). Conflict between humans and leopards (Panthera pardus melas Cuvier, 1809) in Western Java, Indonesia. Biodiversitas (Surakarta) 18(2): 652–658. https://doi.org/10.13057/biodiv/d180229.

Harris, J.B.C., Green, J.M.H., Prawiradilaga, D.M., Giam, X., Giyanto, Hikmatullah, D., Putra, C.A. and Wilcove, D.S. (2015). Using market data and expert opinion to identify overexploited species in the wild bird trade. Biological Conservation 187, 51–60. https://doi.org/10.1016/j.biocon.2015.04.009.

Harrison, J.R., Roberts, D.L. and Hernandez-Castro, J. (2016). Assessing the extent and nature of wildlife trade on the dark web: Wildlife Trade on the Dark Web. Conserv. Biol. 30, 900–904. https://doi.org/10.1111/cobi.12707.

Harrison, R.D., Sreekar, R., Brodie, J.F., Brook, S., Luskin, M., O'Kelly, H., Rao, M., Scheffers, B. and Velho, N. (2016). Impacts of hunting on tropical forests in Southeast Asia. Conservation Biology, 30(5): 972–981.

Harrison, R.D. (2011). Emptying the Forest: Hunting and the Extirpation of Wildlife from Tropical Nature Reserves. BioScience 61, 919–924. https://doi.org/10.1525/bio.2011.61.11.11.

Heinrich, S., Wittmann, T.A., Prowse, T.A.A., Ross, J.V., Delean, S., Shepherd, C.R. and Cassey, P. (2016). Where did all the pangolins go? International CITES trade in pangolin species. Global Ecology and Conservation 8:241–253.

Heinrich, S., Whittman, T.A., Ross, J.V., Shepherd, C.R., Challender, D.W.S. and Cassey, P. (2017). The global trafficking of pangolins: a comprehensive summary of seizures and trafficking routes from 2010–2015. TRAFFIC, Southeast Asia Regional Office, Petaling Jaya, Selangor.

Heinrich, S., Toomes, A. and Gomez, L. (2020). Valuable stones: The trade in porcupine bezoars. Global Ecology and Conservation 24: e01204. https://doi.org/10.1016/j.gecco.2020.e01204.

Hinsley, A., Milner-Gulland, E.J., Cooney, R., Timoshyna, A., Ruan, X. and Lee, T.M. (2020). Building sustainability into the belt and road initiative's traditional Chinese medicine trade. Nature Sustainability, 3(2), 96–100.

Hubschle, A. and Shearing, C. (2018). Ending wildlife trafficking: local communities as change agents. The Global Initiative Against Transnational Organised Crime, Switzerland.

Hughes, A.C. (2017). Understanding the drivers of Southeast Asian biodiversity loss. Ecosphere 8, e01624. https://doi.org/10.1002/ecs2.1624.

IFAW (International Fund for Animal Welfare) (2011). Killing with keystrokes 2.0: IFAW's investigation into the European online ivory trade. https://bit.ly/2H4u61Q.

Ingram, D.J., Coad, L., Milner-Gulland, E.J., Parry, L., Wilkie, D., et al. (2021). Wild meat is still on the menu: progress in wild meat research, policy, and practice from 2002 to 2020. Annual Review of Environment and Resources 46, 221–254.

IUCN SSC Antelope Specialist Group (2018). Saiga tatarica. The IUCN Red List of Threatened Species 2018: e.T19832A50194357. Downloaded on 21 November 2018.

IUCN SSC Pangolin Specialist Group (2018). IUCN SSC PSG, IUCN SSC Asian Species Action Partnership, Wildlife Reserves Singapore, IUCN SSC Conservation Planning Specialist Group. Regional Sunda Pangolin (Manis javanica) Conservation Strategy 2018-2028. IUCN SSC Pangolin Specialist Group, c/o Zoological Society of London, Regent's Park, London, NW1 4RY, UK.

Janssen, J. and Chng, S.C. (2018). Biological parameters used in setting captive-breeding quotas for Indonesia's breeding facilities. Conservation Biology 32(1): 18–25. https://doi.org/10.1111/cobi.12978.

Janssen, J. and Gomez, L. (2021). An examination of the import of live reptiles from Indonesia by the United States from 2000 to 2015. Journal for Nature Conservation 59: e125949. https://doi.org/10.1016/j.jnc.2020.125949.

Janssen, J. and Shepherd, C.R. (2018). Challenges in documenting trade in non-CITES listed species: A case study on crocodile skinks (Tribolonotus spp.). Journal of Asia-Pacific Biodiversity, doi: 10.1016/j.japb.2018.09.003.

Kikuchi, R. (2012). Captive Bears in Human–Animal Welfare Conflict: A Case Study of Bile Extraction on Asia's Bear Farms. Journal of Agricultural and Environmental Ethics 25, 55–77. https://doi.org/10.1007/s10806-010-9290-2.

Kitade, T. (2017). An update review of online ivory trade in Japan. TRAFFIC, Tokyo, Japan.

Krishnasamy, K. and Shepherd, C.R. (2014). A review of the sun bear trade in Sarawak, Malaysia. TRAFFIC Bulletin 26 (1): 37–40.

Krishnasamy, K. and Stoner, S. (2016). Trading Faces: A Rapid Assessment on the use of Facebook to Trade Wildlife in Peninsular Malaysia. TRAFFIC, Petaling Jaya, Selangor.

Krishnasamy, K. and Zavagli, M. (2020). Southeast Asia: At the heart of wildlife trade. TRAFFIC, Southeast Asia Regional Office, Petaling Jaya, Selangor, Malaysia.

Kurniawan, D. and Nurashid, R. (2002). Bear markets: Indonesia - the illegal trade in bear products, bear parts and live sun bears in Indonesia. The Bear Business. WSPA 2002.

Lagrada, L., Schoppe, S. and Challender, D. (2014). Manis culionensis. The IUCN Red List of Threatened Species 2014: e.T136497A45223365. http://dx.doi.org/10.2305/ IUCN.UK.2014-2.RLTS.T136497A4522 3365.en. Viewed on February 2018.

Latinne, A., Saputro, S., Kalengkongan, J., Kowel, C.L., Gaghiwu, L., Ransaleleh, T.A., et al. (2020). Characterizing and quantifying the wildlife trade network in Sulawesi, Indonesia. Global Ecology and Conservation 21: e00887. https://doi.org/10.1016/j.gecco.2019.e00887.

Lavorgna, A. (2014). Wildlife trafficking in the Internet age. Crime Science 3(1), 1–12. https://doi.org/10.1186/s40163-014-0005-2.

Law, Y.H. (2019). This amazing blue tarantula is a new spider species—but did researchers break the law when they studied it? https://www.science.org/content/article/amazing-blue-tarantula-new-spider-species-did-researchers-break-law-when-they-studied. Accessed: 19 January 2022.

Lee, S.L., Burgess, E.A. and Chng, S.C.L. (2015). Hard to bear: an assessment of trade in bear bile and gall bladder in Malaysia. TRAFFIC, Petaling Jaya, Selangor.

Lee, R.J., Gorog, A.J., Dwiyahreni, A., Siwu, S., Riley, J., Alexander, H., Paoli, G.D. and Ramono, W. (2005). Wildlife trade and implications for law enforcement in Indonesia: a case study from North Sulawesi. Biological Conservation 123, 477–488.

Lee, T.M., Sigouin, A., Pinedo-Vasquez, M. and Nasi, R. (2014). The harvest of wildlife for bushmeat and traditional medicine in East, South and Southeast Asia: Current knowledge base, challenges, opportunities and areas for future research. Center for International Forestry Research (CIFOR).

Leupen, B.T.C., Gomez, L. and Shepherd, C.R. (2017). Recent observations of the illegal trade in serows in Lao PDR. TRAFFIC Bulletin 29(1): 37–40.

Li, L., Zhao, Y. and Bennett, E. L. (2007). Report of a survey on saiga horn in markets in China. CoP14 Inf, 14.

Li, S., Tan, H.Y., Wang, N., Hong, M., Li, L., Cheung, F. and Feng, Y. (2016). Substitutes for bear bile for the treatment of liver diseases: research progress and future perspective. Evidence-Based Complementary and Alternative Medicine, 2016.

Lim, N.T. and Ng, P.K. (2008). Home range, activity cycle and natal den usage of a female Sunda pangolin Manis javanica (Mammalia: Pholidota) in Singapore. Endangered Species Research 4(1-2), 233–240.

Lindsey, P.A., Balme, G., Becker, M., Begg, C., Bento, C., et al. (2013). The bushmeat trade in African savannas: Impacts, drivers, and possible solutions. Biological Conservation 160, 80–96. https://doi.org/10.1016/j.biocon.2012.12.020.

Liu, C.X. (2021). Overview on development of ASEAN traditional and herbal medicines. Chinese Herbal Medicines, 13(4), 441–450.

Liu, F., McShea, W.J., Garshelis, D.L., Zhu, X., Wang, D. and Shao, L. (2011). Human-wildlife conflicts influence attitudes but not necessarily behaviors: Factors driving the poaching of bears in China. Biol. Conserv. 144, 538–547. https://doi.org/10.1016/j.biocon.2010.10.009.

Livingstone, E., Gomez, L. and Bouhuys, J. (2018). A review of bear farming and bear trade in Lao People's Democratic Republic. Global Ecology and Conservation 13, e00380. https://doi.org/10.1016/j.gecco.2018.e00380.

Livingstone, E. and Shepherd, C.R., 2014. Bear farms in Lao PDR expand illegally and fail to conserve wild bears. Oryx 50, 176–184. https://doi.org/10.1017/S0030605314000477.

Lunde, D., Aplin, K. and Molur, S. (2016). Hystrix brachyura (errata version published in 2017). The IUCN Red List of Threatened Species 2016: e.T10749A115099298.

Lyons, J.A. and Natusch, D.J. (2011). Wildlife laundering through breeding farms: Illegal harvest, population declines and a means of regulating the trade of green pythons (Morelia viridis) from Indonesia. Biological Conservation 144(12): 3073–3081. https://doi.org/10.1016/j. biocon.2011.10.002.

Mallon, D.P. (2008). Saiga tatarica. The IUCN Red List of Threatened Species 2008: e.T19832A9021682. http://dx.doi. org/10.2305/IUCN.UK.2008.RLTS.T19832A9021682. en. Downloaded on 24 August 2018.

Martin, E.A., Brull, G.R., Funk, S.M., Luiselli, L., Okale, R. and Fa, J.E. (2020). Wild meat hunting and use by sedentarised Baka Pygmies in Southeastern Cameroon. PeerJ 8, p.e9906.

Mayor, P., El Bizri, H.R., Morcatty, T.Q., Moya, K., Bendayán, N., Solis, S., Vasconcelos Neto, C.F.A., Kirkland, M., Arevalo, O., Fang, T.G., Pérez-Peña, P.E. and Bodmer, R.E. (2021). Wild meat trade over the last 45 years in the Peruvian Amazon. Conservation Biology cobi.13801. https://doi.org/10.1111/cobi.13801.

McEvoy, J.F., Connette, G., Huang, Q., Soe, P., Pyone, K.H.H., Valitutto, M., Htun, Y.L., Lin, A.N., Thant, A.L., Htun, W.Y., Paing, K.H., Swe, K.K., Aung, M., Min, S., Songer, M. and Leimgruber, P. (2019). Two sides of the same coin - Wildmeat consumption and illegal wildlife trade at the crossroads of Asia. Biological Conservation 238, 108197. https://doi.org/10.1016/j.biocon.2019.108197.

Meijard, E. (1999). Human imposed threats to sun bears in Borneo. Ursus 11:185−192.

Milliken, T. and Shaw, J. (2012). The South Africa-Viet Nam rhino horn trade nexus: a deadly combination of institutional lapses, corrupt wildlife industry professionals, and Asian crime syndicates. TRAFFIC, Johannesburg, South Africa.

Mills, J.A. and Servheen, C. (1991). The Asian Trade in Bears and Bear Parts. World Wildlife Fund, Inc., USA.

Mills, J.A., Chan, S. and Ishihara, A. (1995). The bear facts: the East Asian Market for bear gall bladder. TRAFFIC International, Cambridge, UK.

Milner-Gulland, E.J., Kholodova, M.V., Bekenov, A., Bukreeva, O.M., Grachev, I.A., Amgalan, L. and Lushchekina, A.A. (2001). Dramatic decline in Saiga Antelope populations. Oryx, 35: 340–345.

Milner-Gulland, E.J. and Bennett, E.L. (2003). Wild meat: the bigger picture. Trends in Ecology and Evolution 18, 351 - 357. https://doi.org/10.1016/S0169-5347(03)00123-X.

Mohapatra, R.K., Panda, S., Acharjyo, L., Nair, M. and Challender, D. W. (2015). A note on the illegal trade and use of pangolin body parts in India. TRAFFIC Bulletin 27(1): 33–40.

Molur, S. (2016). Atherurus macrourus. The IUCN Red List of Threatened Species 2016: e.T2354A 22231214. https://doi.org/10.2305/IUCN.UK.2016-2.RLTS.T2354A22231214.en.

Morgan, K.I., Ewart, K.M., Nguyen, T.Q., Sitam, F.T., Ouitavon, K., Lightson, A.L., Kotze, A. and McEwing R. (2021). Avoiding common numts to provide reliable species identification for tiger parts. Forensic Science International: Reports 3: e100166. https://doi.org/10.1016/j.fsir.2020.100166.

Morton, O., Scheffers, B.R., Haugaasen, T. and Edwards, D.P. (2021). Impacts of wildlife trade on terrestrial biodiversity. Nature, Ecology and Evolution, 5: 540–548. https://doi.org/10.1038/s41559-021-01399-y.

Narang, V. and Watson, S. (2020). Situation Analysis: Illegal wildlife trade and consumer demand reduction efforts in Thailand. TRAFFIC International, Cambridge, United Kingdom.

Nasi, R., Taber, A. and Vliet, N.V. (2011). Empty forests, empty stomachs? Bushmeat and livelihoods in the Congo and Amazon Basins. International Forestry Review 13(3): 355 –368.

Newton, P., Van Thai, N., Roberton, S. and Bell, D. (2008). Pangolins in peril: using local hunters' knowledge to conserve elusive species in Vietnam. Endangered Species Research 6(1): 41–53.

Nijman, V. (2005). Decline of the endemic Hose's langur *Presbytis hosei* in Kayan Mentarang National Park, East Borneo. Oryx 39, 223–226. https://doi.org/10.1017/S0030605305000475.

Nijman, V. (2010). An overview of international wildlife trade from Southeast Asia. Biodiversity Conservation 19, 1101–1114.

Nijman, V. (2015). Pangolin seizure data reported in the Indonesian media. TRAFFIC Bulletin 27(2): 44 –46.

Nijman, V. and Bergin, D. (2017). Reptiles traded in markets for medicinal purposes in contemporary Morocco. Contributions to Zoology 86, 39 - 50. https://doi.org/10.1163/18759866-08601003.

Nijman, V. and Shepherd, C.R. (2011). The role of Thailand in the international trade in CITES-listed live reptiles and amphibians. PloS One 6 (3), e17825. https://doi.org/10.1371/journal.pone.0017825.

Nijman, V. and Shepherd, C.R. (2015). Adding up the numbers: an investigation into commercial breeding of Tokay Geckos in Indonesia. TRAFFIC Southeast Asia, Petaling Jaya, Selangor.

Nijman, V., Oo, H. and Shwe, N.M. (2017). Assessing the Illegal Bear Trade in Myanmar Through Conversations With Poachers: Topology, Perceptions, and Trade Links to China. Human Dimensions of Wildlife, 22 (2): 172–182.

Nijman, V., Spaan, D., Rode-Margono, E.J. and Nekaris, K.A.I. (2017b). 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(11), p.e22517.

Nijman, V. and Stoner, S.S. (2014). Keeping an ear to the ground: monitoring the trade in Earless Monitor Lizards. TRAFFIC Petaling Jaya, Selangor, Malaysia.

Nooren, H. and Claridge, G. (2001). Wildlife trade in Laos: the end of the game. IUCN - The World Conservation Union, Netherlands.

Nowell, K. (2000). Far from a cure: the tiger trade revisited. TRAFFIC International, Cambridge, UK.

Or, O.C., Lau, C.F. and Gomez, L. (2017). Recent reports of sun bear seizures and poaching in Malaysia. International Bear News Summer 2017, Vol 26, No. 2.

Palawan Council for Sustainable Development Staff, IUCN SSC, Pangolin Specialist Group, Katala Foundation Incorporated, Zoological Society of London (2020). Palawan Pangolin Conservation Strategy. IUCN SSC Pangolin Specialist Group, c/o Zoological Society of London, Regent's Park, London, NW1 4RY, UK.

Pantel, S. and Chin. S.Y (Eds) (2009). Proceedings of the workshop on the trade and conservation of pangolins native to South and Southeast Asia: 30 June - 2 July 2008, Singapore Zoo. TRAFFIC Southeast Asia, Petaling Jaya, Malaysia.

Partasasmita, R., Shanida, S.S., Iskandar, J. and Noviar, E. (2016). Human-leopard conflict in Girimukti Village, Sukabumi, Indonesia. Biodversitas 17(2): 783–790. https://doi.org/10.13057/biodiv/d170255.

Pathak, N. (2006) Community conserved areas in South Asia. Parks, Community Conserved Areas 2006 Vol 16, No 1.

Peng, A.Y. and Chen, S. (2021). Traditional Chinese medicine works: a politicised scientific debate in the COVID-19 pandemic. Asian Journal of Communication, 1–5.

Phan, T.D., Nijhawan, S., Li, S. and Xiao, L. (2020). Capricornis sumatraensis. The IUCN Red List of Threatened Species 2020: e.T162916735A162916910. https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T162916735A162916910.en. Accessed on 28 December 2022.

Phanthavong, B. (2008). Pangolin conservation in Lao PDR. In: Pantel, S., Chin, S.Y. (Eds.), Proceedings of the Workshop on Trade and Conservation of Pangolins Native to South and Southeast Asia, 30 June – 2 July 2008, Singapore Zoo, Singapore. TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia, pp. 56e58.

Phelps, J., Biggs, D. and Webb, E.L. (2016). Tools and terms for understanding illegal wildlife trade. Frontiers in Ecology and the Environment 14(9): 479–489.

Pereira, D., Loh, R. and Bonfiglio, M.B. (2002). The bear trade in Malaysia: the bear gall bladder and bear bile trade in traditional Chinese medicine shops in Malaysia. WPSA, UK.

Pruvot, M., Khammavong, K., Milavong, P., Philavong, C., Reinharz, D., et al. (2019). Toward a quantification of risks at the nexus of conservation and health: The case of bushmeat markets in Lao PDR. Science of the Total Environment 676, 732 –745.

Robinson, J.E. and Sinovas, P. (2018). Challenges of analyzing the global trade in CITES-listed wildlife: CITES data. Conservation Bioloci 32, 1203 - 1206. https://doi.org/10.1111/cobi.13095.

Roe, D. and Booker, F. (2019). Engaging local communities in tackling illegal wildlife trade: a synthesis of approaches and lessons for best practice. Conservation Science and Practice 1(5): e26.

Rosen, G.E. and Smith, K.F. (2010). Summarizing the evidence on the international trade in illegal wildlife. EcoHealth 7, 24–32. https://doi.org/10.1007/s10393-010-0317-y.

Rostro-García, S., Tharchen, L., Abade, L., Astaras, C., Cushman, S. A. and Macdonald, D. W. (2016). Scale dependence of felid predation risk: identifying predictors of livestock kills by tiger and leopard in Bhutan. Landscape Ecology 31(6), 1277–1298.

Sathyakumar, S., Kaul, R., Ashraf, N.V.K., Mookerjee, A. and Menon, V. (2012). National Bear Conservation and Welfare Action Plan. Ministry of Environment and Forests, Wildlife Institute of India and Wildlife Trust of India.

Scheffers, B.R., Corlett, R.T., Diesmos, A. and Laurance, W.F. (2012). Local demand drives a bushmeat industry in a Philippine forest preserve. Tropical Conservation Science 5(2): 133–141. https://doi.org/10.1177/194008291200500203.

Schoppe, S. and Cruz, R. (2009). The Palawan Pangolin Manis culionensis. In: Pantel, S. and Chin, S.Y. (Eds). Proceedings of the workshop on trade and conservation of pangolins native to South and Southeast Asia: 30 June - 2 July 2008, Singapore Zoo. TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia.

Schoppe, S., Katsis, L. and Lagrada, L. (2019). Manis culionensis. The IUCN Red List of Threatened Species 2019: e.T136497A123586862. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T136497A123586862.en. Downloaded 20 January 2021.

Scotson, L., Fredriksson, G., Augeri, D., Cheah, C., Ngoprasert, D. and Wai-Ming, W. (2017). Helarctos malayanus (errata version published in 2018). The IUCN Red List of Threatened Species 2017: e.T9760A123798233 (downloaded 20 Aug 2018).

Semiadi, G., Darnaedi, D. and Arief, A.J. (2009). Sunda Pangolin Manis javanica conservation in Indonesia: status and problems. In: Pantel, S., Chin, S.Y. (Eds). Proceedings of the Workshop on Trade and Conservation of Pangolins Native to South and Southeast Asia: 30 June - 2 July 2008, Singapore Zoo. TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia.

Servheen, C., Herrero, S., Peyton, B., Pelletier, K., Moll, K. and Moll, J. (1999). Bears: status survey and conservation action plan. IUCN/SSC Bear and Polar Bear Specialist Goups, IUCN, Gland, Switzerland and Cambridge, UK.

Sethy, J. and Chauhan, N.P.S. (2011). Use and trade of bear body parts: impact and conservation in Arunachal Pradesh State of India. International Journal of Bio-resource and Stress Management 2(4): 409–415.

Shairp, R., Veríssimo, D., Fraser, I., Challender, D. and MacMillan, D. (2016). Understanding Urban Demand for Wild Meat in Vietnam: Implications for Conservation Actions. PLOS ONE 11, e0134787. https://doi.org/10.1371/journal.pone.0134787.

Shepherd, C.R. (2010). Illegal primate trade in Indonesia exemplified by surveys carried out over a decade in North Sumatra. Endangered Species Research 11, 201–205.

Shepherd, C.R. (2022). Capricornis rubidus (amended version of 2021 assessment). The IUCN Red List of Threatened Species 2022: e.T3815A214430673. https://dx.doi.org/10.2305/IUCN.UK.2022-1.RLTS.T3815A214430673.en. Accessed on 28 December 2022.

Shepherd, C. R. and Ibarrondo, B. (2005). The trade of the Roti Island Snake-necked turtle Chelodina mccordi, Indonesia. TRAFFIC Southeast Asia, Petaling Jaya, Selangor.

Shepherd, C.R. and Magnus, N. (2004). Nowhere to hide: the trade in Sumatran Tiger. TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia.

Shepherd, C.R. and Nijman, V. (2008). The trade in bear parts from Myanmar: an illustration of the ineffectiveness of enforcement of international wildlife trade regulations. Biodivers. Conserv. 17, 35–42. https://doi.org/10.1007/s10531-007-9228-9.

Shepherd, C.R., Gomez, L. and Nijman, V. (2020). Illegal wildlife trade, seizures and prosecutions: A 7.5- year analysis of trade in pig-nosed turtles Carettochelys insculpta in and from Indonesia. Global Ecology and Conservation 24: e01249. https://doi.org/10.1016/j.gecco.2020.e01249.

Shepherd, C.R., Gomez, L. and Rachmayuningtyas, B.A. (2022). The illegal trade of the Sumatran serow Capricornis sumatraensis sumatraensis for traditional medicine in Indonesia. Applied Environmental Studies, 3(2): 98–104

Shepherd, C.R., Gomez, L., Siriwat, P. and Nijman, V. (2022). Wildlife conservation in Myanmar: trade in wild sheep and goats for meat, medicine, and trophies, with links to China, India, and Thailand. European Journal of Wildlife Research, 68(6): 1–10.

Shepherd, C. R., Kufnerová, J., Cajthaml, T., Frouzová, J. and Gomez, L. (2020). Bear trade in the Czech Republic: an analysis of legal and illegal international trade from 2005 to 2020. European Journal of Wildlife Research, 66(6): 1–10.

Siriwat, P. and Nijman, V. (2018). Using online media-sourced seizure data to assess the illegal wildlife trade in Siamese rosewood. Environmental Conservation 45 (4): 352–360. https://doi.org/10.1017/S037689291800005X.

Soewu, D., Bakare, O. and Ayodele, I. (2012). Trade in Wild Mammalian Species for Traditional Medicine in Ogun State, Nigeria. Global Journal of Medical Research 12.3(2012): 6–22

Sofowora, A. (1996). Research on medicinal plants and traditional medicine in Africa. The Journal of Alternative and Complementary Medicine 2(3): 365–372.

Som, S. and Cottet, M. (2015). Rescue and relocation programme of turtles and tortoises and elongated tortoise monitoring programme in the Nam Theun 2 Reservoir (Laos). Hydroecol. Appliquee. https://doi.org/10.1051/hydro/2015007.

Sopyan, E. (2009). Malayan Pangolin Manis javanica trade in Sumatra, Indonesia. In: Pantel, S. and Chin, S.Y. (Eds), Proceedings of the workshop on trade and conservation of pangolins native to South and Southeast Asia, 30 June - 2July 2008, Singapore Zoo. TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia.

Stanford, C.B., Iverson, J.B., Rhodin, A.G., van Dijk, P.P., Mittermeier, R.A., Kuchling, G., Berry, K.H., Bertolero, A., Bjorndal, K.A., Blanck, T.E. and Buhlmann, K.A. (2020). Turtles and tortoises are in trouble. Current Biology 30(12): R721 - R735. https://doi.org/10.1016/j.cub.2020.04.088.

Stein, A.B., Athreya, V., Gerngross, P., Balme, G., Henschel, P., Karanth, U., Miquelle, D., Rostro-Garcia S., Kamler, J.F., Laguardia, A., Khorozyan, I., Ghoddousi, A. (2020). Panthera pardus (amended version of 2019 assessment). The IUCN Red List of Threatened Species 2020: e.T15954A163991139.

Sy, E.Y. and Krishnasamy, K. (2020). Endangered by trade: the ongoing illegal pangolin trade in the Philippines. TRAFFIC, Southeast Asia Regional Office, Petaling Jaya, Selangor, Malaysia.

Symes, W.S., Edwards, D.P., Miettinen, J., Rheindt, F.E. and Carrasco, L.R. (2018). Combined impacts of deforestation and wildlife trade on tropical biodiversity are severely underestimated. Nature Communications 9, 4052.

't Sas-Rolfes, M., Challender, D.W.S., Hinsley, A., Veríssimo, D. and Milner-Gulland, E.J. (2019). Illegal Wildlife Trade: Scale, Processes, and Governance. Annual Review of Environment and Resources 44, 201 - 228. https://doi.org/10.1146/annurev-environ-101718-033253.

Tan, M.B.N. and Tan, H.T.W. (2013). The laws relating to biodiversity in Singapore. Raffles Museum of Biodiversity Research, National University of Singapore, Singapore.

Tan, C.S., Ng, C.H., Loh, Y.C. and Yam, M.F. (2019). A traditional folk medicine in Malaysia: Porcupine bezoar. Oriental Pharmacy and Experimental Medicine 19(2): 131–136. https://doi. org/10.1007/s13596-019-00370-4.

Tankandjandji, M. and Sawitri, R. (2016). Analisis penangkapan an perdagangan Trenggiling Jawa (Manis javanica, Desmarest, 1822) di Indonesia (Analysis of capture and trade of Sunda Pangolin in Indonesia). Jurnal Analisis Kebijakan Vol. 13 No. 2, Agustus 2016: 85–101.

Theng, M., Glikman, J.A. and Milner-Gulland, E.J. (2017). Exploring saiga horn consumption in Singapore. Oryx, 1 - 8. Fauna and Flora International. doi:10.1017/S0030605317001624.

Thomas-Walters, L., Hinsley, A., Bergin, D., Burgess, G., Doughty, H., Eppel, S., MacFarlane, D., Meijer, W., Lee, T.M., Phelps, J. and Smith, R.J., (2021). Motivations for the use and consumption of wildlife products. Conservation Biology, 35(2): 483–491

TRAFFIC (2008). "What's Driving the Wildlife Trade? A Review of Expert Opinion on Economic and Social Drivers of the Wildlife Trade and Trade Control Efforts in Cambodia, Indonesia, Lao PDR and Vietnam". East Asia and Pacific Region Sustainable Development Discussion Papers. East Asia and Pacific Region Sustainable Development Department, World Bank, Washington, DC.

Tumbelaka, L. and Fredriksson, G. (2006). The status of sun bears in Indonesia. In: Japan bear network (compiler) Understanding Asian bears to secure their future. Japan bear network, Ibaraki, Japan, 145pp.

UN (2019). United Nations Department of Economic and Social Affairs, Population Division. World Population Prospects 2019: Highlights (ST/ESA/SER.A/423). Online at: https://population.un.org/wpp/. Accessed: June 2021.

UNODC (2020). Pangolin scales. United Nations Office on Drugs and Crime, 2020.

USAID (2020). West Africa biodiversity and climate change: scoping study for pangolin conservation in West Africa. 2nd Labone Link, North Labone, Accra, Ghana. 227pp.

USAID (2021). Counter wildlife trafficking digest: Southeast Asia and China, 2020. Issue IV, May 2021.

Valdez, J.W. (2021). Using Google Trends to Determine Current, Past, and Future Trends in the Reptile Pet Trade. Animals, 11, 676. https://doi.org/10.3390/ani11030676

Van Uhm, D. P. (2016). The illegal wildlife trade: Inside the world of poachers, smugglers and traders (Vol. 15). Springer.

Voigt, M., Wich, S.A., Ancrenaz, M., Meijaard, E., Abram, N., et al. (2018). Global demand for natural resources eliminated more than 100,000 Bornean orangutans. Current Biology 28: 761–769.

Von Meibom, S., Vaisman, A., Neo Liang, S.H., Ng, J. and Xu, H. (2010). Saiga Antelope Trade: Global Trends with a Focus on South-East Asia. TRAFFIC project report to the CITES Secretariat. TRAFFIC Europe, Brussels, Belgium.

WAP (2020). Cruel cures: the industry behind bear bile production and how to end it. World Animal Protection. https://www.dropbox.com/s/2kzpdkfjn4vh347/Bear%20Bile%20Report_Cruel%20Cures_FINAL_compressed.pdf?dl=0.

Watters, F., Stringham, O., Shepherd, C.R. and Cassey, P. (2022). The U.S. market for imported wildlife not listed in the CITES multilateral treaty. Conservation Biology, 36 (6). https://doi.org/10.1111/cobi.13978.

Wibisono, H.T., Wahyudi, H.A., Wilianto, E., Pinondand, I.M.R., Primajati, M., Liswanto, D. and Linkie, M. (2018). Identifying priority conservation landscapes and actions for the Critically Endangered Javan Leopard in Indonesia: conserving the last large carnivore in Java Island. PLoS One 13(6): e0198369. https://doi.org/10.1371/journal.pone.0198369.

WFFT (2020) The Thai 'zoo' where tigers were seized has been on the radar of authorities for illegal wildlife trade. Online at: https://www.wfft.org/tigers/the-thai-zoo-where-tigers-were-seized-has-been-on-the-radar-of-authorities-for-illegal-wildlife-trade/. Accessed: June 2020.

Willcox, D., Minh, N.D.T. and Gomez, L. (2016). An assessment of trade in bear bile and gall bladder in Viet Nam. TRAFFIC, Petaling Jaya, Selangor.

Williamson, D.F. (2007). Proceedings of the fourth International Symposium on the Trade in Bear Parts: Nagano, Japan October 4th, 2006. TRAFFIC East Asia - Japan, Tokyo.

Wilting, A., Patel, R., Pfestorf, H., Kern, C., Sultan, K., Ario, A., Penaloza, F., Kramer-Schadt, S., Radchuk, V., Foerster, D.W. and Fickel, J. (2016). Evolutionary history and conservation significance of the Javan leopard Panthera pardus melas. Journal of Zoology 299(4): 239 - 250. https://doi.org/10.1111/jzo.12348.

WJC (2020). Rapid assessment of the impact of COVID-19 on wildlife trafficking. https://wildlifejustice.org/wp-content/uploads/2020/04/WJC_Impact-of-COVID19-on-wildlife-trafficking_April2020.pdf.

WJC (2021). Convergence of wildlife crime with other forms of organised crime. https://wildlifejustice.org/wp-content/uploads/2021/05/Crime-Convergence-Report-2021.pdf.

Woolloff, A., Nkoke, S., Musing, L. and M. S. Svensson, M.S. (2022). Cyber enabled wildlife trade in Central African countries and Nigeria. TRAFFIC International, Cambridge, United Kingdom.

Wong, R. (2019). The illegal wildlife trade in China: understanding the distribution networks. Palgrave Macmillan, Switzerland.

Wong, R. and Krishnasamy, K. (2019). Skin and bones unresolved: an analysis of tiger seizures from 2000 - 2018. TRAFFIC Southeast Asia, Petaling Jaya, Selangor.

Wu, S.B. and Ma, G.Z. (2007). The status and conservation of pangolins in China. TRAFFIC East Asia Newsletter 4: 1–5.

Xiau, Y., Guan, J. and Xu, L. (2017). Wildlife cybercrime in China: e-commerce and social media monitoring in 2016. TRAFFIC Cambridge, UK.

Xu, L., Guan, J., Lau, W. and Xiao, Y. (2016). An overview of pangolin trade in China. TRAFFIC briefing paper, TRAFFIC, Cambridge, UK.

Zhang, L. and Yin, F. (2014). Wildlife consumption and conservation awareness in China: a long way to go. Biodiversity Conservation 23: 2371–2381.

ANNEX A: LIST OF PUBLICATIONS INCLUDED FOR THIS CRITICAL APPRAISAL (A1-A19)

BEARS

A1. Or, O.C., Lau, C.F. and Gomez, L. 2017. Recent reports of seizures and poaching of sun bears in Malaysia. International Bear News 26 (2): 17-18

A2. Livingstone, E., Gomez, L. and Bouhuys, J. 2018. A review of bear farming and bear trade in Lao PDR. Global Ecology and Conservation 13(2018) e00380. DOI: 10.1016/j.gecco.2018.e00380.

A3. Gomez, L. and Shepherd, C.R. 2018. Trade in bears in Lao PDR with observations from market surveys and seizure data. Global Ecology and Conservation 15 (2018) e00415. DOI: 10.1016/j.gecco.2018.e00415.

A4. Gomez, L. 2019. An update on the bear bile trade in Peninsular Malaysia. TRAFFIC, Petaling Jaya, Malaysia.

A5. Gomez, L. and Shepherd, C.R. 2019. Bearly on the radar: an analysis of bear seizure data in Gomez, L. and Shepherd, C.R. 2019. Bearly on the radar: an analysis of bear seizure data in Indonesia. European Journal of Wildlife Research (2019) 65:89. DOI: 10.1007/ s10344-019-1323-1

A6. Gomez, L., Shepherd, C.R. and Morgan, J. 2019. The online trade of Sun Bears in Indonesia. TRAFFIC Bulletin 31(2): 67-71

A7. Gomez, L., Shepherd, C.R. and Khoo, M.S. 2020. The illegal bear bile trade in Sabah and Sarawak. Endangered Species Research 41: 279–287. DOI: 10.3354/esr01028

A8. Shepherd, C.R., Kufnerová, J., Cajthaml, T., Frouzová, J. and Gomez, L. 2020. Bear trade in the Czech Republic: An analysis of legal and illegal international trade from 2005 to 2020. European Journal of Wildlife Research (2020) 66:92. DOI: https://doi.org/10.1007/s10344-020-01425-7

A9. Gomez, L., Wright, B., Joseph, T. and Shepherd, C.R. 2021. An analysis of the illegal bear trade in India. Global Ecology and Conservation e01552

Global Ecology and Conservation 13 (2018) e00380

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Original Research Article

A review of bear farming and bear trade in Lao People's Democratic Republic

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ABSTRACT

This study reviews the bear farming industry in Lao PDR with the objective of documenting the current number of commercial bear facilities (i.e. captive bear facilities judged to be trading in bear bile and/or bears and bear parts) and the number of bears contained within these facilities, noting changes since it was last examined between 2000 and 2012 by Livingstone and Shepherd (2014). We surveyed all known commercial bear facilities and searched for previously unrecorded facilities. We compared our records with Livingstone and Shepherd (2014) and corrected some duplicate records from their study. In 2017, we recorded seven commercial facilities; four dedicated bear farms, and three tiger farms that were reportedly also keeping bears. We found that between 2012 and 2017 the recorded number of dedicated bear farms reduced by two, and the recorded number of tiger farms also keeping bears increased by one. Within the same period, the total number of captive bears among all facilities in Lao PDR hardly changed (+one), but the number of bears within each facility did. The northern facilities, owned by ethnic Chinese, have expanded since 2012, and central and southern facilities have downsized or closed. While bear farming appears to be downsizing in Lao PDR overall, efforts to phase it out are undermined by the expansion of foreign owned facilities in the north, within Special and Specific Economic Zones that largely cater to a Chinese market, and where the Lao government's efforts to enforce laws and protect wildlife appear to be lacking. Closing the facilities in the north will require political will and decisive law enforcement.

1. Introduction

The practice of keeping bears captive for live bile extraction, commonly known as “bear farming”, has expanded throughout Asia since the 1980's (Servheen et al., 1999). Bile, taken from the gallbladders of bears, has been used in Traditional Medicine in East Asia for more than 1000 years as a treatment for a wide range of inflammatory and degenerative ailments (Feng et al., 2009; Li et al., 2016). Current trends indicate that the bear farming industry is shrinking in some countries and increasing in others. Recent shifts in public attitudes and government policies, however, have cast uncertainty on the sustainability of this industry. In South Korea, where the number of bears in captive facilities once surpassed 1000 (World Animal Protection, 2017), the government has begun sterilizing all remaining captive bears on bile-extraction facilities (est. 660 bile

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producing bears in 2017) in their efforts to phase out the industry (World Animal Protection, 2017; K. Kukreja, personal Communication, 2017). Similarly in Vietnam, a government ban on live bile extraction from captive bears implemented in 2006 has since seen a decrease of over 70% in the numbers of captive bears, from 4000 to 1200 (Animals Asia, 2011; Crudge et al., 2016; Willcox et al., 2016; ENV, 2017). However, Japan's 'bear parks', which reportedly trade in bear bile products, hold more than 1000 bears, and may be expanding through breeding and from orphaned cubs (Foley et al., 2011; Mills and Servheen, 1991; Togawa and Sakamoto, 2002). In China, the world's biggest producer and consumer of bear bile, there are currently more than 20,000 bears in captivity (Jiwen and Shenzhen, 2016). Facilities in China peaked at around 400 and then declined to less than 100 following a tightening of China's industry regulations in the 1990's, as many small-scale farms (<50 bears) consolidated into larger facilities (Animals Asia, 2011; Jiwen and Shenzhen, 2016). The available estimates from China, Japan, South Korea and Vietnam amount to more than 23,000 captive bears in these countries combined.

The international bear bile industry is largely driven by demand from China, as well as Chinese international tourists and ethnic Chinese communities in other countries, such as Australia, Europe, Lao PDR, Malaysia, Myanmar, New Zealand and Singapore (Williamson, 2006; Burgess et al., 2014; Ling et al., 2015). Following a tightening of China's domestic regulations on bear farming (Jiwen and Shenzhen, 2016), within the last two decades bear bile businesses have opened in neighbouring Lao PDR and Myanmar, run by Chinese entrepreneurs who presumably moved across the border to remain close to their main consumers while leveraging the benefits of low government restrictions and weak law enforcement in these lower-income countries (Livingstone and Shepherd, 2014; BANCA, 2017; Nijman et al., 2017). Bear bile trade also operates visibly within several trading hotspots around China's borders, such as the Golden Triangle region (overlapping Myanmar, Lao PDR and Thailand; Fig. 1). In these trading hotspots, the consumer base is largely Chinese tourists attracted by gambling, drugs, prostitution and other trading activities that are illegal in China (Shepherd and Nijman, 2008; EIA, 2015; BANCA, 2017). The captive bear bile industries in Lao PDR and Myanmar are still relatively small, compared with other bile producing countries, with recent records indicating less than 200 captive bears in each country (BANCA, 2017; Livingstone and Shepherd, 2014).

Asiatic black bears (*Ursus thibetanus*) are protected globally as Appendix I Species under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES; Garshelis and Steinmetz, 2016), and are classed as 'Vulnerable'

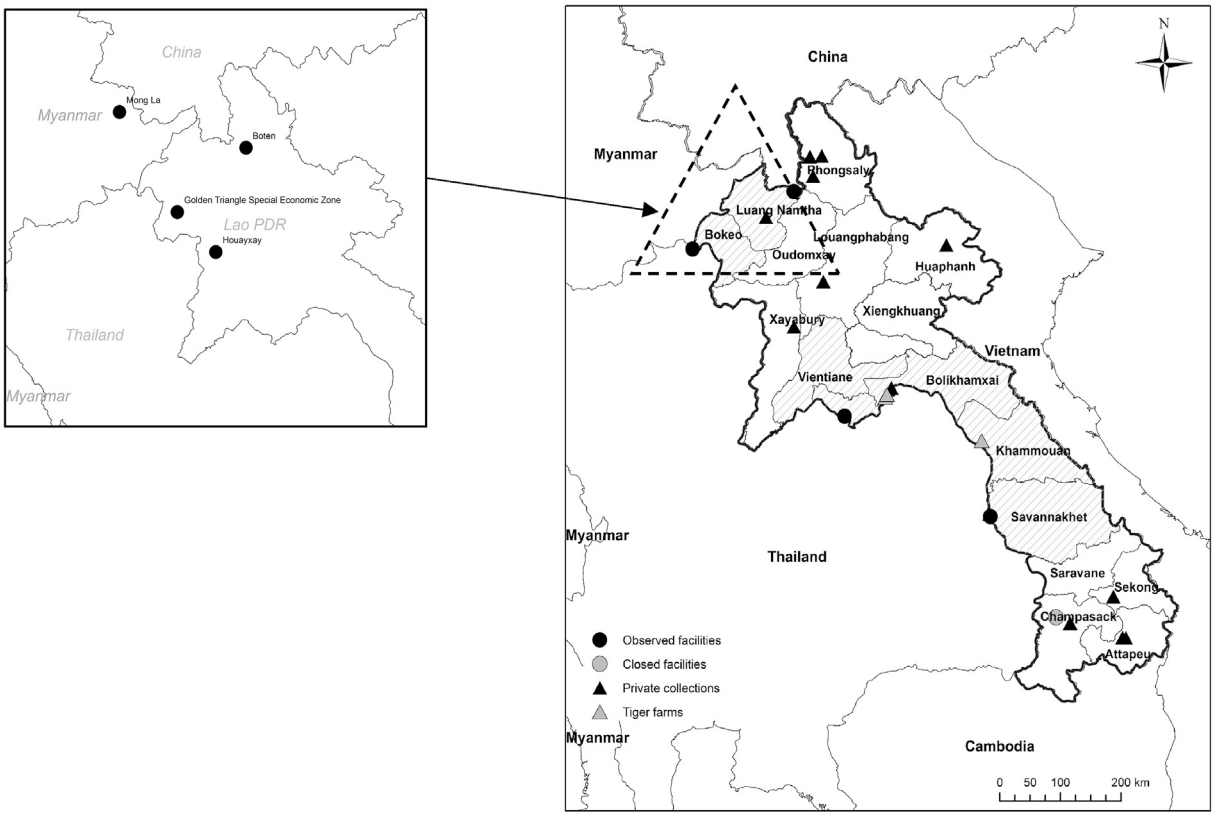

Fig. 1. Locations of recorded bear farms (including facilities found to be closed during our survey), tiger farms and private bear collections in Lao PDR. Excludes bears held within a rescue centre in Louangphabang and in Vientiane Zoo. We searched for facilities in 17 out of 18 Provinces, all except Xaisomboun. Provinces with Special and/or Specific Economic Zones are shaded in grey. Towns and zones within the Golden Triangle region that are mentioned in our report are indicated topleft and within the dashed triangle; this region is a bear bile trading hotspot, catering to Chinese international tourists pursing activities that are illegal in China (e.g. drugs, gambling, prostitution, endangered wildlife trade).

on the IUCN Red List of Threatened species. Asiatic black bears are protected in Lao PDR under the Wildlife and Aquatic Law, 2007, which states that all hunting, catching and possession of bears is prohibited, as is removal and/or possession of carcasses, parts and organs. Experts estimate that the global population of Asiatic black bears has declined by more than 30% in the last 30 years, with declines attributed mainly to over-hunting and habitat loss (Garshelis and Steinmetz, 2016). Some of the highest declines have been in countries with a history of bear farming. For instance, wild bear populations in South Korea have been extirpated bar a small number of reintroduced bears (Jeong et al., 2011), and severely depleted in Vietnam (Crudge et al., 2016; Garshelis and Steinmetz, 2016). In 2012, bear farming came under international scrutiny when the World Conservation Union (IUCN) passed Resolution, WCC-2012-Rec-139-EN, to phase out the industry in most bile producing countries, and to launch an investigation into its impact on wild bear populations in China (IUCN, 2016, 2012).

In recent years, Lao PDR has experienced negative international publicity over its illegal wildlife trade (EIA, 2015; Gomez et al., 2016; Krishnasamy et al., 2016; Nijman and Shepherd, 2012a). Lao PDR's poor border controls, and its geographic placement between Cambodia, China, Myanmar, Thailand and Vietnam, make it a strategic cross-border trading hub between these countries (Nooren and Claridge, 2001; Nijman and Shepherd, 2012a; Obank et al., 2015; Gomez et al., 2016; Krishnasamy et al., 2016). Organised crime groups use Lao PDR to smuggle wildlife into other Asian countries, due to lack of enforcement capacity and loopholes in national laws that regulate trade (CITES Secretariat, 2016). The CITES Secretariat is putting pressure on Lao PDR to adopt adequate domestic legislation that allows for the implementation of CITES, to implement law enforcement, and to monitor and regulate wildlife farming (CITES, 2017). To improve standing with CITES, the Lao Government apparently plans to reduce some of the more contentious operations, including bear and tiger farming (Prime Ministers Office, 2016; WCS, 2016; M. Brocklehurst, personal communication, 2017).

In 2012, Livingstone and Shepherd (2014) assessed the bear bile industry in Lao PDR and reviewed the legal requirements for keeping captive bears. Bear farms were first recorded in Lao PDR in the year 2000, and by 2012, there were 11 recorded facilities holding 122 bears, with a 21% annual increase in bear numbers during that period. Bear facilities were located throughout the country; in the north bordering China and Myanmar, in the centre (in Louangphabang and Vientiane) and in the south (Pakxan, Bolikhamxai and Pakxe, Champasak; Livingstone and Shepherd, 2014). These facilities were concentrated within or close to (i.e. in the same city) four Special or Specific Economic Zones, in Bokeo, Luang Namtha, Vientiane and Savannakhet. Lao PDR's Special and Specific Economic Zones offer a wide range of incentives for businesses, including reductions on import taxes, and lower taxes on foreign corporate profits compared with domestic enterprises (Gunawardana and Sisombat, 2009). Lao's Wildlife and Aquatic Law (2007), which applies to all individuals and organizations, permits trade in bear bile, providing that commercial bear farms, or bears kept for household purposes, are registered with the Prime Minister's office and monitored by the Department of Forest Resource Management within the Ministry of Natural Resources and Environment (Article 62; Wildlife and Aquatic Law, 2007). Additionally, the law permits trade only from second generation (F2) stock and therefore, in Lao PDR, bear farms cannot operate legally if the bears are of direct wild origin. Livingstone and Shepherd (2014) found that while some facilities were government registered, all facilities in Lao PDR were operating illegally by violating national and international laws (mainly by trading from F1 stock, and by transporting bears internationally). They also found the number of captive facilities and captive-held bears to be slowly expanding, and concluded that, given the continuing demand for and high value of wild bear products, bear farming was not benefiting the conservation of wild bears.

The objectives of our study were to 1) review the status of the commercial bear industry in Lao PDR by counting the current number and size of bear farms and other wildlife facilities that keep bears (i.e. tiger farms), and documenting available information on the nature of bear trade at each facility, 2) examine patterns in the growth of the industry in Lao PDR since 2012 by combining our records with those from Livingstone and Shepherd (2014), and 3) document evidence of illegal trade in wild bears and bear parts, including market values of traded products and private collections of wild bears.

2. Materials and methods

During February–March 2017 we visited provinces and main towns in Lao PDR known to have bear farms (based on past records), or known for cross-border wildlife trade with China and Vietnam, including Lao PDR's Special and Specific Economic Zones (Fig. 1). Based on these criteria, we searched in all provinces except Vientiane Province (apart from one facility we visited on the outskirts of Vientiane City) and Xaisomboun Province. We replicated the methods of Livingstone and Shepherd (2014), visiting facilities reported in their study, and searching for new unrecorded facilities by making inquiries at major transport and trading hubs (bus stations, markets, traditional medicine outlets, restaurants, tourist agencies and hotels). We use the term 'commercial facility' to mean a facility trading in or assumed to be trading in bears and/or bear parts. In this study, commercial facilities fall into two main categories, 1) dedicated bear farms, which extract and sell bile from live bears, 2) facilities holding bears with some link to wild animal trade (e.g. wild meat trade, tiger farms). We also recorded private collections of bears (usually 1–2 bears kept as pets), which are treated separately to commercial facilities. We summarized our records and observations to generate an estimated number of captive bears held in each commercial facility in Lao PDR in 2017. We combined our data with records collected by Livingstone and Shepherd (2014) to identify trends in bear numbers within individual facilities over time.

At each facility we recorded the GPS location, number of bears, captive conditions (taking photographs and video when possible) and elicited information from staff and owners, where possible, on the origin (including whether bears were being bred in captivity), purpose, market value, and bear turnover rates. We also searched for evidence of captive breeding by

evaluating each facility's potential to breed bears (i.e. bear group composition [single/pair/group], enclosure size). We recorded evidence of bears being wild caught, such as missing limbs (presumed to be snare injuries). We identified facilities as extracting bear bile when the price of products were openly displayed and by asking staff. We also sought current local knowledge from the Lao PDR Government provincial representatives and local NGOs, including the Wildlife Conservation Society in Vientiane, Free the Bears (FTB) in Louangphabang, and Provincial representatives of Government of Lao PDR Department of Agriculture and Forestry in the provinces of Bolikhamxai, Xiengkhuang and Sekong.

3. Results

3.1. Number of farms and bears

We recorded seven commercial facilities in Lao PDR holding at least 116 Asiatic black bears. Of these, three were bear farms (i.e. bear bile extraction was taking place), respectively located in Savannakhet, Vientiane and Luang Namtha Provinces; one was a "zoo" named the Don Savannh Zoo, located in Bokeo, which held mostly bears (and tigers) that are reportedly being consumed within the local restaurant trade; and three were tiger farms, located in southern Lao PDR, that reportedly also held bears. We documented the closure of two southern bear facilities - one in Pakxan, Bolikhamxai (reportedly closed four to five years ago) and one in Pakxe, Champasak (reportedly closed five to seven years ago). We found no commercial facilities in Saravane, Attapeu, Phongsaly, Oudomxay, Xiengkhuang, Xayabury, Huaphanh and Xekong Provinces (Fig. 1).

Aside from these seven facilities, we also documented one new facility in Louangphabang, known to Free the Bears (FTB) since October 2016, which held 11 Asiatic black bears, one sun bear (*Helarctos malayanus*), and one tiger cub. This facility is reportedly owned by a Chinese national and managed by the Treasure Group Laos (L. Nicholson personal communication, 2017). However, this was not included in our dataset as the facility was not accessible and we were therefore unable to verify whether it was a private or commercial facility. There are reports that it may be opening as a tourist attraction in future.

Of the seven facilities visited, only four were visually inspected - Vientiane, Savannakhet, Luang Namtha and Bokeo, as access to the three tiger farms was denied. Our observations and records on all facilities are summarized in Table 1. The facilities in Vientiane and Savannakhet were extracting and selling bile from 19 and 8 bears respectively and kept only adult bears. A neighbour to the Vientiane facility claimed that the bears were exchanged with a facility in Louangphabang every six months, but we could not verify this. We recorded 29 bears at the Don Savannh Zoo, in Bokeo Province's Golden Triangle Special Economic Zone but found no evidence of bear bile extraction, rather the animals (bear and tigers) were reportedly used for meat consumption. Past studies corroborate this report, with bear paws recorded on the menu at restaurants within the Golden Triangle Special Economic Zone (Livingstone and Shepherd, 2014; EIA, 2015). This facility had mostly adult bears (two adolescents ~1–2 years old) and staff told us the bears were from Myanmar.

In Boten (Luang Namtha Province), Xinglong bear farm, we estimated there to be 60 bears, with a mixture of adults and cubs of unknown origin. According to locals, this facility was trading in bear bile and was moving bears internationally between China and Vietnam by transporting them across the border in boxes. We observed nearby construction around this facility with locals reporting of a planned expansion of the area into a multi-species zoo. This facility is reportedly owned by a Chinese family from Quanzhou, Fujian, China, who also own a facility in Mong La, Myanmar (the Burma East Shan Special Region 4 Xinglong Live Bear Bile Extraction Research Centre; D. Banks, personal communication, 2016). Bear bile products with the Xinglong logo have also been observed for sale in a couple of Chinese groceries in the Golden Triangle SEZ in Bokeo, in the towns/cities of Boten, Muang Sing, Louangphabang and Luang Namtha (C.R.Cruz, Personal Communication 2016).

While we could not gain access to the three tiger farms, locals informed us of one or two Asiatic black bears being held i.e. 1) Ban (Village) Phabat (one bear), 2) Ban Somsaart (one bear) - both located in the district of Thaphabat, Bolikhamxai Province and 3) Muang Thong Tiger Farm, located in Ban Nongboua-Noi, Khammouane Province (two bears). The Ban Phabat and Ban Somsaart tiger farms were both owned by the Souvanasaek Trading Co. and we are not sure if reports meant there was a bear in each facility, or only one bear between the two facilities. It is unknown if any are extracting bile from bears.

3.2. Trends in bear numbers since 2012

We discovered likely errors in records from Livingstone and Shepherd (2014) and corrected these before examining trends in bear numbers since 2012. Three previously recorded facilities which were based on government records but which could not be validated by Livingstone and Shepherd (2014) were not found i.e. Ban Phonsaat and Ban Nongboua-noi in Hinbone District, Kammouan Province and Xaysavang in Paksong District, Bolikhamxai Province. Both the Ban Phonsaat and Ban Nongboua-noi facilities were reportedly located within a short distance of the Muang Thong Tiger Farm (Table 1). Based on a thorough search of the area and discussions with locals we concluded these records were likely duplicates and refer to the Muang Thong Tiger Farm. The Xaysavang facility in Paksong is presumed to be a misprint as there is no Paksong in Bolikhamxai; Paksong is a municipality in the Bolaven Plateau in Southern Lao PDR. Instead, we believe this record refers to the Souvanasaek Tiger Farm in Thaphabat, in Pakxan, Bolikhamxai. Accounting for these corrections, this put the number of captive bear facilities in 2012 at eight (instead of 11), the number of bears at 115 (instead of 122), and the annual increase in bear numbers between 2008 and 2012 at 18.7% (instead of 22%).

Accordingly, since 2012 the number of recorded commercial facilities in Lao PDR decreased by one - with two bear farms closing and the discovery of one more Tiger farm (it is unknown if this was operating in 2012 or if it opened since then). Since

Table 1
Commercial bear facilities that we visited in Lao PDR during February–March 2017, with the number of Asiatic adult black bears (*Ursus thibetanus*) and cubs (<1 year old) seen evidence of any snare injuries, price of bile sold directly to customers, nationality of owners and any comments.

Town (Province)	Type	Trend since 2012	No. Of bears	Cubs	Injuries	Value (USD)	Owners	Other comments
Boten (Luang Namtha)	Bear bile extraction	↑ (+~38)	~60	Unknown	Unknown	$1500 for two cubs	Chinese	Mix of adults and young. Bears sold to China and Vietnam. Construction underway, with plans to develop surrounding area into a multi-species zoo.
Don Savannh Casino 'Zoo' (Bokeo)	Mixed bear and tiger	↑ (+21)	29	0	None[a]	Unknown	Chinese (with Burmese staff)	Bears reportedly from Myanmar. Reports that bears sold for meat to casino customers.
Savannakhet (Savannakhet)	Bear bile extraction	↓ (−3)	8	0	2 with missing limbs[b]	150,000kip/cc	Vietnamese	Thai, Vietnamese and local customers. Bears from the north of Lao PDR.
Vientiane (Vientiane)	Bear bile extraction	↓ (−4)	19	0	1 with missing limb[b]	150,000kip/cc	Vietnamese	Staff member claims bears are exchanged every six months with a farm in Louangpahbang[c]
Ban Phabhat, Thaphabat (Bolikhamxai)	Tiger farm	Unknown	1	0	Unknown	Unknown	Reportedly Vietnamese	Vannaseng tiger farm; owned by Vannaseng Trading Co, Ltd. Reported that there used to be 4 bears
Ban Somsaart, Thaphabat (Bolikhamxai)	Tiger farm	↓ (−14)	1	0	Unknown	Unknown	Reportedly Vietnamese	Sookvanneseng tiger farm; also owned by Vannaseng Trading Co, Ltd.
Ban Nongboua-Noi, (Khammouane)	Tiger farm	↓ (-~2)	2	0	Unknown	Unknown	Unknown	Muang Thong Tiger Farm; >100 tigers and reported they want to turn the facility into a zoo.

[a] A cub observed in 2012 with a missing limb was not there.
[b] Same number of bears with missing limbs that were observed in 2012; assumed to be the same bears.
[c] We found no evidence to support this report.

2012, the total number of captive bears on commercial facilities in Lao PDR overall increased by one but these numbers fluctuated widely within the individual facilities. Bear numbers in the Savannakhet and the Vientiane bear farms have dropped since 2012, while in the Boten facility and Don Savannh Zoo, bear numbers tripled (Fig. 2). The rate of increase in captive bears on commercial facilities between 2000 and 2017 is 15.2% per annum; a 3.5% decline since 2012.

3.3. Illegal trade in bears and bear parts

We found no change in compliance with national and international legislation since facilities were surveyed in 2012 and all commercial bear facilities were judged to be operating illegally by trading in wild caught bears. No facility appeared capable of breeding bears, with bears housed in individual enclosures in all but the Don Savannh Zoo, which had three to four bears per enclosure. Additionally, the Boten facility was reportedly transporting bears internationally between China and Vietnam in violation of CITES.

We found 12 cases of one to two Asiatic black bears, mostly cubs (amounting to 14 animals) held by private owners. While some claimed these as pets, most of them intended the animals for trade. All bears were reportedly wild caught, and in five cases, owners told us they had a turnover of cubs. Owners quoted prices that they had bought bears for, and prices for which they were willing to sell. Cubs sold in pairs ranged from $970–$1940, (Mean = $1,600, SD = 231) and single cubs sold for between $360 and $970 (Mean = $750, SD = 289). Adult live bears ranged from $2000 - $2900 (Mean = $2450, SD = 636). Two of the adult bears recorded in this instance were reportedly purchased from the Savannakhet farm. Most prices represent current values in 2016–2017. Values were converted from Lao Kip (LAK) or Thai Bhat (THB) into US$ at the current exchange rate of 1$ = 8199 LAK and 34.35 THB (www.xe.com, accessed 01 April 2017).

4. Discussion

The absolute number of recorded captive bears on commercial facilities in Lao PDR hardly changed between 2012 and 2017 (+one bear; not including 12 bears in a waterpark in Louangphabang), and the number of recorded commercial facilities declined by one. There appears to be a south to north trend in captive bear numbers, with southern facilities either closing or reducing in size, and the northern facilities near the Chinese border expanding. Although the number of commercial bear facilities in Lao PDR has declined, the number of captive bears looks set to rise if the two northern Chinese owned facilities continue their rate of expansion; both have roughly tripled in size between 2012 and 2017. For the facilities that have downsized, we found no information on where most of the bears have gone, apart from two bears residing in the Thai owned Savan Mixay Park, Savannakhet, which the owners reportedly bought from the Savannakhet farm. Fluctuation of bear

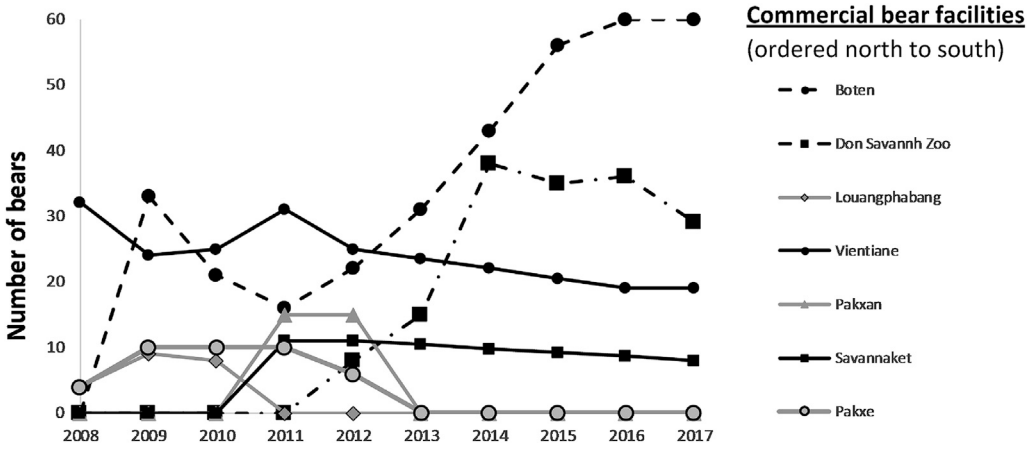

Fig. 2. North to south trends in number of bears on 7 recorded commercial bear facilities between 2008 and 2017 in Lao PDR. Records were collected from published and unpublished literature and government documents collected by Livingstone and Shepherd (2014). New records were added from Don Savannh Zoo in 2014 (D. Banks, personal communication, 2016) and 2016 (BANCA, 2017), and for Boten in 2016 (C. R. Cruz, personal communication, 2016). Dashed lines are commercial bear facilities that have increased in number since 2012, solid black lines are facilities that have reduced numbers, and grey lines are facilities that are now closed. Values were averaged between years when no records were available (Boten: 2013, 2014, 2015; Vientiane: 2013, 2014, 2015, 2016; Savannaket, 2013, 2014, 2015, 2016). Reports suggest that Pakxan and Pakxe facilities closed around 2013 (real dates may be plus or minus a year). The legend is ordered geographically, north to south from top to bottom. There are four known commercial bear facilities in Lao PDR as of April 2017.

numbers within these facilities could be due to mortality, transfer between facilities and new cubs entering facilities. Livingstone and Shepherd (2014) recorded evidence of trading in wild products at several facilities and it is possible (but unverified during our study) that facilities could be selling their bears off as parts; in Vietnam, there have been recent seizures of frozen bear paws and observations of bear parts for sale in markets that reportedly originated from Lao PDR (Thanh Nien News, 2016; Willcox et al., 2016). Closures and downsizing of bear numbers in the south may be attributed to a lower demand for bile from captive bears (less profit) or, considering that these facilities are owned by a Vietnamese family, it could be linked to the waning demand in Vietnam as the industry there is being phased out. Alternatively, it could simply be down to a change in personal circumstances of the owners. The trade in bear cubs in Lao PDR appears to be ongoing, evident by the fluctuation in number of bears on farms that don't breed bears (i.e. assumed due in part to new bear cubs entering farms from the wild), and the number of young bears we found being traded within private collections.

4.1. The future of the bear bile industry

At the time of writing, the Vietnamese owners of the Vientiane and Savannakhet facilities were seeking government assistance to close their facilities and to relocate all the bears to bear rescue centres (M. Brocklehurst, personal communication, 2016). This apparent move to phase out bear farming is in line with the IUCN's Resolution, WCC-2012-Rec-139-EN, which calls for closure of illegal bear bile extraction facilities in Lao PDR, South Korea and Vietnam (IUCN, 2012). South Korea and Vietnam, the two largest bear farming countries after China, are already in a phase-out period. In Vietnam, public consumption of bear bile dropped by 61% between 2010 and 2015, attributed to the success of public awareness campaigns to discourage bear bile consumption (ENV, 2015) and the creation of bear rescue centres throughout the country which supported government-led enforcement on the ban in trading or advertising of bear bile. There was also an apparent decline in the availability of bear bile products in Traditional Medicine outlets in Vietnam within a similar period (Willcox et al., 2016). However, Willcox et al. (2016) also found that trade in wild-origin products and parts in Vietnam remains lucrative and that bear farms are likely to play a role in the laundering of wild caught bears.

The global decline in public, political and scientific support for bear farming may be linked to several factors, including wide spread public awareness and education campaigns led by several animal welfare organizations (i.e. Animals Asia Foundation, Free the Bears, World Animal Protection), and growing awareness of the decline in wild bear populations throughout Asia. Davis et al. (2016) surveyed >1200 Lao nationals and Chinese tourists in Lao PDR and most respondents of each group did not like bear farming, and felt that harvesting bear bile from wild bears would result in wild population declines. Within China, the largest producer and consumer of bear bile, there is an increasingly negative public perception, and some internal push to consolidate and potentially down size farms (Jiwen and Shenzhen, 2016). As a signal of this change, in 2014, KaiBao Pharmaceuticals, China, the largest bear bile retailer, began pursuing research and development of synthetic alternatives, using 'biotransformation technology' with poultry bile (Hance, 2015).

The Lao PDR Government has reportedly expressed interest in ending bear farming in the country. They plan to audit all commercial bear facilities and to close at least one of the Chinese-owned northern bile extraction facilities, in Boten, Luang Namtha, pending a suitable place to rehome the bears (M. Brocklehurst, personal communication, 2016). However, efforts to

phase out bear farming are being undermined by expansion of commercial bear facilities in the north, particularly within the special economic regions that are heavily influenced by Chinese investments (e.g. business are run by Chinese nationals, prices are given in Chinese Yuan, staff employed are ethnic Chinese, places like Boten are on Beijing time, and mobile phones are on Chinese networks), and where the Lao PDR government appears reluctant to enforce wildlife (and other) laws and to protect wildlife.

4.2. Chinese influence in the bear bile the industry in Lao PDR

Our findings suggest that Chinese business ventures and tourism may be propping up the bear bile industry in Lao PDR, although there is not much support for it locally or internationally. Much of the growth in the commercial bear industry since 2000, in both Lao PDR and Myanmar, appears to be down to the efforts of two rich and influential Chinese businesses. Boten's commercial bear facility, the largest facility in Lao PDR, is reportedly owned by Chinese family with ties to a bear farm in Mong La, Myanmar (D. Banks, personal communication, 2016). In 2016, a TRAFFIC survey of the availability of bear parts and derivatives in Lao PDR found that most wildlife products for sale in Boten contained bear parts or products e.g. bear bile in liquid and powder form, bear wine, bear fat/grease, gall bladder and bear teeth (Gomez and Shepherd, *in prep.*). The second largest facility in Lao PDR, which also keeps Tigers *Panthera tigris*, is controlled by a group based in Hong Kong, and according to BANCA (2017), the owner allegedly has links to anti-government forces in Myanmar. This heavy influence by the 'Chinese market' has also been seen to drive the demand for other illicit wildlife products traded within the country, including pangolin scales and meat, Helmeted Hornbill *Rhinoplax vigil* casques, elephant ivory, and rhino horn (EIA, 2015; Gomez et al., 2016; Krishnasamy et al., 2016; Nijman and Shepherd, 2012a). Notably, the 2012 IUCN recommendation to phase out bear farming did not extend to China, with the Chinese State Forestry Administration (SFA) opting instead to halt expansion of the industry, and conduct a formal investigation into the impact of bear farming on wild bear populations, a study that is currently ongoing with results expected in 2020 (IUCN, 2012, 2016).

Wildlife farms (bears, tigers) are concentrated in and near Special and Specific Economic Zones, presumably to leverage benefits from government trading incentives and to access trading hotspots (MoPI, 2017). The southern Savannakhet bear facility is located close to the Savan – Seno Special Economic Zone within Southeast Asia's East-West Economic Corridor, and the Bokeo and Luang Namtha facilities are located within the Golden Triangle Special Economic Zone and the Boten Specific Economic Zone respectively, both within Asia's North-South Economic corridor that runs from Kunming, China to Bangkok, Thailand (Tan, 2012). In the Vietnamese dominated East-West Economic Corridor, tiger farming seems to be more prevalent, which may reflect current Vietnamese consumer preferences. Staff at the Savannakhet facility reported that their consumers are largely Lao, Thai and Vietnamese. Chinese consumers represent the greatest demand for bear bile globally, and Chinese foreign investment and tourism is more prevalent in the north (near the Lao PDR-China border regions), which may explain why the northern facilities appear to be doing better than the southern facilities. Boten and Golden Triangle have long-term concessions to Chinese Investors (Tan, 2012). Boten was initially leased by a Hong Kong based company for 30 years, and after receiving a lot of bad publicity concerning gambling and other criminal activities, many companies pulled out of the region around 2010 (EIA, 2015; Ganjanakhundee, 2013; Gluckman, 2011). It has since been taken over by a Yunnan based company (Nyíri, 2012). Both Economic Zones appear to be thriving, with lots of new infrastructure development observed during our survey.

5. Conclusions

The domestic bear bile industry in Lao PDR is downsizing, and closures of commercial bear facilities in the south of Lao PDR may be partially indicative of poor economic returns of farming. The future of bear farming in Lao PDR may lie within Chinese tourist trade hotspots along the Chinese border in the north, within Special and Specific Economic Zones. The north-south trend we observed may be due to geographic differences in international business investments, with Vietnamese traders exerting a heavier influence in the south, where trade in other wildlife, such as tigers, is more lucrative than trade in bears. The expansion of the northern commercial bear facilities may also continue as part of the Lao PDR government's plan to encourage development under the auspices of the Special and Specific Economic Zones in the country. The remaining southern facilities have not significantly changed in numbers since 2012 (downsized slightly), and those that have closed within the last decade have presumably done so as they are not economically viable. Campaigning efforts by NGOs working to protect bears from illegal trade in Lao PDR may be succeeding in changing public attitudes, as Lao citizens appear to be cognisant of bear welfare and conservation needs (Davis et al., 2016). NGO campaigns, however, will have little impact on a transient Chinese tourist population that fuels trade in the northern border regions, especially those areas that have established reputations as regional wildlife trade hubs. Closing the facilities in the north will require political will and decisive law enforcement. This is complicated by the unclear application of domestic laws within Special and Specific Economic Zones, the length of leases granted to Chinese businesses, and the large income these Economic Zones contribute to the Lao PDR government.

To strengthen law enforcement efforts related to the bear bile trade in Lao PDR, we urge the Lao government to follow steps recommended by the CITES Secretariat, including amending national legislation to meet the minimum criteria necessary to implement CITES, and by developing and implementing legislative guidelines for farming bears and other endangered wildlife (CITES, 2017). Law enforcement agencies should increase surveillance and monitoring of domestic and

international wildlife trade, and of trade in hotspots (i.e. Special and Specific Economic Zone) and all establishments that sell wildlife illegally should be closed. Individuals and organizations found to be acting illegally should be prosecuted to the full extent of the law. To foster positive public attitudes towards the conservation of wild bears and against consumption of illegal wildlife products, NGO's should continue awareness raising campaigns and consumer education, and monitor the impact of those campaigns on consumer behaviour. Additionally, we recommend campaigns that are targeted at local communities who hunt and trade bears, to educate those living near to bears on the illegality of the trade and of the conservation importance of protecting them.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.gecco.2018.e00380.

References

Animals Asia, 2011. Bear Farming Industry in China. Animals Asia Foundation, Chengdu, China.
BANCA, 2017. The Bear Trade and the Bear Farms in Cross-border Regions in Eastern Myanmar. Yangon, Myanmar.
Burgess, E.A., Stoner, S.S., Foley, K.-E., Network, I.T., 2014. Brought to Bear: an Analysis of Seizures across Asia (2000-2011). TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia.
CITES, 2017. In: Sixty-ninth Meeting of the Standing Committee ARTICLE XIII PROCESSES. Geneva, Switzerland.
Crudge, B., Wilkinson, N.M., Thoai, D., Van Dung, C.T., Trung, C.T., Weegenaar, A., Hunt, M., 2016. The Status and Distribution of Bears in Vietnam. Free the Bears, Vietnam.
Davis, E.O., O'Connor, D., Crudge, B., Carignan, A., Glikman, J.A., Browne-Nuñez, C., Hunt, M., 2016. Understanding public perceptions and motivations around bear part use: a study in northern Laos of attitudes of Chinese tourists and Lao PDR nationals. Biol. Conserv. 203, 282–289. https://doi.org/10.1016/j.biocon.2016.09.009.
EIA, 2015. Sin City Illegal Wildlife Trade in Laos' Golden Triangle Special Economic Zone. London, UK.
ENV, 2015. An Analysis of Change in Bear Bile Use in Vietnam. Education for Nature, Vietnam.
ENV, 2017. Wildlife Crime, Issue 1. Education for Nature, Vietnam.
Feng, Y., Siu, K., Wang, N., Ng, K.-M., Tsao, S.-W., Nagamatsu, T., Tong, Y., 2009. Bear bile: dilemma of traditional medicinal use and animal protection. J. Ethnobiol. Ethnomed. 5 https://doi.org/10.1186/1746-4269-5-2.
Foley, K.-E., Stengel, C.J., Shepherd, C.R., (Program), T.S.A, 2011. Pills, Powders, Vials and Flakes: the Bear Bile Trade in Asia. Traffic Southeast Asia, Petaling Jaya; Cambridge.
Ganjanakhundee, S., 2013. No More Casinos in Laos: Somsavat. The Nation Vientiane (Laos). [WWW Document]. Nation Vent. http://www.nationmultimedia.com/aec/No-more-casinos-in-Laos-Somsavat-30214434.html. (Accessed 8 July 2017).
Garshelis, D., Steinmetz, R., 2016. Ursus thibetanus asiatic black bear [www document]. IUCN red list threat. SpeciesSpecies. www.iucnredlist.org. (Accessed 5 October 2017).
Gluckman, R., 2011. Bungle in the jungle [www document]. Forbes Asia. http://www.forbes.com/global/2011/0808/companies-laos-china-economy-gambling-gangsters-bungle-jungle.html. (Accessed 8 July 2017).
Gomez, L., Leupen, B.T.C., Heinrich, S., 2016. Observations of the Illegal Pangolin Trade in Lao PDR, 2016. Petaling Jaya, Selangor, Malaysia.
Gunawardana, P.J., Sisombat, S., 2009. An overview of foreign investment laws and regulations of Lao PDR [www document]. Int. J. Bus. Manag. 3 (5), 31–43. http://www.ccsenet.org/journal/index.php/ijbm/article/view/1499.
Hance, J., 2015. Is the End of “house of Horror” Bear Bile Factories in Sight? Guard.
IUCN, 2012. In: Resolutions and Recommendations World Conservation Congress, Jeju, republic of Korea, 6–15 September 2012. IUCN.
IUCN, 2016. Progress on Implementation of IUCN Recommendation 5.0139 “Bear Farming in Asia”: a Joint Report by the IUCN Species Survival Commission and the State Forestry Administration of the People's Republic of China.
Jeong, D.H., Lee, B.K., Kang, J.K., 2011. The Status of Asiatic Black Bears Transplanted into Jirisan National Park, South Korea, vol. 20. Int. Bear News, pp. 14–16.
Jiwen, C., Shenzhen, G., 2016. Investigation report. Research on the Current Situation of Chinese Bear-Bile Industry and Strategies for Transition. Development Research Center of the State Council. Beijing, China.
Krishnasamy, K., Leupen, B.T.C., Or, O.C., 2016. Observations of the Helmeted Hornbill Trade in Lao PDR, 2016. Petaling Jaya, Selangor, Malaysia.
Li, S., Tan, H.Y., Wang, N., Hong, M., Li, L., Cheung, F., Feng, Y., 2016. Substitutes for bear bile for the treatment of liver diseases: research progress and future perspective. Evid. base Compl. Alternative Med. https://doi.org/10.1155/2016/4305074.
Ling, L.S., Burgess, E.A., Chng, S.C.L., 2015. Hard to Bear: an Assessment of Trade in Bear Bile and Gall Bladder in Malaysia (PDF, 2 MB).
Livingstone, E., Shepherd, C.R., 2014. Bear farms in Lao PDR expand illegally and fail to conserve wild bears. Oryx 50, 1–9. https://doi.org/10.1017/S0030605314000477.
Mills, J., Servheen, C., 1991. The Asian Trade in Bears and Bear Parts. In: Int. Conf. Bear Res. Manag, vol. 9, pp. 161–167.
MoPI, 2017. Investment Promotion Department [WWW Document]. Minist. Plan. Invest. http://www.investlaos.gov.la/. (Accessed 4 October 2017).
Nijman, V., Shepherd, C.R., 2012a. China's role in trade in ivory and elephant parts from Lao PDR. Oryx 46, 172–173. https://doi.org/10.1017/S0030605312000452.
Nijman, V., Oo, H., Shwe, N.M., 2017. Assessing the illegal bear trade in Myanmar through conversations with poachers: topology, perceptions, and trade links to China. Hum. Dimens. Wildl. 22, 172–182. https://doi.org/10.1080/10871209.2017.1263768.
Nooren, H., Claridge, G., 2001. Wildlife Trade in Laos: the End of the Game. IUCN, Netherlands.
Nyíri, P., 2012. Enclaves of improvement: sovereignty and developmentalism in the special Zones of the China-Lao borderlands. Comp. Stud. Soc. Hist. 54, 533–562. https://doi.org/10.1017/S0010417512000229.
Obank, R., Schatz, A., Flick, A., Heading, A., Kuzmierkiewicz, S., Brookes, E., 2015. Empty threat 2015 ;: Does the law combat illegal wildlife trade? A review of legislative and judicial approaches in fifteen jurisdictions.
Prime Ministers Office, 2016. Notice 1990. Government of Lao PDR, Vientiane, Lao PDR.
Secretariat, C.I.T.E.S., 2016. In: Application of Article XIII in the Lao Peoples Democratic Republic, Sixty-seventh Meeting of the Standing Committee. Johannesburg, South Africa.
Servheen, C., Herrero, S., Peyton, B., Pelletier, K., Moll, K., Moll, J., 1999. Bears: Status Survey and Conservation Action Plan. IUCN/SSC Bear and Polar Bear Specilist Goups, IUCN, Gland, Switzerland and Cambridge, UK.

Shepherd, C.R., Nijman, V., 2008. The trade in bear parts from Myanmar: an illustration of the ineffectiveness of enforcement of international wildlife trade regulations. Biodivers. Conserv. 17, 35–42. https://doi.org/10.1007/s10531-007-9228-9.
Tan, D., 2012. "Small is beautiful": lessons from Laos for the study of Chinese overseas. J. Curr. Chines Aff. 41, 61–94.
Thanh Nien News, 2016. Vietnam busts illegal transport of 18 bear legs from Laos [WWW Document]. Thanh Nien News. http://www.thanhniennews.com/society/vietnam-busts-illegal-transport-of-18-bear-legs-from-laos-64663.html.
Togawa, K., Sakamoto, M., 2002. Bear Markets : Japan, Asummary of the Findings of: "Japan"s Illegal Trade in Bear Products: a Threat to Bears Worldwide' Published by. Japan Wildlife Conservation Society (JWCS), Japan. February 2002.
WCS, 2016. CITES CoP17: WCS Applauds Lao PDR for Committing to Shut Down Commercial Tiger Farms: Lao PDR: No More Breeding of Tigers for Body Parts. WCS News Releases.
Willcox, D., Minh, N.D.T., Gomez, L., 2016. An Assessment of Trade in Bear Bile and Gall Bladder in Viet Nam. Petaling Jaya, Selangor, Malaysia.
Williamson, D.F., 2006. In: Proceedings 4th International Symposium on the Trade in Bear Parts. Nagano, Japan.
World Animal Protection, 2017. Ending Bear Bile Farming in South Korea. World Animal Protection, London UK.

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Original Research Article

Trade in bears in Lao PDR with observations from market surveys and seizure data

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ABSTRACT

This analysis examines seizure data that implicates Lao People's Democratic Republic (PDR) as a place of origin, transit point or destination of illegally-sourced live bears, their parts and derivatives, from 2010 to 2016. Intensive surveys of trade in 25 towns and villages carried out in 2016 recorded bear parts and derivatives for sale in more than half of locations surveyed, largely for use in traditional medicine. Live bears that were seized or surrendered to authorities are also analysed here, and of all cases combined, live bears accounted for more than half (62.7%). Live bears were largely cubs, and were most likely intended for sale to stock bear bile extraction facilities (bear farms). At least four other countries were implicated in cases involving trade in bears, their parts or derivatives, with Lao PDR, including China, Myanmar, the United States of America (US) and Viet Nam. This study provides evidence of Lao PDR's ongoing and open trade in bears, their parts and derivatives, in direct violation of national legislation, and of the continuing violations against the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Lao PDR remains a source of bears taken illegally from the wild, in Lao PDR and in neighbouring countries, and a hub of illegal wildlife trade. Clearly, more effort is needed to close down this trade, and steps need to be urgently taken to halt the adverse impacts on Lao PDR's wild bear populations.

1. Introduction

In recent years Lao People's Democratic Republic (PDR) has surfaced as a major hub of international illegal wildlife trade in Southeast Asia (Duckworth et al., 1999; Anon, 2015; EIA, 2015; Anon, 2016). Illegal and unsustainable wildlife trade is a leading threat to a growing number of species in Lao PDR with records indicating depletion of a diversity of taxa such as cats, deer, pangolins, birds, snakes, freshwater turtles and even insects across the country (Nooren and Claridge, 2001; Phanthavong, 2008; Coudrat et al., 2012; Som and Cottet, 2015). This rampant over-exploitation is due primarily to weak laws and poor enforcement effort, and at least partially fuelled by high levels of corruption (Duckworth et al., 1999; Anon, 2015; EIA, 2015). Criminal elements in neighbouring countries have taken advantage of this situation, with foreign-run wildlife markets operating openly within Lao PDR, especially along its borders and in the country's Special Economic Zones, and illicit

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shipments of wildlife flow across Lao PDR's borders, and through international airports (Nooren and Claridge, 2001; Nijman and Shepherd, 2012; Gomez et al., 2016; Krishnasamy et al., 2016). Lao PDR shares its borders with Cambodia, China, Myanmar, Thailand and Viet Nam, all having high levels of illegal wildlife trade as well (Shepherd and Nijman, 2007; TRAFFIC, 2008). As enforcement efforts increase in neighbouring countries, Lao PDR is increasingly used by organised crime syndicates as a place of business. Lao PDR has made headline news recently with the exposure of one major wildlife crime syndicate that has been operating for more than a decade, implicating the involvement of high level government officials (Davies and Holmes, 2016). Lao PDR has further been implicated in numerous trafficking incidents involving species from other parts of Asia and increasingly from Africa, including rhino horn, elephant ivory, Tiger *Panthera tigris*, tortoises and freshwater turtles, Helmeted Hornbills *Rhinoplax vigil,* pangolins and more (Nijman and Shepherd, 2012; Anon, 2015; EIA, 2015; Gomez et al., 2016; Krishnasamy et al., 2016), further highlighting its role as a hub of international illegal wildlife trade, and its failure to effectively enforce the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). This has resulted in the country coming under scrutiny by the CITES Secretariat with missions in the last two years (since July 2016 to April 2018) being carried out by the Secretariat to assess and well as monitor Lao PDR's progress in addressing these issues.

Bears are among the many species heavily traded, and threatened, in Lao PDR. Studies have revealed widespread illegal trade of live bears, their parts and derivatives in 13 countries and territories across Asia, in clear violation of national laws and CITES protocols (Shepherd and Nijman, 2007; Foley et al., 2011; Shepherd and Krishnasamy, 2013; Burgess et al., 2014; Lee et al., 2015; Willcox et al., 2016). These studies found Lao PDR to be in the top four countries in Asia as both a key source and consumer of live bears, their parts and derivatives (Foley et al., 2011; Burgess et al., 2014), and as having an increasing number of bear bile extraction facilities (bear farms) (Livingstone and Shepherd, 2014).

Lao PDR is home to two species of bears, the Asiatic Black Bear *Ursus thibetanus* and the Sun Bear *Helarctos malayanus*, with the former being the species most exploited for the bear bile trade. Both bear species are currently assessed as Vulnerable on the IUCN Red List of Threatened Species and overall considered to be in decline across their range due to habitat loss and widespread poaching for the illegal wildlife trade (Fredriksson et al., 2008; Garshelis and Steinmetz, 2016). In Lao PDR, there is a paucity of data on populations and population densities of both species although records do indicate populations are low and declining, particularly for the Asiatic Black Bear (Duckworth et al., 1999; Garshelis and Steinmetz, 2016).

Both species are poached to supply the demand for live bears as well as their parts and derivatives including gall bladder and bile, skin, claws, teeth and skulls (Shepherd and Nijman, 2007; Foley et al., 2011; Burgess et al., 2014). Demand for parts for use in Traditional Chinese Medicine (TCM) is the principle driver, especially for bile and gall bladder as these are highly valuable and used to treat a variety of ailments such as flu, sores, haemorrhoids, sprains, epilepsy and liver diseases. While there is some local use of bear bile in traditional medicines in Lao PDR, the greatest demand is from China and Viet Nam (Davis et al., 2016). This demand encourages the persistent poaching of bears in Lao PDR as it is a significant source of income for local hunters (Nooren and Claridge, 2001; Scotson, 2010; Davis et al., 2016). Live bears, especially cubs, are captured and sold to bear bile extracting facilities within Lao PDR and across its borders including China, Myanmar and Viet Nam (Foley et al., 2011; Free the Bears, 2016; Livingstone and Shepherd, 2014). In one study carried out in Myanmar, internationally sourced gall bladders were reported to be entirely from Lao PDR (Foley et al., 2011).

2. Protection status and legislation

Asiatic Black Bears and Sun Bears are protected in Lao PDR under the Wildlife and Aquatic Law, 2007 as Category 1 (Prohibition) species. Species in this Category are classified as 'rare, near extinct, high value, and are of special importance in the development of social-economic, environmental, educational and scientific research'. Under this Law, the catching, hunting (including removal of carcasses, organs and parts), trading and possession of animals under this Category is prohibited unless authorized by the government for necessary circumstances e.g. educational research or breeding purposes. This Law prohibits the trade of Category I species unless they are second or third generation captive-bred. More recently, a new order has been issued by the Lao PDR Prime Minister that has stricter regulations concerning the hunting and trade in protected species. Order No. 5 issued on 8th May, also prohibits the farming of protected species and instructs that those found trading prohibited wildlife be investigated and prosecuted (TRAFFIC, 2018).

Both the Asiatic Black Bear and the Sun Bear are also listed in Appendix I of CITES, meaning no international commercial trade in live animals, their parts or derivatives is allowed. Lao PDR has been a signatory to CITES since May 2004. Its legislation is currently classed as Category III country in the CITES National Legislation Project (CITES Resolution Conf. 8.4 (Rev.CoP15)), which assesses Parties on their readiness to take appropriate measures to enforce provisions of the Convention and to consider appropriate compliance measures. This implies that national wildlife laws in Lao PDR need to be strengthened and improved to effectively regulate the Convention through national legislation, ensuring that the penalties for violations are sufficient to deter illegal trade. CITES Secretariat missions to Lao PDR in 2016 concluded that organised crime groups target the country to smuggle wildlife through its borders due to lack of enforcement capacity and significant weaknesses and loopholes in national laws where wildlife trade is concerned (Anon, 2016). However, the Lao National Assembly is in the midst of amending the penal code, to include increased penalties for wildlife trafficking with those convicted possibly facing three months to five years in prison and fines of up to KIP10,000,000 (~USD1200).

The main objective of this paper was to examine the current levels of trade in live bears, their parts and derivatives in Lao PDR through (1) an analysis of seizure data and (2) observations of open availability in physical markets. Findings from this

study are intended to guide further conservation action to safeguard Lao PDR's bears, and to work towards reducing Lao PDR's overall status as an international hub for illegal wildlife trade.

3. Method

3.1. Seizure data

We obtained bear seizure data from between 2010 and 2016, from TRAFFIC publications, open source media, Customs, police, CITES Trade Database, grey literature and, for seizures of live animals, Non-governmental organisations in Lao PDR (NGOs) i. e Free The Bears (FTB) and Lao Wildlife Rescue Centre (LWRC). We included records involving Lao PDR as an origin, transit point or end destination. We defined a "seizure country" as the country where products were seized, a "source country" as the first known point of a trade route, a "transit country" as a country that functioned as an importing and a re-exporting country within a given trade route, and a "destination country" as the last known point of a given trade route. Reported seizures are likely to represent a fraction of the illegal trade and so under-estimate it's full extent (Burgess et al., 2014; Nijman, 2015). In addition, due to inherent biases in the way seizure data is reported (given varying levels of law enforcement, reporting and recording practices, language biases, NGO efforts and advocacy, etc in different countries), this dataset is interpreted with caution and not to be assumed as representing absolute trafficking trends or volumes.

3.2. Market survey

We conducted surveys across Lao PDR within three periods in 2016; 18th to 28th April, 19th to 22nd July, and 6th to 20th December. We surveyed 25 locations throughout the country (Fig. 1). We visited areas based on previous research into Lao PDR's wildlife trade hotspots (Nijman and Shepherd, 2012; EIA, 2015). In the northern part of the country, we encountered a wide variety of retail outlets which we surveyed including public markets and malls, street stalls, traditional medicine shops, hotel shops, tourist markets and tourist shops. In the central and southern parts of the country, we only surveyed markets and street stalls as these were most prevalent in these areas. We surveyed shops opportunistically i.e. we did not have a pre-determined list of shops to visit but rather selected shops based on the general type of product observed for sale.

We surveyed all outlets selling wildlife parts and products and recorded only those that were selling bear products. We recorded all products that were openly displayed and did not engage in conversation with vendors. Therefore it is likely that what we observed represented only a portion of what was available. We observed numerous gall bladders said to be from bears. However, since fake gall bladders and gall bladders of other mammals are known to be offered for sale as bear gall bladders (Mills et al., 1995; Willcox et al., 2016), we noted their presence but are aware that these may not have been from a bear. We also assume that any processed medicine observed for sale such as bear bile powder and pills, do in fact contain bear parts as claimed.

3.3. Data analysis

Based on seizure data and market survey data, we estimated a minimum number of bears recorded in trade from parts observed or seized by either: counting whole or near-whole specimens observed/seized (e.g. live animals, skins, carcass); or tallying quantities of body parts observed/seized (e.g. gall bladders, claws, teeth, jaws, paws) that form one whole individual based on 'per seizure' or 'per location' during the market surveys. For products containing bear bile and derivatives (e.g. powders, pills, wine, fat/grease) it was not possible to determine the number of bears utilised and therefore, no minimum count was stated for these products.

4. Results

4.1. Seizure analysis

We found 51 bear seizure incidents between 2010 and 2016 in which Lao PDR was named as either a source, transit or destination country. These records involved seizures/surrender of live bears (62.7%), parts (29.4%), including teeth, paws, claws, head, body, gall bladders and skins, and derivatives/medicines (7.8%) (Table 1).

Species identified in the recorded incidents involved both Sun Bears (minimum estimate of 7 individuals) and Asiatic Black Bears (minimum estimate of 64 individuals). However, in at least 14 incidents amounting to an estimated minimum of 102 individuals, the species involved was not identified, particularly where the commodity seized were of bear parts (claws, gall bladder, paws, skin, teeth) (Fig. 2).

Of the 51 seizure records, 32 incidents were of live animals amounting to 55 bears. These were identified as 5 Sun Bears and 41 Asiatic Black Bears, while 9 were not recorded to species level. Of the live bears seized/surrendered, at least 41 were cubs, though the age of the bears was not always recorded. Seizures of bear paws and gall bladders were also frequent, with nine and seven incidents amounting to 149 paws and 80 gall bladders respectively. In four of the incidents, reported in the CITES Trade Database, the commodity seized was described as 'medicines' and 'derivatives' which amounted to 49 items. However, no further information was provided describing these items.

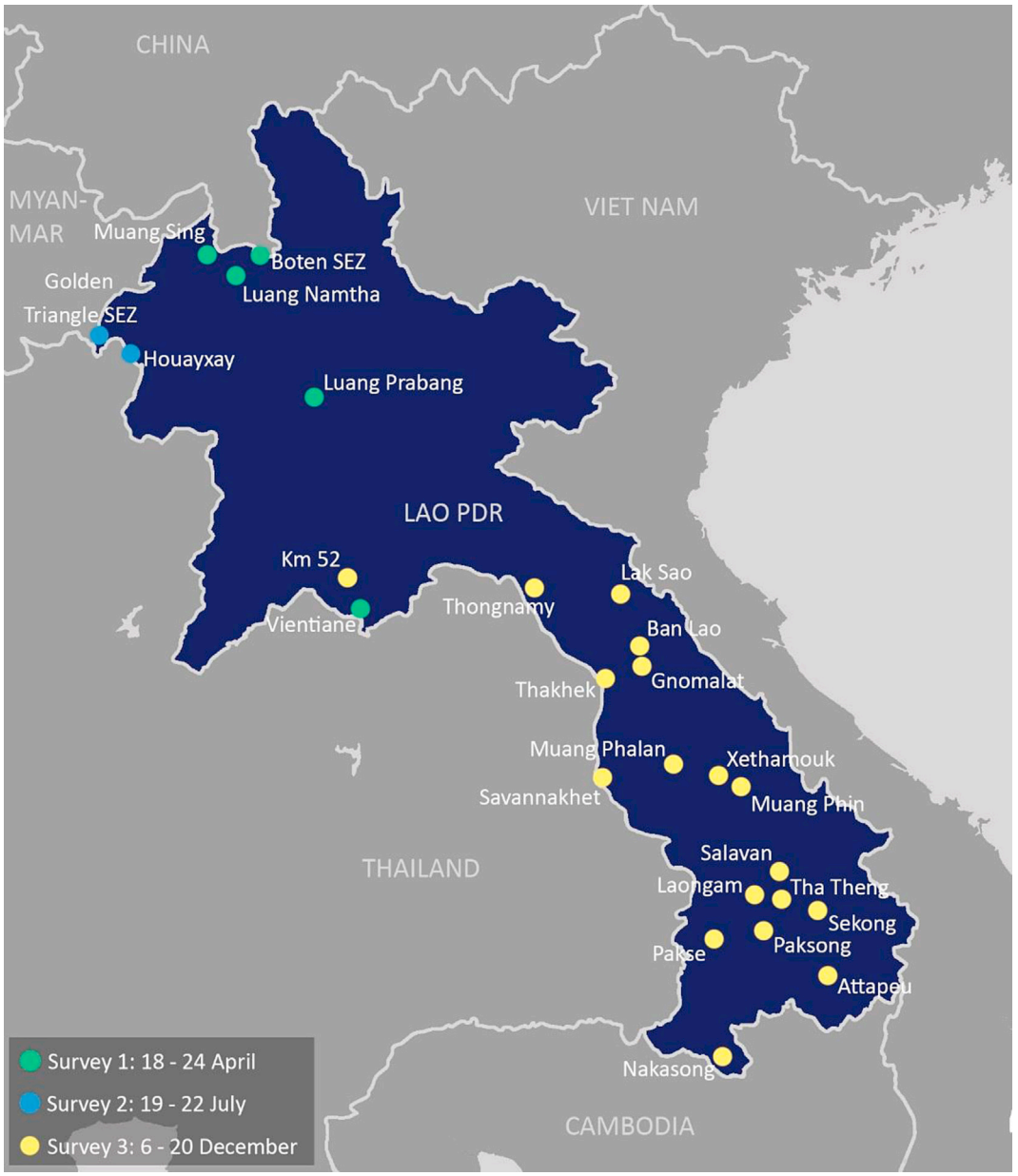

Fig. 1. Locations surveyed for the open availability of bears, their parts and derivatives in 25 locations across Lao PDR, covering the northern, central and southern regions between April, July and December 2016.

Previous seizure analysis of the trade of bears, their parts and derivatives across Asia between 2000 and 2011, revealed a total of 29 records for Lao PDR (averaging 2–3 seizures/year) which was estimated to amount to 44 bears (averaging 4 bears/year). In comparison, we found 51 seizure records between 2010 and 2016 of bears, their parts and derivatives, with an increase in average number of incidents per year as well as number of bears involved (i.e. 7–8 seizures/year, estimated at 173 bears, averaging 25 bears/year).

The majority of seizures occurring in this study period (2010–2016) were in Lao PDR (n = 30 incidents). There were also four countries implicated in the illegal trade of bears with Lao PDR: Viet Nam (n = 11 incidents), the United States of America (US) (n = 8 incidents), as well as China and New Zealand with one incident each (Fig. 3). The US was implicated as a destination country with all eight seizures occurring in the US and origins reported as Lao PDR. This mostly involved the seizure of 'medicines and derivatives' (n = 49 items) and gall bladders (n = 14 gall bladders). Viet Nam was also found to be a destination country with all eleven incidents occurring in Viet Nam. An additional two seizures that took place in Lao PDR also had Viet

Table 1
Seizure of bear parts that occurred in Lao PDR and other countries that implicate Lao PDR as either a source, transit or destination country from 2010 to 2016 and an estimate of the number of bears that were involved in these seizures.

Year	Country of Seizure	No. of Seizures	Estimated Min No. of Animals[a]	Commodity Seized
2010	Lao PDR	7	17	live, paws, gall bladders
	New Zealand	1	10	gall bladders
	United States of America	1	–	derivatives
	Viet Nam	3	18	live, paws
2011	Lao PDR	1	1	live
	United States of America	1	–	derivatives
	Viet Nam	3	4	live, paws
2012	Lao PDR	2	2	live
	United States of America	1	1	gall bladder
	Viet Nam	1	3	live
2013	Lao PDR	2	5	live
	United States of America	2	–	medicines
2014	Lao PDR	3	7	live
	United States of America	1	12	gall bladders
	Viet Nam	1	6	paws
2015	Lao PDR	7	14	live
	United States of America	2	2	gall bladder, skin
	Viet Nam	2	2	live
2016	Lao PDR	8	62	live, gall bladders, dead, teeth, claws, skin
	China	1	2	paws
	Viet Nam	1	5	paws
	Total	**51**	**173**	

[a] Estimated number of animals for seized commodity reported as 'medicines' and 'derivatives' from the CITES Trade Database that amounted to 49 items are excluded as it is impossible to estimate the number of bears that were involved in making these medicines or derivatives.

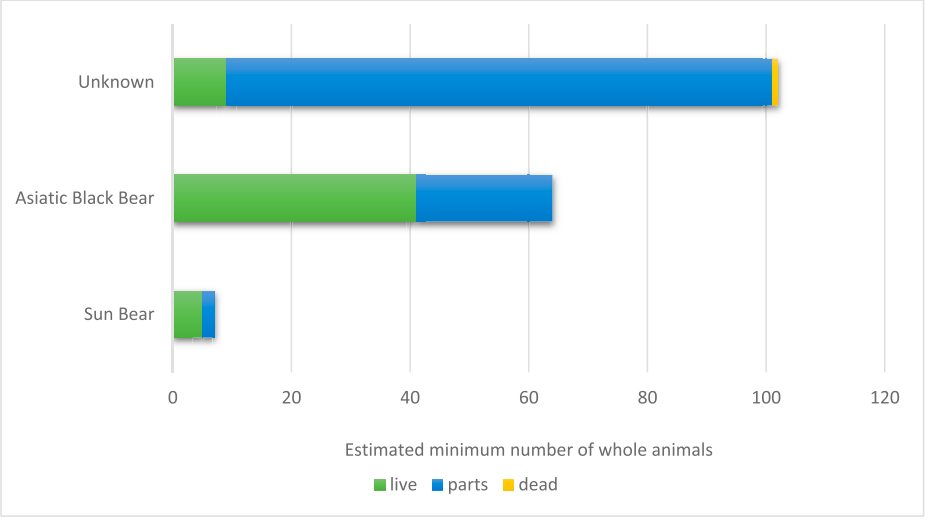

Fig. 2. The estimated minimum number of Sun Bears and Asiatic Black Bears involved based on commodities seized which include live and dead animals, as well as parts (claws, gall bladders, paws, skin, teeth) between 2010 and 2016.

Nam reported as the intended destination. Seizures involving Viet Nam were mostly made up of lives bears (n = 14 bears) and bear paws (n = 88 paws).

4.2. Market survey data

4.2.1. Locations

We surveyed a total of 25 towns/villages and found 14 with bear items openly available for sale (Table 2), 10 without any observations made of bear items for sale and one where the market visited was closed. Boten and Luang Namtha towns, both within the Luang Namtha Province, had the greatest diversity and quantities of bear products on sale. This was followed by the Golden Triangle Special Economic Zone (SEZ), in Bokeo Province and Vientiane with four different products for sale, although quantities were much greater in the Golden Triangle SEZ.

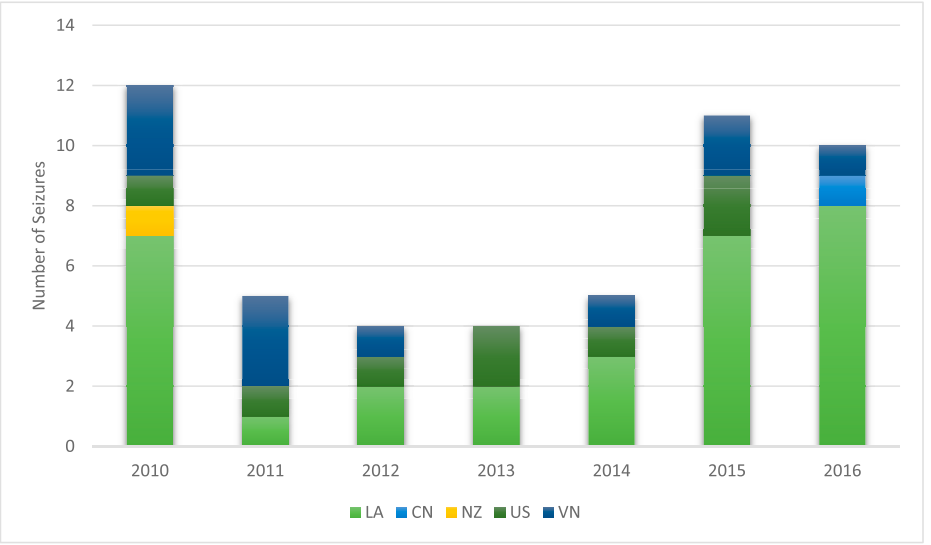

Fig. 3. Number of bear seizures that occurred in Lao PDR and other countries that implicate Lao PDR as either a source, transit or destination country, between 2010 and 2016. Abbreviations in the legend are as follows, LA: Lao PDR, CN: China, NZ: New Zealand, US: United States of America, VN: Viet Nam.

Table 2
Locations in Lao PDR where bear parts and derivatives were observed openly available for sale during market surveys in 2016.

Location	Medicinal					Trophy/Decoration				Grand Total
	pills	powder	wine	fat/grease	gall bladder	claw	jaw	skin	teeth	
Attapeu					2					2
Ban Nakasang								1		1
Boten	37	290	15	77	2				4	425
Golden Triangle SEZ	5	142	2		5					154
Houey Xai					1				46	47
Luang Namtha	32	122		5		6			33	198
Luang Prabang									29	29
Pakse					6	1		1	1	9
Salavan					2					2
Savannakhet						2	1			3
Tha Theng					1					1
Thakhek					4					4
Thongnamy					5					5
Vientiane		12			7	2			7	28
Grand Total	74	566	17	82	35	11	1	2	120	908

4.2.2. Products/items

We recorded nine types of bear products in the market, five for medicinal purposes and three for trophies/decorations (Table 2) (Figs. 4 and 5). We also found a bear jaw for sale, although the purpose of this part was not known. Of the types of products we observed, five were raw bear parts and four were processed, or semi-processed.

Gall bladder was the most common raw bear product for sale, encountered in at least 10 of the 14 locations that were recorded with bear products openly available, followed by canine teeth. The most numerous processed products were the packages of powdered bile (n = 566), the bottles of fat/grease (n = 82) and bottles of pills (n = 74). We recorded three varieties of powder for sale, one manufactured in Lao PDR, one in Myanmar and the third was unknown. The products made in Lao PDR were the most numerous.

Of the products we used to estimate the minimum number of bears, gallbladders were the most numerous (n = 35). However, as it is possible that not all of these were from bears (gallbladders of bears, pigs and other species are difficult to discern in the field), canine teeth are the most definite, of which there were 120, representing an absolute minimum of 30 bears (Table 3), although the actual number of bears was likely much higher.

5. Discussion

Illegal trade in bears and their parts and derivatives, remains a serious issue in Lao PDR. Cross-border-trade, in violation of national legislation and CITES appears to be rampant, and has been so dating back decades, at least (Mills and Servheen, 1991;

Fig. 4. Bear products that were observed for sale during the market survey in 2016 in Lao PDR – (a) bear bile powder recorded in Boten (Photo credit: E. John/TRAFFIC) and (b) bear bile pills (with the gold caps) and fat/grease (white caps) recorded in Luang Namtha (Photo credit: K. Krishnasamy/TRAFFIC). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

Fig. 5. Bear products that were observed for sale during the market survey in 2016 in Lao PDR – (a) reported bear gall bladder and bear canines observed in Vientiane (Photo credit: O.O. Ching/TRAFFIC) and (b) bear canines recorded in Luang Namtha (Photo credit: E. John/TRAFFIC).

Nooren and Claridge, 2001). Foley et al. (2012)'s assessment of the trade of bear bile medicines in Asia; and Livingstone and Shepherd (2014)'s assessment of the bear farming industry have further solidified Lao PDR's status as a major hub for illegal trade in live bears, and their parts and products. This study further confirms that the illicit trade in bear parts and derivatives and well as live bears persists, openly and blatantly in violation of national as well as international laws with implications on wild bear populations.

During this market survey, bear parts and derivatives were observed in more than half of locations surveyed (56%). Nine different types of items sourced from bears were recorded mostly for traditional medicine (packages of powder, bottles of fat/grease, bottles of pills, raw gall bladders and bottles of wine) followed by trophy/ornamental (teeth, claws, jaw and skins) purposes; while seizure data involved mostly live bears followed by bear parts, the majority of which were paws and gall bladders. Far more parts and derivatives were observed openly for sale than were recorded as being seized, highlighting the lack of enforcement effort, and clearly retailers do not fear enforcement or respect the law.

Lao PDR has at least six known facilities (four dedicated bear farms and two tiger farms) that hold bears which may be a source of products available in the markets. Bears are being poached from the wild to stock these facilities (Livingstone et al., 2018). Recent surveys of bear bile extraction facilities throughout Lao PDR found bears kept in tiny individual cages with no discernible conditions for breeding (Livingstone et al., 2018) (Fig. 6). This is further substantiated by the large number of seizures involving wild-caught live bears (n = 56 bears), of which 39 were cubs (Fig. 7). Similar findings were observed in Livingstone and Shepherd (2014) which concluded that bear farms in Lao PDR rely on wild-caught bears and that none are

Table 3
Bear parts recorded for sale during the market survey in Lao PDR, 2016 and an estimate of the number of bears involved.

Location	Bear Products	Estimated Minimum number of bears[a]
Attapeu	gall bladder	2
Ban Nakasang	skin	1
Boten	gall bladder, teeth	2
Golden Triangle SEZ	gall bladder	5
Houey Xai	gall bladder, teeth	11
Luang Namtha	claw, teeth	8
Luang Prabang	teeth	7
Pakse	claw, gall bladder, skin, teeth	6
Salavan	gall bladder	2
Savannakhet	claw, jaw	1
Tha Theng	gall bladder	1
Thakhek	gall bladder	4
Thongnamy	gall bladder	5
Vientiane	Claw, gall bladder, teeth	7
Total		62

[a] Assumption is that all gall bladders are from bears; estimate of minimum number of bears does not include processed bear products (i.e. pills, powder, fat/grease and wine) observed for sale as it was not possible to determine how many bears were used in the manufacturing of these products.

Fig. 6. Facilities across Lao PDR that were observed with captive bears during a TRAFFIC survey in 2017 – (a) at least 60 Asiatic Black Bears held in a facility located in Boten and (b) at least 29 Asiatic Black Bears held captive in a facility in the Golden Triangle Special Economic Zone (Photo credit: L. Gomez/TRAFFIC). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

bred in captivity; and during a recent survey in which several Asiatic Black Bear cubs (n = 14 animals) were observed for sale within a span of two weeks (Livingstone et al., 2018). Crudge et al. (2018) also concluded the same in Viet Nam of the restocking of bear farms relying on wild bear populations based on interviews with current and previous owners of such facilities across the country.

The seizure data also show that at least four countries (China, New Zealand, US and Viet Nam) are involved in the international trafficking of bears with Lao PDR in clear violation of CITES. Of the four, the US and Viet Nam were the most frequent countries of demand. The US was found to be a destination country for medicinal products and gall bladders, and Viet Nam a destination country for live bears and bear paws. While information on the illegal trade of bears to the US is less known, the connection between Lao PDR and Viet Nam has been reported in Foley et al. (2011) and Willcox et al. (2016). According to Willcox et al. (2016), while the demand for farmed bear bile products in Viet Nam appears to be decreasing, the trade in wild-origin bear products and parts remains lucrative; and wild bear parts and/or products are reportedly sourced from Lao PDR as well as Russian Federation and Thailand.

Some products observed for sale during the market surveys also reveal a cross-border trade of bears taking place between China, Lao PDR, Myanmar and Viet Nam. One brand is manufactured by the Xinglong commercial bear bile extraction facility in Boten and the owner reportedly distributes it across Lao PDR and elsewhere (which was not specified). According to locals, the bears within this facility are sometimes sold to buyers from China and Viet Nam, and it is probable that these manufactured products are as well. This Xinglong commercial bear facility is said to be owned by a Chinese family from the Fujian Province of China, who also own a commercial bear facility in Mong La, Myanmar (Livingstone et al., 2018). Another brand of bear bile powder observed for sale in Lao PDR, although less common, was produced in Myanmar, according to package

Fig. 7. Asiatic Black Bear cubs that were observed for sale during a TRAFFIC survey of bear farms across Lao PDR in 2017 – (a) two cubs male cubs, less than a year old, being sold for ~ USD1800 in Ban Boun Tai and (b) a two year old male cub being sold for ~ USD2000 in Sainyabuli (Photo credit: L. Gomez/TRAFFIC).

labelling, and as there is no recorded trade of this product in the WCMC-UNEP CITES Trade Database, it has clearly been sourced, in an illegal manner.

6. Conclusion and recommendations

Continued poaching and trade of bears to meet demand for their parts and derivatives, and live bears, particularly cubs to stock bear bile extraction facilities, is clearly a threat to Lao PDR's wild bear populations. Although bears are protected under the Wildlife and Aquatic Law and international commercial trade is not permitted as both species are listed in CITES Appendix I, trade remains open, widespread and unabated across Lao PDR. We urge the Government of Lao PDR to take immediate and appropriate action against anyone found selling live bears, or bear parts and derivatives in accordance with the new Order No. 5 issued in May 2018. As Lao PDR is currently revising national legislation, we strongly recommend that both species of bears native to Lao PDR are provided effective levels of protection. We also call upon the Government of Lao PDR to close all of the bear bile extraction facilities in the country. Anyone found illegally keeping bears should be prosecuted to the full extent of the law. Finally, conservation organisations working in Lao PDR should continue to monitor the trade in bears, and bear parts and derivatives, to measure progress towards ending this trade, to inform authorities of emerging trends in this trade and to assist the authorities where possible to bring about an end to the trade in bears, and their parts and derivatives, in Lao PDR.

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References

Anon, 2015. Wildlife seizures in 2014 highlighting Lao PDR's role in trafficking. Online at: http://www.traffic.org/home/2015/1/6/wildlife-seizures-in-2014-highlight-lao-pdrs-role-in-traffic.html. (Accessed 4 July 2016).

Anon, 2016. Application of article XIII in the Lao People's democratic Republic. SC67 Doc.12.1 CITES Sixty-seventh meeting of the Standing Committee Johannesburg (South Africa), 23 September 2016. https://cites.org/sites/default/files/eng/com/sc/67/E-SC67-12-01.pdf.

Burgess, E.A., Stoner, S.S., Foley, K.E., 2014. Brought to bear: an Analysis of Seizures across Asia (2000-2011). TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia.
Coudrat, C.N.Z., Duckworth, J.W., Timmins, R.J., 2012. Distribution and conservation status of the red-shanked douc (Pygathrix nemaeus) in Lao PDR: an update. Am. J. Primatol. 74, 874–889.
Crudge, B., Nguyen, T., Cao, T., 2018. The challenges and conservation implications of bear bile farming in Viet Nam. Oryx 1–8. https://doi.org/10.1017/S0030605317001752.
Davies, N., Holmes, O., 2016. The crime family at the centre of Asia's animal trafficking network. The Guardian. Online at: https://www.theguardian.com/environment/2016/sep/26/bach-brothers-elephant-ivory-asias-animal-trafficking-network?CMP=share_btn_tw. (Accessed 4 July 2016).
Davis, E.O., O'Conner, D., Crudge, B., Carignan, A., Glikman, J.A., Browne-Nuñez, C., Hunt, M., 2016. Understanding public perceptions and motivations around bear part use: a study in northern Laos of attitudes of Chinese tourists and Lao PDR nationals. Biol. Conserv. 203, 282–289.
Duckworth, J.W., Salter, R.E., Khounboline, K., 1999. Wildlife in Lao PDR: 1999 Status Report. Vientiane: IUCN-the World Conservation Union/Wildlife Conservation Society/Centre for Protected Areas and Watershed Management (Vientiane, Lao PDR).
EIA, 2015. Sin city: illegal wildlife trade in Laos's golden Triangle special economic Zone. EIA, March 2015. Online at: https://eia-international.org/wp-content/uploads/EIA-Sin-City-FINAL-med-res.pdf. (Accessed 4 July 2016).
Foley, K.E., Stengel, C.J., Shepherd, C.R., 2011. Pills, Powders, Vials and Flakes: the bear Bile Trade in Asia. TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia.
Fredriksson, G., Steinmetz, R., Wong, S., Garshelis, D.L., IUCN SSC Bear Specialist Group, 2008. Helarctos malayanus. The IUCN Red List of Threatened Species 2008: e.T9760A13014055. Online at: https://doi.org/10.2305/IUCN.UK.2008.RLTS.T9760A13014055.en. (Accessed 6 October 2016).
Free the Bears, 2016. Notorious wildlife market raided in Laos. Online at: http://www.freethebears.org/index.php/media-page/news-stories/130-market-raid-2016. (Accessed 4 July 2016).
Garshelis, D., Steinmetz, R., 2016. Ursus thibetanus. (Errata version published in 2017) the IUCN red list of threatened species 2016. Online at: e.T22824A114252336. https://doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22824A45034242.en. (Accessed 15 August 2017).
Gomez, L., Leupen, B.T.C., Heinrich, S., 2016. Observations of the Illegal Pangolin Trade in Lao PDR. TRAFFIC, Southeast Asia Regional Office, Petaling Jaya, Selangor, Malaysia.
Krishnasamy, K., Leupen, B., Or, O.C., 2016. Observations of the Helmeted Hornbill Trade in Lao PDR. TRAFFIC, Southeast Asia Regional Office, Petaling Jaya, Selangor, Malaysia.
Lee, L.S., Burgess, E.A., Chng, S.C.L., 2015. Hard to bear: an Assessment of Trade in bear Bile and Gall Bladder in Malaysia. TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia.
Livingstone, E., Gomez, L., Bouhuys, J., 2018. A review of bear farming and bear trade in Lao People's Democratic Republic. Global Ecology and Conservation 13 (2018) e00380.
Livingstone, E., Shepherd, C.R., 2014. Bear farms in Lao PDR expand illegally and fail to conserve wild bears. Oryx 1–9.
Mills, J.A., Chan, S., Ishihara, A., 1995. The bear Facts: the East Asian Market for bear Gall Bladder. TRAFFIC International, Cambridge, UK.
Mills, J., Servheen, C., 1991. The asian trade in bears and bear parts. Int. Conf. Bear Res. Manag. 9, 161–167.
Nijman, V., 2015. Pangolin seizure data reported in the Indonesian media. Traffic Bull. 27 (2), 44–46.
Nijman, V., Shepherd, C.R., 2012. China's role in trade in ivory and elephant parts from Lao PDR. Oryx 46, 172–173. https://doi.org/10.1017/S0030605312000452.
Nooren, H., Claridge, G., 2001. Wildlife Trade in Laos: the End of the Game. Netherlands Committee for IUCN, Amsterdam.
Phanthavong, B., 2008. Pangolin conservation in Lao PDR. In: Pantel, S., Chin, S.Y. (Eds.), Proceedings of the Workshop on Trade and Conservation of Pangolins Native to South and Southeast Asia, 30 June-2July 2008, Singapore Zoo, Singapore. TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia, pp. 56–58.
Scotson, L., 2010. The distribution and status of asiatic Black bear Ursus thibetanus and malayan Sun bear Helarctos malayanus in Nam et Phou Louey national protected area, Lao PDR. Online at: www.bearbiology.com/fileadmin/.../SCOTSON_NEPL_bear_status_report_2010.pdf. (Accessed 6 October 2016).
Shepherd, C.R., Nijman, V., 2007. The trade in bear parts from Myanmar: an illustration of the ineffectiveness of enforcement of international wildlife trade regulations. Biodivers. Conserv. 17, 35–42.
Shepherd, C.R., Krishnasamy, K., 2013. Increased Enforcement and Reduced Demand: Tackling the Illegal Bear Trade in Malaysia, vol 22. International Bear News. Fall 2013, No. 3.
Som, S., Cottet, M., 2015. Rescue and relocation programme of turtles and tortoises and elongated tortoise monitoring programme in the Nam Theun 2 Reservoir (Laos). Hydroécol. Appliquée. https://doi.org/10.1051/hydro/2015007.
TRAFFIC, 2008. What's Driving the Wildlife Trade? a Review of Expert Opinion on Economic and Social Drivers of the Wildlife Trade and Trade Control Efforts in Cambodia, Indonesia, Lao PDR and Vietnam. East Asia and Pacific Region Sustainable Development Discussion Papers. East Asia and Pacific Region Sustainable Development Department. World Bank, Washington D.C.
TRAFFIC, 2018. Lao PDR Prime Ministerial Order raises hope for clean-up of country's illegal wildlife trade hubs. Online at: http://www.traffic.org/home/2018/6/4/lao-pdr-prime-ministerial-order-raises-hope-for-clean-up-of.html. (Accessed 20 June 2018).
Willcox, D., Minh, N.D.T., Gomez, L., 2016. An Assessment of Trade in bear Bile and Gall Bladder in Viet Nam. Petaling Jaya, Selangor, Malaysia).

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Illegal trade of sun bear parts in the Malaysian states of Sabah and Sarawak

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ABSTRACT: Malaysia is a known source and consumer of bear bile products in Asia, and sun bears are persistently poached to meet the demand for traditional Chinese medicine (TCM). Surveys of TCM outlets in the East Malaysian states of Sabah and Sarawak were conducted in 2018 and 2019 as part of continuing efforts to monitor the availability of bear bile products in the country. Despite being illegal, the trade in bears and their parts persists, although with fewer TCM outlets offering such products in comparison to numbers reported in previous studies. In 2012, 42% of TCM outlets in Sabah and 35.4% in Sarawak were found to contain bear bile products. This has since dropped to 35% in Sabah and 19.3% in Sarawak in 2018–2019. Gall bladders were the main type of commodity for sale in both states, and were reportedly sourced predominantly by indigenous people. It was evident that most retailers surveyed were aware that the trade in bears and their parts was strictly prohibited, and some traders claim to have stopped selling illegal bear products for this reason. However, some traders who continue to trade in these illegal commodities have become more discreet. These factors contribute to the reduction in TCM outlets observed selling bear bile products. This reduction may also be due to diminishing sun bear populations, as some traders have claimed to have stopped selling bear bile products because of the rarity of or difficulty in procuring genuine bear gall bladders. The threat of illegal trade, combined with loss and degradation of suitable habitat and food resources as well as conflict with humans, puts sun bears at considerable risk. Efforts to mitigate these threats are urgently needed. Reduction of demand for bear parts is essential, as is stronger legal protection, enhanced enforcement and increased community involvement in bear conservation actions to ensure the long-term survival of viable bear populations in Asia.

KEY WORDS: *Helarctos malayanus* · Malaysia · Sun bears · Wildlife trade

1. INTRODUCTION

Globally, 8 species of bears exist across Asia, Europe, North America and South America. Asia is home to 6 of these species, with 4 species, Asiatic black bear *Ursus thibetanus*, sun bear *Helarctos malayanus*, sloth bear *Melursus ursinus* and giant panda *Ailuopoda melanoleuca*, endemic to the region and 2 others, brown bear *Ursus arctos* and polar bear *Ursus maritimus*, found across a broader range. All 4 bear species endemic to Asia are threatened with extinction as assessed by the IUCN Red List of Threatened Species (Scotson et al. 2017). Asian bear species are considered to be in decline across their range, in part due to habitat loss, but increasingly due to the illegal and widespread poaching and killing of bears fueled by a black-market trade in live bears, their parts and derivatives (Shepherd & Nijman 2008, Foley et al. 2011, Burgess et al. 2014, Lee et al. 2015, Wilcox et al. 2016, Nijman et al. 2017, Or et al. 2017, Gomez & Shepherd 2018, Crudge et al. 2020).

Bears are targeted for their gall bladder or bile used in traditional Chinese medicines (TCM), for their meat (and especially paws) coveted by specialised

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wild meat restaurants, their parts (e.g. claws, teeth, skull, skin) prized as trophies, and, increasingly, live for the exotic pet trade. This demand has also fueled the establishment of bear farms in some parts of Asia; these farms arguably have no conservation benefit as most of these facilities continuously rely on wild-caught bears that are captured throughout the region, and due to consumer preference for bile extracted from wild-caught animals (Livingstone & Shepherd 2014, Willcox et al. 2016, Crudge et al. 2020). Malaysia plays a key role in the illegal trade of bears, as a source and consumer of bear parts and products (Mills & Servheen 1994, Pereira et al. 2002, Foley et al. 2011, Burgess et al. 2014, Lee et al. 2015).

The smallest and least understood of the Asian bear species is the sun bear (Crudge et al. 2019). Globally, sun bears are assessed as Vulnerable on the IUCN Red List of Threatened Species, with populations considered to be in decline throughout their range (Fig. 1) (Scotson et al. 2017). This decline is largely attributed to deforestation and high levels of poaching for commercial trade (Wong 2006, Shepherd & Nijman 2008, Foley et al. 2011, Wilcox et al. 2016, Nijman et al. 2017, Gomez & Shepherd 2018, Livingstone et al. 2018, Crudge et al. 2020). While the status of sun bear populations is largely unknown, they are generally considered to be more abundant or common in the southern regions of their range (e.g. Indonesia and Malaysia), rare in the other regions (e.g. Bangladesh, Cambodia, India, Lao PDR, Myanmar, Thailand and Viet Nam), and extinct in Singapore and possibly China (Scotson et al. 2017).

Sun bears are the only bear species native to Malaysia and occur as 2 subspecies: *Helarctos malayanus malayanus*, which is found in Peninsular Malaysia, and *H. m. euryspillus*, found in the States of Sabah and Sarawak, on the island of Borneo. Estimations by the Malaysian Department of Wildlife and National Parks put sun bear populations in Malaysia at between 300 and 500 individuals as of 2018 (The Star Online 2019). The sun bear is a protected species across Malaysia, and therefore any trade in the species, their parts or derivatives is strictly illegal. Conservation efforts to end the illegal trade in bears, their parts and derivatives in Malaysia have been ongoing for over 20 yr (Gomez 2019). Systematic surveys undertaken to monitor the extent of the trade and to identify areas with high levels of open availability of bear parts and derivatives in retail outlets have been continuous since 2010 (Foley et al. 2011, Burgess et al. 2014, Lee et al. 2015). Information obtained from these surveys has been provided to the relevant authorities for enforcement action, and to the Federation of Chinese Physicians and Medicine Dealers Associations of Malaysia, in the hope that the federation itself would start regulating its members to ensure no illegal trade was taking place. Awareness raising activities have also been held with TCM practitioners in Malaysia to highlight the illegality of prescribing medicine that contains protected species and encouraging them to protect their reputation by practicing TCM within the confines of local laws.

From 2012 to November 2019, there were at least 32 seizures of sun bears in Malaysia, most of which occurred in Sabah (14 incidents) and involved both live bears and parts (gall bladders, paws, teeth and skin). Aside from seizures, there were at least 6 cases in Sabah (2016–2017) involving

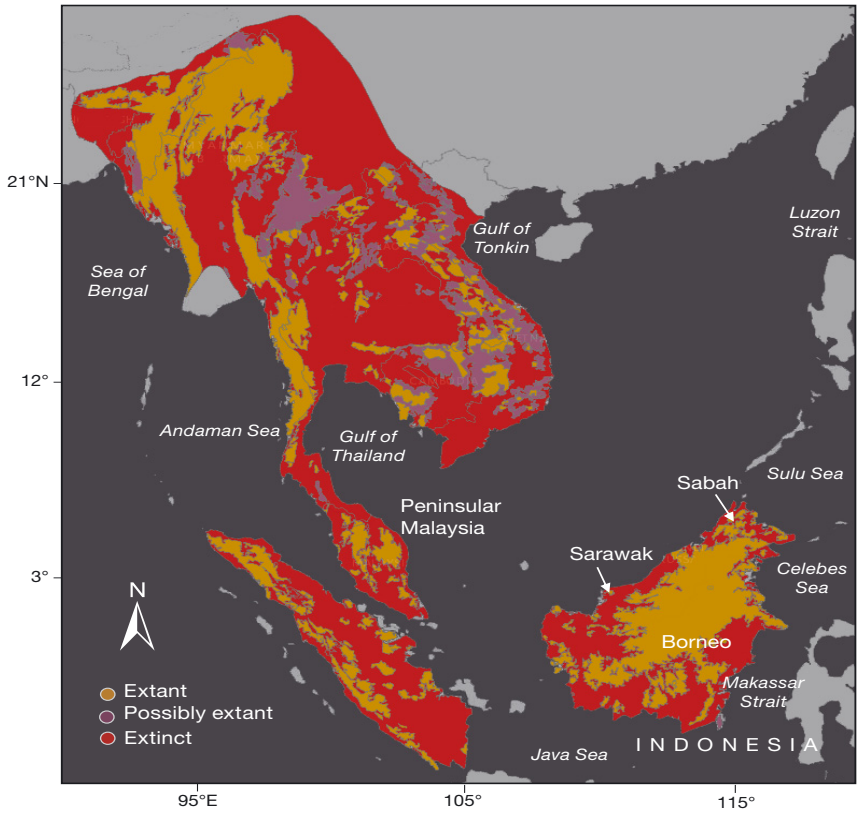

Fig. 1. Range map of sun bears extracted from the IUCN Red List of Threatened Species (Scotson & Fredriksson 2016). Our study was undertaken in East Malaysia, i.e. the States of Sabah and Sarawak located on the island of Borneo, which also encompasses Brunei Darussalam and Kalimantan, Indonesia

10 bears found butchered with their paws and gall bladders missing or found injured from snares and hunting spears (Or et al. 2017). In Sarawak, the hunting and killing of bears has been openly posted on Facebook, bear meat has been found for sale in local markets, live bears are being kept as pets, and skins have been seized from local and foreign poachers (Krishnasamy & Shepherd 2014, Balakrishnan 2016, Chu 2017, Then 2019, Veno 2019). Despite efforts to mitigate against the trafficking of sun bears in Malaysia, it is clear that illegal trade continues to put bear populations at risk.

In 2017, the IUCN SSC Bear Specialist Group, Free the Bears and TRAFFIC Southeast Asia organised the 1st International Symposium on Sun Bear Conservation and Management to gather the collective knowledge and opinions from sun bear experts relevant to the conservation of this species. Information gathered from this symposium was then used to develop a 10-yr range-wide conservation action plan specifically for sun bears (Crudge et al. 2019). It outlines a strategic approach for priority actions identified as key in ensuring wild sun bear populations remain an ecologically functioning component across their range. The plan has 5 main goals, one of which is aimed at eliminating illegal exploitation of the species. A primary objective under this goal is to 'improve law enforcement effectiveness for laws pertaining to hunting, trade and use of sun bears and their parts' (Crudge et al. 2019) and encompasses continued monitoring and investigation of availability of sun bear parts and products to support law enforcement action.

In conjunction with this goal, the objective of this study was examine the illegal trade of bears used in the TCM industry in Sabah and Sarawak to (1) assess current levels of availability of sun bear parts and derivatives to support law enforcement action; and (2) understand current trends in trade and levels of awareness amongst retailers, in comparison to past studies undertaken, in order to aid in the development of further bear conservation interventions and to catalyse targets and effective enforcement actions.

2. MATERIALS AND METHODS

A physical market survey was undertaken from December 2018 to February 2019 in key locations (i.e. cities and towns) across the Malaysian states of Sabah and Sarawak (Fig. 1, Table 1). This encompassed 13 locations in Sabah and 11 locations in Sarawak. At each location, a search was made for TCM outlets and, once identified, a local consultant posing as a potential customer would visit the outlet to enquire about the availability of bear gall bladder or bear bile products for sale. When such products were offered, the consultant gathered additional data on quantity, origin, price and demand, as well as their understanding of legality of the product on sale through an informal discussion with the TCM retailers (although it should be noted that this depended on the traders' willingness to provide such details, which was not always the case). Bear parts and products observed for sale in TCM outlets were assumed to be genuine where reported as such by a retailer. Verification of the products on sale was not possible as no products were purchased as part of this study. TCM outlets found selling or claimed to be selling bear gall bladders and derivatives were reported to the relevant enforcement agencies for their further action.

The conversion of prices from MYR to USD was based on https://www1.oanda.com/currency/converter/, as of 22 July 2019.

Table 1. The number of locations surveyed in Sabah and Sarawak and the number of traditional Chinese medicine (TCM) outlets visited at each location between December 2018 and February 2019

No.	Sabah		Sarawak	
	Location	No. TCM outlets surveyed	Location	No. TCM outlets surveyed
1	Beaufort	2	Bintangor	3
2	Keningau	2	Bintulu	9
3	Kota Kinabalu	12	Kanowit	1
4	Kota Marudu	2	Kapit	1
5	Labuan	1	Kuching	17
6	Lahad Datu	4	Lawas	2
7	Penampang	2	Limbang	3
8	Ranau	1	Miri	18
9	Sandakan	9	Sarikei	3
10	Sepitang	1	Sibu	23
11	Tawau	6	Sri Aman	3
12	Tenom	2		
13	Tuaran	1		

3. RESULTS

3.1. Availability

A total of 128 TCM outlets in 24 locations across Sabah and Sarawak were surveyed (Table 1). Bear parts and derivatives were recorded for sale in 25% of TCM outlets surveyed but in more than half of the locations visited (54.2%). In Sabah, bear parts and derivatives were found for sale in 9 of the 13 locations

(69.2%) visited (i.e. Beaufort, Keningau, Kota Kinabalu, Kota Marudu, Lahad Datu, Ranau, Sandakan, Tawau, Tenom and Tuaran) and in 16 of the 45 TCM outlets surveyed (35%) (Fig. 2). In Sarawak, only 4 of the 11 locations (36.4%) visited were recorded with bear parts and derivatives for sale, i.e. Bintulu, Kuching, Miri and Sibu, as were 16 of the 83 TCM outlets (19.3%) surveyed (Fig. 2).

3.2. Forms of bear product

The main type of bear product observed for sale in both Sabah and Sarawak was gall bladder, with a minimum of 79 whole gall bladders recorded in 25 TCM outlets in both states combined. The majority of these were found in Sarawak (n = 53 whole gall bladders in 15 TCM outlets) in 3 main locations, Miri (n = 25), Kuching (n = 19) and Bintulu (n = 9). In Sabah, 26 gall bladders were observed for sale in 10 TCM outlets in 7 locations, the majority in Beaufort (n = 11), followed by Sandakan (n = 5), Tawau (n = 3), Kota Kinabalu (n=2), Keningau (n = 1), Ranau (n = 1) and Tenom (n = 1). Five traders claimed to have gall bladders but refused to reveal them. In these instances we assumed these traders to be in possession of at least one whole gall bladder. Aside from whole gall bladders, one Sabah-based trader sold gall bladder in vials containing shredded pieces of gall bladder, and one Sabah-based trader sold it as wine, i.e. gall bladder soaked in wine. The price of gall bladders ranged widely. In Sabah, gall bladder prices ranged between MYR300 and 1000 per gall bladder (~USD73–243) or were priced per kilogram (MYR180 [USD44] per 11 g or MYR300 [USD73] per 18 g). In Sarawak, prices ranged between MYR50 and 1900 per gall bladder (~USD12–462). Shredded gall bladder was being sold at MYR80 per vial (~USD20) while bear bile wine was being sold at MYR60 per 30 ml (~USD15).

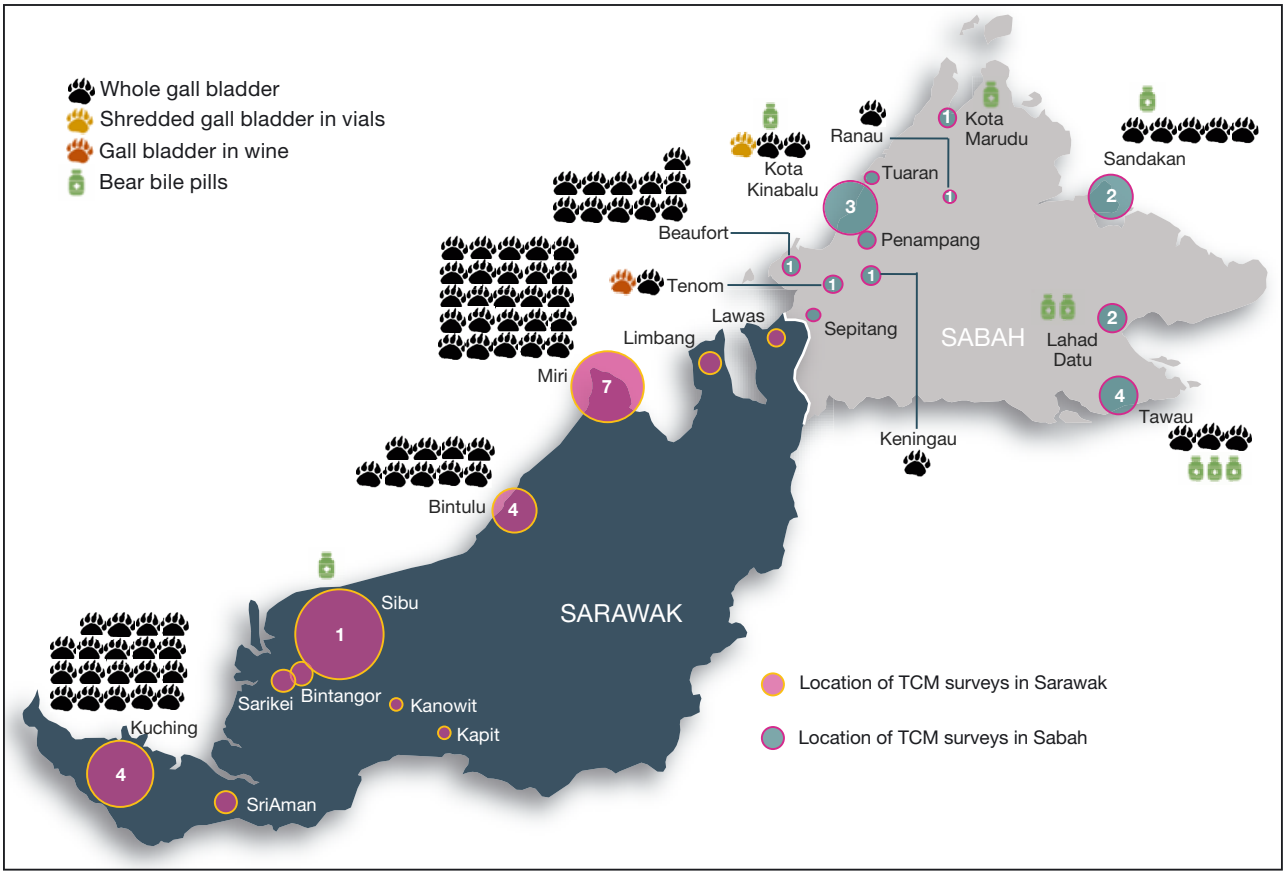

Fig. 2. Location of surveys undertaken in main cities and towns in Sabah and Sarawak between December 2018 and February 2019. The size of the circles represents survey effort at each location based on the number of traditional Chinese medicine (TCM) outlets visited (as presented in Table 1) and the number within each circle represents the number of TCM outlets that were observed with bear parts and derivatives for sale. The number of symbols for gall bladder and bear bile represents the number of the respective bear part or derivative found at these locations. An additional location not marked on the map is the island of Labuan, off the coast of Sabah, where 1 TCM outlet was visited but no bear parts or derivatives were found for sale

The only other bear products observed for sale were pills (pure or mixed with herbs or pearl powder), found in 9 TCM outlets (n = 8 in Sabah; n = 1 in Sarawak). Four traders (n = 3 in Sabah, 1 in Sarawak) claimed to be uncertain of the content of the pills, stating they consisted mostly of plant-based material, with one of these traders further noting that even if they did contain bear bile, it was likely to be in very low quantities. One trader claimed to have pure bear bile pills that were made from the bile of polar bears, and offered to source for other bear-based ointment from Hong Kong. The pills were priced at MYR0.50 per pill (~USD0.12) in Sarawak and between MYR0.50 and 1.20 per pill (~USD0.12–0.30) in Sabah, or between MYR37.70 and 90 per bottle (100 pills) (~USD9–22).

3.3. Source/demand

Nineteen traders reported that indigenous peoples were the main source of gall bladders to TCM outlets in both Sabah and Sarawak, but that the supply was irregular. One trader in Sarawak claimed the gall bladders he was selling were from Indonesia. The pills were reportedly sourced from Peninsular Malaysia (n = 3 TCM outlets), China (n = 1 TCM outlet) and Thailand (n = 1 TCM outlet).

Most traders (76%), regardless of whether they were selling bear bile products, were aware that it is illegal to sell bear parts and derivatives. Of the traders recorded selling bear parts, 7 claimed to keep bear gall bladders for their own personal use but on occasions sold these to trusted customers if it meant saving a life. Five traders noted that it is illegal to keep gall bladders in the shop and either kept these out of sight or at a different location, e.g. at home. A further 4 traders in Sabah claimed that it is legal to keep bear gall bladders provided it is for personal use. Some traders (n = 17) also claimed to be only selling the last of their stock. In Sarawak, 4 traders reportedly sold bear bile products to Chinese nationals looking specifically for bear gall bladder, with one trader claiming this is done through an agent who buys and takes the gall bladders to China.

Of the traders not found with bear products for sale (n = 67 in Sarawak, n = 29 in Sabah), 13 traders cited reasons such as it is illegal, or it was too risky for too little profit, while a further 17 traders cited being unable to distinguish between real and fake gall bladders as the main reason, with 10 of these traders stating that most gall bladders in the market are likely to be fake. It was also stated that bears were becoming harder to find and that indigenous people were substituting genuine products with the gall bladders of other animals, such as pigs. That said, there were 3 traders who expressed a willingness to source gall bladders if required and on a few occasions, provided contact details for middlemen that they thought could source for genuine bear gall bladders. Seven traders offered pills when asked for bear gall bladder but noted that the pills were purely herbal in nature (and as such, we consider this as not selling bear bile products). Only one trader in Sibu, Sarawak, claimed to have stopped selling bear gall bladder due to a lack of demand.

4. DISCUSSION

This study confirms that sun bears are still being hunted for use in TCM in Malaysia, despite this trade being strictly illegal. With observations of availability of bear parts in more than half of the locations surveyed in Sabah and Sarawak, this demand remains a significant threat to the species. Sun bears are being targeted for their gall bladders, the most commonly observed bear commodity in both Sabah and Sarawak. These results are similar to the findings of previous studies in Malaysia (Mills & Servheen 1994, Pereira et al. 2002, Foley et al. 2011, Burgess et al. 2014, Lee et al. 2015, Gomez 2019), which indicates that conservation initiatives to mitigate this threat have not yet been successful. Enforcement efforts have also had insufficient impact in eradicating this illegal trade. Sun bears are reported to be in decline across their range, with an estimated ~35% decline over the past 30 yr and a predicted decline of more than 40% over the next 30 yr (Scotson et al. 2017). The Sundaic Region, covering Indonesia, mainland Peninsular Malaysia and the island of Borneo, is described as having the highest abundance and population density of sun bears, although this is based on historical estimates and data (Crudge et al. 2019). Whether this remains true is questionable, considering that bears are persistently being hunted and killed for their parts throughout Indonesia and Malaysia (Gomez & Shepherd 2019, Gomez et al. 2019).

While the illegal trade in bear parts and derivatives is far from being eradicated in these 2 Malaysian states, there has been an apparent reduction in the number of TCM outlets offering bear bile parts and products. In 1997, Meijard (1999) reported that 6 of the 10 TCM shops they surveyed in Sarawak had gall bladders in stock, whereas in Sabah it was more discreet, with traders reporting they were prohibited

from selling protected species. In 2001, TCM shops were surveyed by the World Society for the Protection of Animals (WSPA), across several states in the country for trade in bears and their parts (Pereira et al. 2002). They found that 75% of outlets in Kota Kinabalu, Sabah, and 53% of outlets in Kuching, Sarawak, were found to contain gall bladders, bear bile powders and other medicines manufactured out of bear bile. Over 90 gall bladders were observed for sale. In 2010–2011, 38% of TCM outlets surveyed in Sabah and 28% in Sarawak were found to be selling bear parts (Foley et al. 2011). Surveys in 2012 saw a decline in open availability in Sabah (42.9% of TCM outlets surveyed had bear parts for sale) but a slight increase in Sarawak (35.4% of TCM outlets had bear parts for sale) (Lee et al. 2015). The present study shows further declines in Sabah (35% of TCM outlets had bear parts for sale) and a significant decrease in Sarawak (19.3% of TCM outlets had bear parts for sale). Similarly, the number of gall bladders encountered for sale has dropped since 2012. A total of 72 TCM outlets in Sabah and Sarawak were surveyed in 2012 and 117 whole gall bladders were observed for sale, in comparison to a total of 128 TCM outlets surveyed and 79 whole gall bladders in 2019. This was largely attributed to fewer gall bladders observed for sale in Sarawak (i.e. 53 gall bladders in comparison to 93 in 2012), whereas in Sabah, 26 whole gall bladders were found in 2019 compared to 25 gall bladders in 2012.

The reduction in open availability of bear products could be attributed to a multitude of factors. There has been increased awareness on the illegality of trading in bears, their parts and derivatives in Malaysia, which has pushed the trade underground, or possibly online. Over the past 20 yr, a number of studies have been undertaken, resulting in publications and media coverage to draw attention to the illegal nature of the trade in bears in Malaysia and to highlight potential impacts of trade on wild bear populations. These data are evidence of illegal trade activities and have thus been used to support law enforcement action and to raise awareness with the TCM community and the public. These measures have had some positive impact: we know most traders in Malaysia are currently aware that sun bears are a protected species and that the trade in their parts or derivatives is prohibited by law; fewer traders were observed with bear products for sale. However, some traders continuing to trade in illegal commodities have become more discreet. This is exemplified by some traders who were unwilling to show their stock of bear gall bladders or claimed to keep their stock elsewhere, a factor also noted by Lee et al. (2015) particularly in reference to the sale of bear gall bladders (i.e. not on open display, hidden in different rooms, or stored in a different location altogether). This is not surprising considering that wildlife traffickers are continuously adapting or finding alternative means to meet black market demands. Heinrich et al. (2017) found that the global trafficking of pangolin scales involved highly mobile networks that used 27 new global trade routes annually. Wildlife traders in Asia are also increasingly moving from physical markets to online platforms, which are harder to police and monitor and afford greater anonymity (Derraik & Phillips 2010, IFAW 2011, Lavorgna 2014, Harrison et al. 2016a).

Another factor that needs to be considered is the possibility that the decline in open availability may be a sign that the hunting and trade of bears is reducing sun bear populations in Malaysia, a case in point being the proclamations of many TCM traders on the rarity of or difficulty in procuring genuine bear gall bladders. Studies in Sabah and Sarawak show that wildlife declines are increasingly due to poaching more so than deforestation (Brodie et al. 2015, Voigt et al. 2018). In one seizure incident alone, as recently as October 2019, over 800 wildlife parts were found in Sarawak, of which 183 were bear gall bladders (Ling 2019). This is also reflected elsewhere in Southeast Asia, where indiscriminate and illegal use of snares is decimating vertebrates across the region, including bears (Harrison et al. 2016b, Gray et al. 2018, Symes et al. 2018, Tilker et al. 2019). In Cambodia, seizure rates involving bears have reportedly decreased in recent years and this is thought to be due to declining bear populations, in addition to trade becoming more discreet (Crudge et al. 2019). Population declines of bears in Viet Nam have been attributed to intense hunting and trapping that coincided with the rise of bear bile farming in the country (Crudge et al. 2016). Similar findings were reported in Myanmar, where intense and targeted hunting resulted in declines of both Asiatic black bear and sun bear populations in the Imawbum Mountains, primarily attributed to demand from China (Nijman et al. 2017). With bear populations depleting in other parts of Asia where they are in high demand, this also exacerbates the threat in countries and neighbouring regions that still have wild bears. At least 4 traders in Sarawak claimed to sell bear bile products to Chinese nationals. China and Viet Nam have been reported as key drivers in the poaching of bears for traditional medicine and exotic meat in Cambodia, Indonesia, Lao PDR, Myanmar, Thailand and Russia

(Burgess et al. 2014, Nijman et al. 2017, Livingstone et al. 2018). During a national crackdown on poaching and trafficking of wildlife throughout Malaysia in 2019, at least 44 foreign nationals were arrested in connection with these crimes, namely from Bangladesh, Cambodia, China, Indonesia, Myanmar, Thailand and Viet Nam (TRAFFIC 2019).

It is clear that TCM traders are largely aware of the illegality of selling protected species, and while some may have genuinely stopped selling bear parts and derivatives for this very reason, there are others who continue to flout local wildlife laws to feed the demand for such products. International trade regulations are also being violated, with the reported trafficking of bear parts and products to and from Malaysia involving China, Indonesia and Thailand. Sun bears are listed in Appendix I of CITES, and international commercial trade such as this is prohibited. Sun bears are a 'totally protected' species under the Sabah Wildlife Conservation Enactment, and penalties for offences involving 'totally protected' species include fines of between MYR50K and 250K (~USD12K–60K) and imprisonment from 1 to 5 yr. Despite numerous crimes against bears in Sabah (Or et al. 2017), only 2 people have been prosecuted over the years: one was sentenced to 2 yr in jail and a fine of MYR50K (~USD12K), while the other is still pending an appeal (Jeffrey 2019). The Sarawak Wildlife Protection Ordinance is weak for bears that are only listed as 'protected', a category that allows for the hunting of bears with a permit, as opposed to 'totally protected' status, which prohibits any hunting. Further, the penalties are low, with fines of up to MYR10K (~USD2400) and imprisonment of up to 1 yr. Such weak legal protection and low monetary fines impede conservation efforts. Weak legislation also fails to empower enforcement authorities or judiciary in taking affirmative action against illegal wildlife traders. From September to November 2019 alone, there were at least 6 incidents concerning sun bears in Sarawak, involving the seizure of either live bears or meat and gall bladders. But seizure of wildlife parts is not sufficient, and if not in conjunction with arrests and strong prosecution, has limited impact as a deterrent. It is therefore essential that the Sarawak government strengthens current legislation and affords sun bears full protection, which will enhance efforts made by authorities to end this trade. This measure was proposed to the Sarawak government in 1997 within a Master Plan for Wildlife in Sarawak (Krishnasamy & Shepherd 2014), and yet more than 20 yr have passed and this recommendation has yet to be implemented.

Efforts to engage the indigenous community through education and awareness programs, capacity building or alternative livelihood solutions is also urgently required to reduce their role and exploitation in the illicit sourcing of wildlife products. Currently, local wildlife laws are such that indigenous people are given rights to hunt certain species for their own personal use but not for commercial purposes. Nevertheless, these rights are being exploited by wildlife traders and this has serious implications for all wildlife species. During the present study, aside from bear parts, pangolin scales, hornbill casques and rhino horn, all 'totally protected' species, were also observed for sale in TCM outlets. While enhanced enforcement against poachers and hunters is crucial, the importance of engaging local communities that live near wildlife is also seen as essential in complementing enforcement efforts to disrupt the illegal exploitation of wildlife (Challender & MacMillan 2014, Hubschle & Shearing 2018, Roe & Booker 2019). As noted in Hubschle & Shearing (2018), local communities are more likely to support illegal wildlife trade or poaching activities if they remain on the margins of protected areas and are excluded from the economic benefits of conservation. Such initiatives have had some measure of success with indigenous communities in Kinabatangan, Sabah (Ancrenaz et al. 2007), local communities in India and Nepal (Pathak 2006), and traditional herding communities in China (Foggin 2018).

Lastly, the Sun Bear Conservation Action Plan (2019–2028) calls for the elimination of illegal exploitation of sun bears through the reduction of demand for live bears, their parts and products. The degree to which consumers knowingly or unwittingly contribute to this demand or their motivations is an aspect that has yet to be thoroughly investigated and addressed in Malaysia (Gomez 2019). Aside from a preliminary survey of attitudes and awareness of the bear bile trade carried out in 2013, little has been done to understand and address the demand (Lee et al. 2015). We reiterate here the urgent need for more detailed evidence-based research to better understand consumer behavior and develop and implement appropriate consumer behavior and a demand-reduction strategy in Malaysia.

5. CONCLUSIONS

Our study shows that sun bears are still being hunted and exploited for use in TCM in the Malaysian states of Sabah and Sarawak, and that this remains a persistent threat to wild bear populations.

The threat of illegal trade, combined with loss and degradation of suitable habitat and food resources as well as conflict with humans, puts sun bears at considerable risk. Efforts to mitigate these threats are urgently needed. Enhanced enforcement efforts, stronger legislation, increased local engagement and a significant reduction in demand for bear parts are all essential actions that must be taken to ensure the long-term survival of viable bear populations in Asia.

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LITERATURE CITED

Ancrenaz M, Dabek L, O'Neil S (2007) The costs of exclusion: recognising a role for local communities in biodiversity conservation. PLOS Biol 5(11):e289

Balakrishnan N (2016) Malayan sun bears are being brutally slaughtered in Sarawak. https://says.com/my/news/sun-bears-are-getting-slaughtered-in-sarawak (accessed 20 Jun 2019)

Bedi RS (2019) Perhilitan still taking statement of singer who kept sun bear in apartment. The Star Online. www.thestar.com.my/news/nation/2019/06/10/perhilitan-still-taking-statement-of-singer-who-kept-sun-bear-in-apartment/#mueZL2ug6boGlqcC.99 (accessed 10 Jun 2019)

Brodie JF, Giordano AJ, Zipkin EF, Bernard H, Mohd-Azlan J, Ambu L (2015) Correlation and persistence of hunting and logging impacts on tropical rainforest mammals. Conserv Biol 29:110–121

Burgess EA, Stoner SS, Foley KE (2014) Bring to bear: an analysis of seizures across Asia (2000–2011). TRAFFIC, Petaling Jaya, Selangor

Challender DWS, MacMillan DC (2014) Poaching is more than an enforcement problem. Conserv Lett 7:484–494

Chu MM (2017) Black day for animal lovers in Malaysia (graphic content). The Star Online. https://www.thestar.com.my/news/nation/2017/12/25/black-day-for-animal-lovers-in-malaysia-graphic-content/#XMKXI4DUEmZiubF2.99 (accessed 20 Jun 2019)

Crudge B, Wilkinson NM, Do VT, Cao TD, Cao TT, Weegenaar A, Hunt M (2016) Status and distribution of bears in Vietnam, 2016. Tech Rep, Free the Bears/Animals Asia, Vietnam

Crudge B, Lees C, Hunt M, Steinmetz R, Fredriksson G, Garshelis D (eds) (2019) Sun bears: global status review & conservation action plan, 2019–2028. IUCN SSC Bear Specialist Group/IUCN SSC Conservation Planning Specialist Group/Free the Bears/TRAFFIC

Crudge B, Nguyen T, Cao TT (2020) The challenges and conservation implications of bear bile farming in Viet Nam. Oryx 54:252–259

Derraik JGB, Phillips S (2010) Online trade poses a threat to biosecurity in New Zealand. Biol Invasions 12:1

Foggin JM (2018) Environmental conservation in the Tibetan Plateau Region: lessons for China's belt and road initiative in the mountains of Central Asia. Land 7:52

Foley KE, Stengel CJ, Shepherd CR (2011) Pills, powders, vials and flakes: the bear bile trade in Asia. TRAFFIC, Petaling Jaya, Selangor

Gomez L (2019) An update on the bear bile trade in Peninsular Malaysia. TRAFFIC, Southeast Asia Regional Office, Petaling Jaya

Gomez L, Shepherd CR (2018) Trade in bears in Lao PDR with observations from market surveys and seizure data. Glob Ecol Conserv 15:e000415

Gomez L, Shepherd CR (2019) Bearly on the radar — an analysis of seizures of bears in Indonesia. Eur J Wildl Res 65(6)

Gomez L, Shepherd CR, Morgan M (2019) Revealing the online trade of sun bears in Indonesia. Traffic Bull 31(2)

Gray TNE, Hughes AC, Laurance WF, Long B, and others (2018) The wildlife snaring crisis: an insidious and pervasive threat to biodiversity in Southeast Asia. Biodivers Conserv 27:1031–1037

Harrison JR, Roberts DL, Hernandez-Castro JC (2016a) Assessing the extent and nature of wildlife trade on the darkweb. Conserv Biol 30:900–904

Harrison RD, Sreekar R, Brodie JF, Brook S and others (2016b) Impacts of hunting on tropical forests in Southeast Asia. Conserv Biol 30:972–981

Heinrich S, Whittman TA, Ross JV, Shepherd CR, Challender DWS, Cassey P (2017) The global trafficking of pangolins: a comprehensive summary of seizures and trafficking routes from 2010–2015. TRAFFIC, Southeast Asia Regional Office, Petaling Jaya

Hubschle A, Shearing C (2018) Ending wildlife trafficking: local communities as change agents. The Global Initiative Against Transnational Organised Crime, Switzerland

IFAW (International Fund for Animal Welfare) (2011) Killing with keystrokes 2.0: IFAW's investigation into the European online ivory trade. https://bit.ly/2H4u61Q

Krishnasamy K, Shepherd CR (2014) A review of the sun bear trade in Sarawak, Malaysia. Traffic Bull 26:37–40

Jeffrey S (2019) Armed unit to tackle poaching. Daily Express. www.dailyexpress.com.my/news/145475/armed-unit-to-tackle-poaching/ (accessed 27 Dec 2019)

Lavorgna A (2014) Wildlife trafficking in the internet age. Crime Science 2014(3):15

Lee SL, Burgess EA, Chng SCL (2015) Hard to bear: an assessment of trade in bear bile and gall bladder in Malaysia. TRAFFIC, Petaling Jaya, Selangor

Ling S (2019) Wildlife parts seized in Sarawak. The Star Online. www.thestar.com.my/news/nation/2019/10/10/wildlife-parts-seized-in-swak (accessed 10 Jun 2019)

Livingstone E, Shepherd CR (2014) Bear farms in Lao PDR expand illegally and fail to conserve wild bears. Oryx 50: 1–9

Livingstone E, Gomez L, Bouhuys J (2018) A review of bear farming and bear trade in Lao People's Democratic Republic. Glob Ecol Conserv 13:e00380

Meijard E (1999) Human imposed threats to sun bears in Borneo. Ursus 11:185–192

Mills J, Servheen C (1994) The Asian trade in bears and bear parts. TRAFFIC USA

Nijman V, Oo H, Shwe NM (2017) Assessing the illegal bear trade in Myanmar through conversations with poachers: topology, perceptions and trade links to China. Human dimensions of wildlife. Traffic Bull 27:44–46

Or OC, Gomez L, Lau CF (2017) Recent reports of sun bear seizures and poaching in Malaysia. International Bear News, Summer 2017, Vol 26, No. 2

Pathak N (2006) Community conserved areas in South Asia. Parks, Community Conserved Areas 2006, Vol 16, No 1

Pereira D, Loh R, Bonfiglio MB (2002) The bear trade in Malaysia: the bear gall bladder and bear bile trade in tra-

ditional Chinese medicine shops in Malaysia. WPSA, UK; www.worldanimalprotection.ca/sites/default/files/media/ca_-_en_files/bearbilemalaysia_tcm22-2714.pdf

Roe D, Booker F (2019) Engaging local communities in tackling illegal wildlife trade: a synthesis of approached and lessons for best practice. Conserv Sci Practice 2019:e26

Scotson L, Fredriksson G (2016) *Helarctos malayanus.* The IUCN Red List of Threatened Species. Version 2019-3

Scotson L, Fredriksson G, Augeri D, Cheah C, Ngoprasert D, Wai-Ming W (2017) *Helarctos malayanus* (errata version published in 2018). The IUCN Red List of Threatened Species 2017: e.T9760A123798233 (downloaded 20 Aug 2018)

Shepherd CR, Nijman V (2008) The trade in bear parts from Myanmar: an illustration of the ineffectiveness of enforcement of international wildlife trade regulations. Biodivers Conserv 17:35–42

Symes WS, Edwards DP, Miettinen J, Rheindt FE, Carrasco R (2018) Combined impacts of deforestation and wildlife trade on tropical biodiversity are severely underestimated. Nat Commun 9:4052

Then S (2019) Illegal wildlife farm in Sibu busted. The Star Online. www.thestar.com.my/news/nation/2019/10/17/illegal-wildlife-farm-in-sibu-busted (accessed 12 Dec 2019)

Tilker A, Abrams, JF, Mohamed A, Nguyen A and others (2019) Habitat degradation and indiscriminate hunting differentially impact faunal communities in the Southeast Asian tropical biodiversity hotspot. Commun Biol 2:396

TRAFFIC (2019) Malaysia's newly launched enforcement operation showing promising results to protect wildlife. https://www.traffic.org/news/malaysias-newly-launched-enforcement-operation-showing-promising-results-to-protect-wildlife/ (accessed 2 Jan 2020)

Veno J (2019) Sun bear rescued from longhouse in Betong. Borneo Post. https://www.theborneopost.com/2019/11/14/sun-bear-rescued-from-longhouse-in-betong/ (accessed 12 Dec 2019)

Voigt M, Wich SA, Ancrenaz M, Meijaard E, and others (2018) Global demand for natural resources eliminated more than 100,000 Bornean orangutans. Curr Biol 28: 761–769

Willcox D, Minh NDT, Gomez L (2016) An assessment of trade in bear bile and gall bladder in Viet Nam. TRAFFIC, Petaling Jaya, Selangor

Wong ST (2006) The status of Malayan sun bear in Malaysia. In: Japan Bear Network (compiler) Understanding Asian bears to secure their future. Japan Bear Network, Ibaraki, p 66–72

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ORIGINAL ARTICLE

Bear trade in the Czech Republic: an analysis of legal and illegal international trade from 2005 to 2020

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Abstract

There is a large demand for bear parts in the Czech Republic, and this drives legal and illegal trade in various bear species sourced from outside the country. From 2010 to 2018, the Czech Republic reported legal imports of 495 bear parts, mostly as trophies from Canada and Russia. Illegal trade in bear parts and derivatives for medicine as well as trophies persists as evidenced by the number of seizures made by the Czech Environmental Inspectorate during this same period. From January 2005 to February 2020, 36 seizures involving bears, their parts and derivatives, were made totalling 346 items. Most cases involved trophies (skins, skulls, taxidermies) predominantly from Canada, Russia and the USA, followed by traditional medicines claiming to contain bear parts mostly from Vietnam and China. Three cases involved souvenirs or jewellery, and one case involved live bear cubs. The greatest number of seizures made originated from Vietnam, followed by Canada and Russia. As all countries involved in these incidents are Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), there is a mechanism in place to jointly tackle this illegal trade. International collaboration is essential if efforts to end the illegal international trade in bear parts and derivatives are to succeed.

Keywords Bears · CITES · Seizures · Traditional medicine · Trophy hunting · Wildlife trade

Introduction

The unsustainable and illegal trade in wildlife has become a leading impediment to the preservation of biodiversity (van Uhm 2016; WWF 2018; UNODC 2020). Illegal wildlife trade involves multiple source, transit and destination countries, impacting species on a global scale. The incessant demand for and high commercial value of wildlife as pets, food, traditional medicines, luxury goods, ornaments, trophies, etc. is driving the declines and extinctions of an ever-expanding list of species (Harrison et al. 2016; Voigt et al. 2018; Stanford et al. 2020). Tigers, for example, coveted for traditional medicinal use and trophies, are on the brink of extinction (Wong and Krishnasamy 2019), and depletion of Asian pangolin species has resulted in the over-harvesting and illegal trafficking of African pangolins in tremendous volumes (Challender et al. 2016; Gomez et al. 2016; Heinrich et al. 2016). Lesser studied species such as tortoises and freshwater turtles, amphibians and songbirds are being silently extinguished for the exotic pet trade (Auliya et al. 2016; Lee et al. 2016; Nijman et al. 2019; Shepherd et al. 2019; Stanford et al. 2020). The list of species threatened by illegal and unsustainable trade is growing, and among these species in peril are bears.

There are only eight extant species of bears in the world, all of which are affected by wildlife trade, although some more than others. Bears are hunted for their gall bladder and bile coveted in traditional Asian medicine, their meat and paws are considered by some to be delicacies and their parts are prized as trophies (Foley et al. 2011; Burgess et al. 2014). Live bears are also hunted for the pet trade, to stock bear bile extracting facilities (misleadingly known as bear farms), for wildlife

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exhibitions and performances, bear baiting, etc. (Gupta et al. 2007; D'Cruze et al. 2011; Livingstone et al. 2018). The demand for bears is high and fuels both a legal and black market trade in bear species that are having detrimental impacts on wild populations. This is particularly evident in the Asian region, where bear species are legally protected throughout their range. The illegal wildlife trade has been identified as the leading threat to bears, especially the Asiatic black bear *Ursus thibetanus*, sloth bear *Melursus ursinus* and sun bear *Helarctos malayanus* (Mills and Servheen 1994; Shepherd and Nijman 2007; Burgess et al. 2014; Gomez et al. 2020).

The illegal trade of bears in Asia has been well documented including the international trafficking of bears from Asia to other parts of the world (Foley et al. 2011; Burgess et al. 2014; Lee et al. 2015; Willcox et al. 2016; Nijman et al. 2017; Crudge et al. 2018; Gomez and Shepherd 2018; Gomez and Shepherd 2019). While we know the trade in bears is prevalent outside of Asia, it remains poorly understood in terms of its extent, legality as well as trade dynamics. According to Burgess et al. (2014), the USA and New Zealand have seized a significant number of shipments containing illegal bear items, mainly derivatives, exported from Asia (69% and 50%, respectively, of all their bear-related seizures). Its scale and magnitude, however, is unknown, although it is believed to be largely fuelled by the demand for traditional medicine products by Asian communities in these countries (Burgess et al. 2014). Europe is considered one of the biggest importers of bear trophies which are reportedly leading to unsustainable levels of trophy hunting in some places, but the extent of the impact is unclear (Gaius 2018).

Recent anecdotal information has also revealed an illegal trade in bear parts and derivatives in the Czech Republic. The only bear species in the Czech Republic is the brown bear *Ursus arctos*, though the population has been greatly decimated by hunting during the seventeenth and eighteenth century, and its continued existence in this country is uncertain (McLellan et al. 2017). Nevertheless, brown bears in the Czech Republic are afforded the highest level of protection, and no hunting is permitted. It is uncertain what is driving the trade in bear parts in the Czech Republic or where they are being sourced from. Clearly further study is warranted to understand the dynamics and potential threat to bears including possible illegal trade emanating from Asia.

Here we analyse seizures of bears, bear parts and derivatives, to determine the role of the Czech Republic in the illegal trade of bears and make recommendations to disrupt the trade. We also examine the legal import of bear parts and derivatives into the Czech Republic to gauge the overall size of the import of bears into the Czech Republic and to better understand the demand.

Legislation regulating the trade in bears in the Czech Republic

All eight of the world's extant bear species are listed in the Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), to which the Czech Republic is a Party. CITES is implemented and enforced in the Czech Republic under the Czech CITES Act 100/2004 on protection of wild species of flora and fauna by regulating the trade with them and about other measures for their protection (also known as the Act on trade in endangered species). Penalties for smuggling bear parts and derivatives into the Czech Republic depend on the species involved. Illegal trade involving a bear species listed in Annex A of EU Council Regulation (EC) No. 338/97 (all bear species excluding American black bear *Ursus americanus* and polar bear *Ursus maritimus*) is a criminal offence and is punishable with imprisonment of up to 3 years, confiscation of the specimen(s) and a ban of activities associated with the offence. If the accused acted as a member of an organized group, the maximum prison sentence is increased to up to 5 years. If the group operated internationally, the maximum prison sentence is further increased to between 2 and 8 years. If the violation involved 25 or more specimens of a species listed in Annex B (i.e., American black bear and polar bear), the case is prosecuted in accordance with the regime for illegal trade of Annex A species.

Cases involving Annex A species are prosecuted by police or customs, and in these cases, the Czech Environmental Inspectorate usually carries out the initial investigation, identifies illegal activities and provides expert opinions for courts. The Czech Environmental Inspectorate is one of the main enforcement agencies (together with the customs and national park authorities) responsible for investigation, identification of law offences and law enforcement in the field of nature conservation and CITES. Cases involving Annex B species are prosecuted by the Czech Environmental Inspectorate. If the state attorney or a judge considers that the offence posed little risk to the community, the case is treated as a civil law offence, punishable with a fine of up to CZK1,500,000 (approx. USD66,180) and confiscation of the specimen(s). The Czech Environmental Inspectorate also prosecutes cases considered as civil law offences, including cases involving countries within or outside the EU (maximum fine of CZK1,500, 000 (approx. USD66,180) and confiscation of the specimen(s)) and poaching or illegal trade of local Czech bear specimens (maximum fine of CZK100,000 (USD4400)). If the offender is a corporation, the maximum fine is CZK2,000,000 (USD88,241).

Brown bears are protected under various pieces of legislation in the Czech Republic. As a native species, it is protected under the Nature and Landscape Conservation Act (114/1992) and as a CITES-listed species under the national CITES Act

(100/2004) and EU-related CITES legislation (EC 338/97 and related implementing pieces of legislation). Under the Nature and Landscape Conservation Act, the killing of brown bears in the Czech Republic is prohibited, as is possession of live brown bears or any parts or derivatives of a brown bear without special permit granted by government and violations are punishable by imprisonment for up to 3 years, prohibition of activity or confiscation of belongings.

Methods

We looked at seizure records provided by the Czech Environmental Inspectorate as the CITES enforcement focal point of the Czech Republic, from January 2005 to February 2020, as well as associated prosecution records, which included details of individuals arrested/prosecuted, volumes and origins of shipments seized. Based on this, we analysed the type and source of the contraband and the country or territory of origin reported in each instance.

As the Czech Republic is a Party to CITES, we also accessed the CITES Trade Database for the years 2005 to 2018 (2018 is the most recent data available at the time of writing), to determine which countries are important sources of legal and illegal bear parts and derivatives for the Czech Republic and to identify the most commonly imported bear derivatives to the Czech Republic. When interrogating the CITES Trade Database, we examined all records of import into the Czech Republic of Ursidae, looking at all sources and all purpose codes.

We also used the data to determine if native brown bears are appearing in seizures made in the Czech Republic.

Results

Illegal trade

From January 2005 to February 2020, there were a total of 36 seizures involving various bears species, their parts and derivatives, totalling 346 items in the Czech Republic (Table 1). Most cases (n = 19) involved trophies (skins, skulls, taxidermies), followed by traditional medicines (n = 13). Three cases involved souvenirs or jewellery, one involved live bear cubs and in two cases the items seized were not reported. In six cases, the items, all trophies, were returned once the required paperwork was provided (Fig. 1).

Seizures were made of products coming from eight countries and territories, outside of the Czech Republic (Table 2). For two cases, the sources were unknown or not reported and involved one trophy (whole bear taxidermy) and 187 bear bile vials. The greatest number of seizures (n = 9) were made of products coming from Vietnam. The majority of items seized were manufactured bear bile medicines (5 incidents, 36 items) followed by gall bladder (2 incidents, 2 gall bladders) and jewellery made from bear teeth (2 incidents, 2 bear teeth pendants).

After Vietnam, the greatest number of cases involved bear parts coming from Canada and Russia with seven seizures each. All cases involving Canada were of the skulls and skins and one bear taxidermy. Most seized parts were of American black bears (6 incidents amounting to 8 animals), with the exception of two polar bear skulls seized in one incident in 2018. Cases involving Russia were mostly of trophies (i.e. skins and skulls) (5 incidents amounting to 6 brown bears) followed by one case involving three packages each containing ten bear bile pills (species unknown) and one case involving two live brown bear cubs. The two cubs were seized in 2017 and were the only live bears reported in this dataset. In four of the 14 cases involving Canada and Russia, the seized commodities were returned as the required paperwork was later provided.

The remaining incidents involved China (n = 2), the Czech Republic (n = 2), the USA (n = 4), Georgia (n = 1), Hong Kong (n = 1), Slovakia (n = 1) and two of unreported origin.

Legal trade

According to the CITES Trade Database, between 2005 and 2018, there were 221 records relating to imports of bears, their parts and derivatives to the Czech Republic involving at least six species of bear, i.e. American black bear, brown bear, polar bear, Asiatic black bear, sloth bear and sun bear. The majority of imports were from Canada (67.4%) followed by Russia (14%) (Table 3). Other countries exporting bears and parts to the Czech Republic included Croatia (4.0%), India (0.9%), Greenland (0.45%), Myanmar (0.9%), Norway (0.9%), Romania (2.7%), Switzerland (1.4%), Tajikistan (0.45%), Tunisia (0.45%), Ukraine (0.45%), the USA (5.4%) and Vietnam (0.45%) (Fig. 2).

Of the 221 import records involving bears into the Czech Republic, 93.2% were of bear trophies encompassing whole bears and their parts (bones, claws, feet, genitalia, meat, skins and skulls) amounting to between 639 items (importer reported quantities) and 1018 items + 92.7 kg of meat (exporter reported quantities) (Table 3). This comprised three bear species, American black bear (103 records), brown bear (62 records) and polar bear (41 records). Needless to say, the majority of these were from wild bears with the exception of four records (3 from the USA and 1 from Canada) which reported the source and seized (sourced code I) and seven records (5 from Canada and 2 from Russia) that were pre-convention specimens (source code O). Bear trophies were imported predominantly under three purpose codes, i.e. hunting trophy (H), 106 records; personal (P), 61 records; and

Table 1 Bear commodities seized in the Czech Republic from January 2005 to February 2020 including origins of commodities seized and total quantities seized of each commodity

Commodity seized	Origin										Total
	CA	CN	CZ	GE	HK	RU	SK	US	VN	Unknown	
Pet											
Live (cubs)						2					2
Souvenir/Jewellery											
Claw (pendant)								1			1
Tooth (gold pendant)									1		1
Tooth (silver pendant)									1		1
Traditional medicine											
Bear bile (cream)					22				5		27
Bear bile (suppository)		35									35
Bear bile (vials)						30			31	187	248
Bear bile in vodka			1								1
Gall bladder									2		2
Trophy											
Skin	7					1		2			10
Skin (tanned)			1			2	1				4
Skin (untanned)							1				1
Skull	6					2		1			9
Taxidermy (whole)	1									1	2
Unknown				1		1					2
Total	14	35	2	1	22	38	2	4	40	188	346

CA Canada, *CN* China, *CZ* Czech Republic, *GE* Georgia, *HK* Hong Kong, *RU* Russia, *SK* Slovakia, *US* USA and *VN* Vietnam

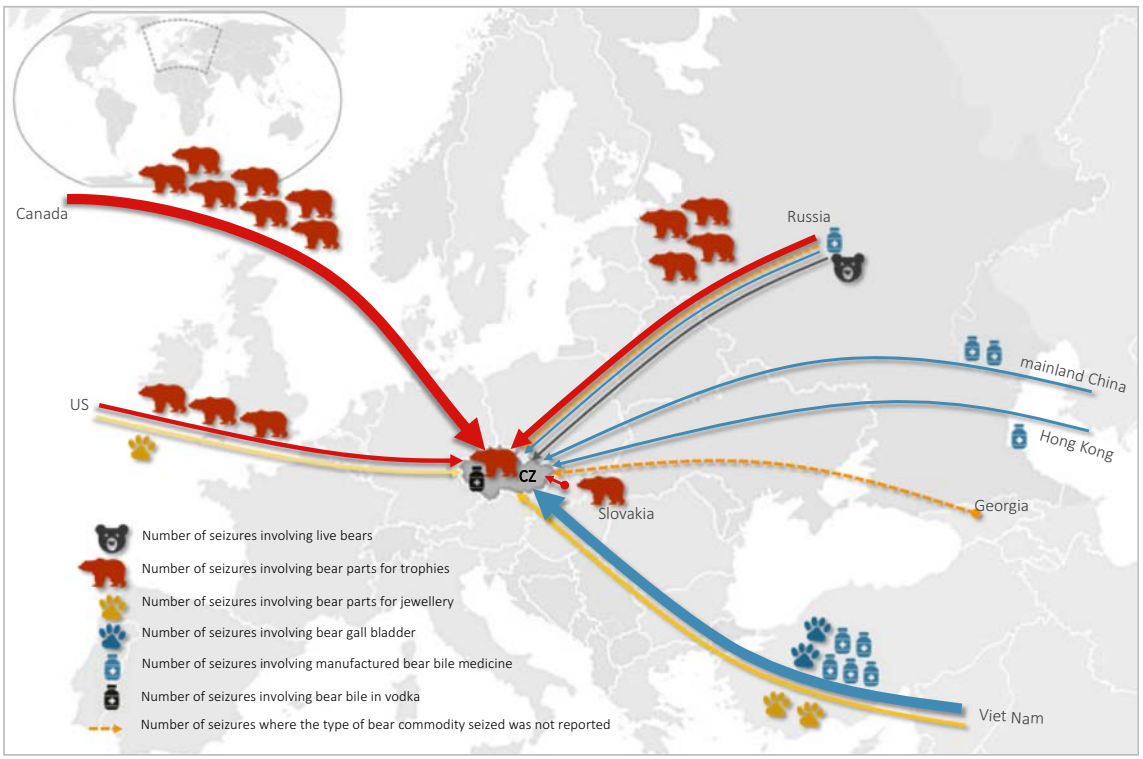

Fig. 1 The number of seizure records involving bears, their parts and derivatives that occurred in the Czech Republic from 2005 to February 2020, including origins of seized shipments and the commodities seized in each incident. Not included in this figure are quantities of each commodity seized, which are referred to in Table 1

Table 2 The countries implicated in the trafficking of bear parts to the Czech Republic including frequency of shipments originating from these countries from 2005 to February 2020

Origins of commodity seized	Commodity*	Number of seizures	Species identified	Outcome/penalty
Canada	Skull, skin, bear taxidermy	7	American black bear polar bear	-In three cases, seized items were returned once required documents were provided-Only three cases resulted in fines, i.e. CZK2000 (~ USD90), CZK5000 (~ USD220) and CZK20 000 (~ USD885) (Polar Bear skulls along with 1 walrus skull and 1 whale skull)
China	Bear bile suppositories	2	Unknown	-Both cases resulted in fines of CZK1000 (~ USD45)
Czech Republic	Bear bile in vodka, skin	2	Brown bear	-The seized skin was returned as proper documentation was later provided-A fine of CZK2000 (~ USD90) for seized bear bile in vodka
Georgia	Unknown	1	Unknown	-A bear item was seized, but no other details reported
Hong Kong	Bear bile cream	1	Unknown	-A fine of CZK2200 (~ USD100)
Russia	Bear bile, live, skins, skull	7	Brown bear	-In one case, seized item was returned once proper documentation was provided -Only three cases involving the skins and skull resulted in fines, CZK3000 (~ USD130), CZK4000 (~ USD180) and CZK5000 (~ USD220) -One case still ongoing
Slovakia	Skins	1	Unknown	-Skins seized, but no other details reported
Unknown	Bear bile vials, stuffed	2	American black bear (stuffed)	-No details reported
USA	Claw pendant, skin, skull	4	American black bear, brown bear	-In one case, seized item was returned once proper documentation was provided -Two cases involving the skins and skull resulted in fines, CZK1000 (~ USD45) and CZK500 (~ USD20) -One case still ongoing
Vietnam	Bear bile, gall bladder, jewellery	9	Asiatic black bear brown bear	-six cases resulted in fines ranging from CZK1000 to CZK5000 (~ USD45–USD220) -Two cases still ongoing

*Refer to Table 1 for detailed breakdown of commodities seized and quantities

commercial (T), 24 records. Canada was the greatest exporter of hunting trophies to the Czech Republic (70.1% of records) followed by Russia (13.1% of records) and the USA (5.3% of records), while the greatest number of trophy items were from Canada, Russia and Croatia (Table 3).

To a lesser extent, live bears were also imported into the Czech Republic in at least 13 records involving six bear species and ranging from 15 (importer reported quantities) to 16 (exporter reported quantities) animals (Table 3). There were eight countries that exported live bears to the Czech Republic, of which, Russia had the highest number of records (n = 4) and then India (n = 2) and Myanmar (n = 2). The remaining countries were Switzerland, Romania, Tajikistan, Tunisia and the USA with one record each. Live bears were imported primarily under purpose code Z, zoos (8 records) followed by Q, circus/travelling exhibition (3 records); B, captive breeding (1 record); and T, commercial (1 record). Most live bears were declared as source code C, implying captive bred animals (5 records); W, wild-caught (5 records) followed by F, born in captivity (3 records).

There were also two import records in 2010 of bear derivatives from Ukraine (0.15 L) and Vietnam (2.75 kg), although the source of both items was reported as seized (source code I).

Discussion and recommendations

There is clearly a demand for bear parts and derivatives in the Czech Republic which fuels the trade in various bear species though this does not appear to be sourced from local populations of brown bears in the country. Bear trophies are the main driver of demand as evident by the number of records of the claws, skulls and skins imported by the Czech Republic within the CITES Trade Database and by the seizure of the skins, skulls and taxidermy products. The number of claws exported to the Czech Republic is noteworthy (Canada reported exporting 343 claws to the Czech Republic), and it is assumed these are for talismans or jewellery. Canada and Russia are the biggest exporters of trophies to the Czech Republic both legally and illegally. It is unclear why trophies that can be legally imported were smuggled into the country unless they were illegally acquired in the country of origin. This is not without merit considering both countries have been previously implicated in the international trafficking of bears and their

Table 3 Import records of bears and their parts into the Czech Republic from 2005 to 2018 including importer and exporter reported quantities, which have been extracted from the CITES Trade Database

	CA		CH		GL		HR		IN		MM		NO		RO		RU		TJ		TN		UA		US		VN	
	IR	ER	IR	ER	IR	ER	IR	ER	IR	ER	IR	ER	IR	ER	IR	ER	IR	ER	IR	ER	IR	ER	IR	ER	IR	ER	IR	ER
Helarctos malayanus																												
Live											2	2																
Melursus ursinus																												
Live									2	3																		
Ursus americanus																												
Bodies		1																										
Bones	2	2																										
Claws	275	345																										
Feet		4																										
Genitalia		1																										
Live																									1	1		
Meat (kg)		92.7																										
Skin (pieces)	3	4																							3			
Skins	23	217																										
Skulls	9	104																							2			
Trophies	59	7																							1	5		
Ursus arctos																												
Bodies			1															1										
Claws	2	2																										
Live			1	1											2	4	3	3	2			1						
Rug																		1										
Skin (pieces)		4																										
Skins		6		1									1	1			4	16										
Skulls		3																										
Trophies	2						33	24							6	21	185	197							7	10		
Ursus maritimus																												
Bodies	2																											
Bones		5																										
Claws						1																						
Live																		1										
Skin (pieces)		8																										
Skins	5	17															1											
Skulls	2	9																										
Trophies	11	1																										
Ursus thibetanus																												
Live																	2											
Unknown sp																												
Derivatives (l/kg)																							0.15				2.75	
Grand total	395	740 + 92.7 kg	2	2		1	33	24	2	3	2	2	1	1	8	25	195	219	2			1	0.15 L		14	16	2.75 kg	

IR importer reported quantities, *ER* exporter reported quantities, *Am* American, *As* Asiatic. Exporting countries: *CA* Canada, *CH* Switzerland, *GL* Greenland, *HR* Croatia, *IN* India, *MM* Myanmar, *NO* Norway, *RO* Romania, *RU* Russia, *TJ* Tajikistan, *TN* Tunisia, *UA* Ukraine, *US* USA, *VN* Vietnam

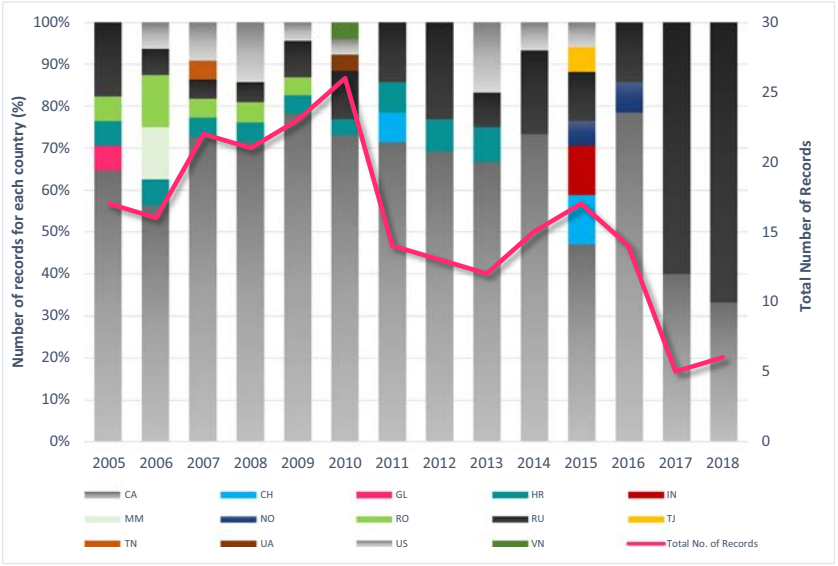

Fig. 2 The number of legal import records of bears and parts into the Czech Republic from 2005 to 2018 and exporting countries: CA, Canada; CH, Switzerland; GL, Greenland; HR, Croatia; IN, India; MM, Myanmar; NO, Norway; RO, Romania; RU, Russia; TJ, Tajikistan; TN, Tunisia; UA, Ukraine; US, USA; VN, Vietnam. This information has been extracted from the CITES Trade Database (https://trade.cites.org/)

parts (Foley et al. 2011; Burgess et al. 2014; Gaius 2018). In 2004, the EU implemented a ban on imports of brown bear trophies from British Columbia over concerns of unsustainable hunting pressure, of which residents of Europe were responsible for 1/3 the total number of bears killed in the province. Despite this, brown bear trophies were reportedly being smuggled into the EU facilitated by the Canadian authorities and trophy hunting industry (Gaius 2018). In Russia, while the hunting of some bears is allowed with a valid permit, bear populations are under threat from poaching and illegal harvest for trade (Braden 2014). Thousands of bear paws have been seized by customs officers at the China-Russia Far East border alone—as recent as November 2019, 240 bear paws were seized by Russian authorities (Stewart 2019); in January 2018, 867 bear paws along with an unknown quantity of bear teeth and claws were seized (Stewart 2018). Nevertheless, much remains unknown on the impact of hunting (i.e. trophy, illegal, etc.) and trade dynamics involving bears from these countries which clearly warrants further investigation.

There also appears to be demand for traditional medicines containing bear parts in the Czech Republic. These medicines are being smuggled in from Asia (primarily Vietnam and to a lesser extent mainland China and Hong Kong) in violation of CITES regulations. Nine of the seizures made had origins in Vietnam, with Vietnamese nationals involved. It is likely all medicines originating from Vietnam contained derivatives of the Asiatic black bear, as this species is the most commonly utilised species in Vietnam's domestic trade in bear bile medicines and the most frequently encountered species in the bear bile extraction facilities (bear farms) in Vietnam (Foley et al. 2011; Willcox et al. 2016). Bear bile in vodka is an unusual item, and this should be investigated further to determine if this is an emerging use for bear bile and what its purpose is. The demand for bear parts in traditional medicines, i.e., gallbladders and bile, is particularly significant in China and Vietnam (Mills and Servheen 1994; Shepherd and Nijman 2007; Foley et al. 2011; Burgess et al. 2014; Davis et al. 2016; Willcox et al. 2016; Gomez and Shepherd 2018). This demand has been the reported cause for bear declines in Cambodia, Lao PDR, Myanmar and Vietnam (Nijman et al. 2017; Crudge et al. 2018). China and Vietnam are also the major sources of processed bear bile medicines, and regardless of policies in place that prohibit the international export of these products, medicines manufactured in both China and Vietnam have been observed illegally for sale in other countries in Asia (Foley et al. 2011; Burgess et al. 2014; Gomez and Shepherd 2018) as well as the USA and Canada (WAP 2020). The Czech Republic has a relatively large Vietnamese community (~close to 60,000 in 2016 - Kim, Kim 2020), and it is therefore not surprising that there is some demand for traditional medicines used in Vietnam. Nevertheless, the trafficking of bear bile medicines from Vietnam is illegal, and steps are urgently needed to mitigate this particularly since it undermines conservation efforts in Vietnam to protect its bear species. Bear bile farming is not only illegal in Vietnam, but studies show that wild bears are poached to restock these facilities in violation of national laws (Crudge et al. 2018). Furthermore, these threats are amplified when considering that these market demands likely exists across the rest of Europe where a significant Asian community is present, as reported in the USA and Canada.

While the maximum penalty for individuals caught smuggling bear parts and derivatives into the Czech Republic is USD66,180, the highest penalty reported in this analysis was USD885, and it should be noted that this offence included multiple species and not only bears. The lowest penalty handed down was USD20, and the average fine was USD175—far below the potential maximum amount and therefore unlikely to be a deterrent. For context, it is necessary to consider the average income in the Czech Republic; in 2005, the average

income was USD13,346, and by 2018, the average income had risen to USD23,069 (https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=CZ). Clearly penalties should be increased if the law is to serve as a deterrent.

The Czech Republic has been a Party to CITES since 1993 and was previously a Party to CITES as part of the former Czechoslovakia since 1992. Notably, seizures of bears, their parts and products, made in the Czech Republic have all originated from CITES Parties as well. While there are no specific bilateral agreements between the Czech Republic and Canada or Russia, there is a 2015 bilateral agreement between the Czech Republic and Vietnam to counter illegal wildlife trade, the *Declaration on Cooperation in the field of CITES implementation*, signed by the Deputy Minister of the Environment of the Czech Republic and the Deputy Minister of Agriculture and Rural Development of Vietnam. This declaration is aimed at improving the sharing of information in implementing CITES and to raise awareness regarding the protection and conservation of wildlife, which therefore includes joint regulation of trade in bear parts and derivatives between the two countries. Of the eight species of bears in the world, six are listed on CITES Appendix I (the exceptions being the American black bear, polar bear and certain populations of the brown bear), prohibiting the international commercial trade in wild animals as markets demands are considered a significant enough threat to the conservation status of remaining populations, all of which are reported to be in decline. Despite this, a black market in bears, their parts and derivatives persists across their range both domestically and internationally. This study shows just how global the threat of illegal wildlife trade is to bear species with the international trafficking of bear parts and derivatives into the Czech Republic from eight countries and territories from as far as Vietnam to neighbouring Slovakia, yet, only a small facet of this illegal trade has been examined outside of Asia.

As the illegal trade in bear parts and derivatives in the Czech Republic is clearly in need of attention, we make the following recommendations:

Monitoring of traditional medicine trade in the Czech Republic Retail outlets selling traditional medicines, especially within communities that are known for using bear parts and derivatives, should be monitored, and all incidents of illegal trade should be prosecuted to the full extent of the law so as to serve as a deterrent. Consumer awareness-raising programmes should be initiated within these communities, especially the Vietnamese community, to ensure the public is aware of the Czech Republic's legislation prohibiting the buying, selling and possessing of bear parts and products. Finally, the Czech Environmental Inspectorate should enhance collaborative efforts with Vietnam's Ministry of Agriculture and Rural Development (MARD) as the CITES Management Authority and CITES Enforcement Focal Point of Vietnam, to jointly tackle the smuggling of bear parts and derivatives from Vietnam to the Czech Republic.

Monitoring of trophies entering the Czech Republic As most cases involved trophies, we recommend the authorities carefully monitor the import of trophies and potential leakage of illegally sourced bears (or restricted bear parts, such as gallbladders) into the trade, especially from Canada and Russia. Both Canada and Russia allow for export of bear trophies, so an investigation into the reasons behind smuggling versus legal trade should be considered. The Czech Environmental Inspectorate should enhance collaborative efforts with the CITES Enforcement Focal Point of Canada (the Wildlife Enforcement Directorate) and the CITES Management Authority of Russia (the Ministry of Natural Resources and Environment of the Russian Federation) to jointly tackle the illegal trade in bear trophies. Discrepancies between numbers of reported imports and reported exports should be investigated further by the CITES Management Authorities of the Czech Republic and relevant exporting countries, especially Canada and Russia.

Strengthened deterrents The government of the Czech Republic should consider handing down larger fines for bear trafficking crimes as current fines are low and are not likely to serve as a deterrent. Ideally, fines should be greater than the value of the contraband.

Raising public awareness to catalyse participation in anti-illegal wildlife trade efforts Raising awareness of the illegal trade in wildlife, and bears in particular, should be increased through public awareness campaigns, such as the Czech Republic's Stolen Wildlife Campaign (http://www.stolenwildlife.org/), to discourage illegal trade and consumption of bears and to encourage the public to report incidents of selling, buying and possession of illegal wildlife, including traditional medicines claiming to contain bear parts, bear trophies such as the skulls and skins and other parts and products derived from bears.

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Data availability Not applicable.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethics approval We declare that there have been no ethical violations in this work.

Consent to participate All authors agreed to participate in this work.

Consent for publication All authors consent to the submission of this manuscript for publication.

Code availability Not applicable.

References

Auliya M, Altherr S, Ariano-Sanchez D, Baard EH, Brown C, Brown RM, Cantu J-C, Gentile G, Gildenhuys P, Henningheim E (2016) Trade in live reptiles, its impact on wild populations, and the role of the European market. Biol Conserv 204:103–119

Braden K (2014) Illegal recreational hunting in Russia: the role of social norms and elite violators. Eurasian Geogr Econ 55(5):457–490

Burgess EA, Stoner SS, Foley KE (2014) Brought to bear: an analysis of seizures across Asia (2000–2011). TRAFFIC, Petaling Jaya, Selangor, Malaysia

Challender D, Baille J, Waterman C, Pietersen D, Nash H, Wicker L, Parker K, Thomson P, Nguyen TV, Hywood L, Shepherd CR (2016) On scaling up pangolin conservation. Traffic Bull 28(1): 19–21

Crudge B, Nguyen T, Cao T (2018) The challenges and conservation implications of bear bile farming in Viet Nam. Oryx 1-8

D'Cruze N, Sarma UK, Mookerjee A, Singh B, Louis J, Mahapatra RP, Jaiswal VP, Roy TK, Kumari I, Menon V (2011) Dancing bears in India: a sloth bear status report. Ursus 22(2):99–105

Davis EO, O'Conner D, Crudge B, Carignan A, Glikman JA, Browne-Nuñez C, Hunt M (2016) Understanding public perceptions and motivations around bear part use: a study in northern Laos of attitudes of Chinese tourists and Lao PDR nationals. Biol Conserv 203: 282e289

Foley KE, Stengel CJ, Shepherd CR (2011) Pills, powders, vials and flakes: the bear bile trade in Asia. TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia

Gaius J (2018) Grizzly trophies in Europe: are B.C. grizzly bear parts being unlawfully imported into the EU? David Suzuki Foundation. https://davidsuzuki.org/wp-content/uploads/2018/07/Grizzly-Trophies-in-Europe-DSF-report-July2018-final.pdf (Accessed 14 May 2020)

Gomez L, Shepherd CR (2018) Trade in bears in Lao PDR with observations from market surveys and seizure data. Glob Ecol Conserv 15(2018):e00415

Gomez L, Shepherd CR (2019) Bearly on the radar – an analysis of seizures of bears in Indonesia. Eur J Wildl Res 65(6). https://doi.org/10.1007/s10344-019-1323-1

Gomez L, Leupen BTC, Tian KH (2016) The trade of African pangolins to Asia: a brief case study of pangolin shipments from Nigeria. Traffic Bull 28(1):3–5

Gomez L, Shepherd CR, Khoo MS (2020) Illegal trade of sun bear parts in the Malaysian states of Sabah and Sarawak. Endanger Species Res 41:279–287. https://doi.org/10.3354/esr01028

Gupta BK, Singh R, Satyanarayan K, Seshamani G (2007) Trade in bears and their parts in India: threats to conservation of bears. In: Williamson, D. (Ed). Proceedings of the fourth international symposium on the trade in bear parts. TRAFFIC East Asia-Japan

Harrison RD, Sreekar R, Brodie JF, Brook S, Luskin M, O'Kelly H, Rao M, Scheffers B, Velho N (2016) Impacts of hunting on tropical forests in Southeast Asia. Conserv Biol 30:972–981

Heinrich S, Wittmann TA, Prowse TAA, Ross JV, Delean S, Shepherd CR, Cassey P (2016) Where did all the pangolins go? International CITES trade in pangolin species. Glob Ecol Conserv 8:241–253

Kim TS (2020) Young migrant Vietnamese in the Czech Republic reflect diasporic contexts in their identification of cultural proximity with Korean media. J Intercult Stud 41(4):524–539

Lee SL, Burgess EA, Chng SCL (2015) Hard to bear: an assessment of trade in bear bile and gall bladder in Malaysia. TRAFFIC. Petaling Jaya, Selangor, Malaysia

Lee JGH, Chng SCL and Eaton JA (2016) Conservation strategy for Southeast Asian songbirds in trade. Recommendations from the first Asian Songbird Trade Crisis Summit 2015 held in Jurong Bird Park, Singapore, 27–29 September 2015. Wildlife Reserves Singapore. TRAFFIC Southeast Asia

Livingstone E, Gomez L, Bouhuys J (2018) A review of bear farming and bear trade in Lao People's Democratic Republic. Glob Ecol Conserv 13(2018):e00380

McLellan BN, Proctor MF, Huber D, Michel S (2017) *Ursus arctos* (amended version of 2017 assessment). The IUCN Red List of Threatened Species 2017: e.T41688A121229971. https://doi.org/10.2305/IUCN.UK.2017-3.RLTS.T41688A121229971.en. Downloaded on 21 March 2020

Mills J, Servheen C (1994) The Asian trade in bears and bear parts: impacts and conservation recommendations. Int Conf Bear Res Manage 9(1):161–167

Nijman V, Oo H, Shwe NM (2017) Assessing the illegal bear trade in Myanmar through conversations with poachers: topology, perceptions and trade links to China. Hum Dimens Wildl 22:172–182

Nijman V, Nekaris KAI, Imron MA (2019) Asian Songbird Crisis also affects unprotected species. Oryx 53:13

Shepherd CR, Janssen J, Noseworthy J (2019) A case for listing the Union Island Gecko Gonatodes daudini in the Appendices of CITES. Glob Ecol Conserv 17:e00549

Shepherd CR, Nijman V (2007) The trade in bear parts from Myanmar: an illustration of the ineffectiveness of enforcement of international wildlife trade regulations. Biodivers Conserv 17:35–42

Stanford CB, Iverson JB, Rhodin AGJ, van Dijk PP, Mittermeier RA et al (2020) Turtles and tortoises are in trouble. Curr Biol 30:R721–R735

Stewart W (2018) Bear and tiger body parts including hacked off tails and genitals are seized from smugglers taking them to China where they are believed to make men better in bed. MailOnline. https://www.dailymail.co.uk/news/article-5340069/Animal-parts-believed-make-men-better-bed-seized.html (Accessed 20 Jan 2018)

Stewart W (2019) Grisly cargo of 240 bear paws which were 'destined for China to be turned into food and traditional medicine' is seized by Russian security agents. MailOnline. https://www.dailymail.co.uk/

news/article-7676875/Grisly-cargo-240-bear-paws-60-illegally-slaughtered-animals-seized.html (Accessed 12 Nov 2019)

UNODC (2020) World Wildlife Crime Report. United Nations Office on Drugs and Crime, 2020

Van Uhm DP (2016) The illegal wildlife trade: inside the world of poachers, smugglers and traders. Springer, Switzerland, 2016

Voigt M, Wich SA, Ancrenaz M, Meijaard E, Abram N, Banes GL, Campbell-Smith G, d'Arcy L, Delgado RA, Erman A, Gaveau D, Goosens B, Heinicke S, Houghton M, Husson SJ, Leiman A, Llano S, Makinuddin N, Marshall A, Meididit A, Miettinen J, Mundry R, Musnanda N, Nurcahyo A, Odom K, Panda A, Prasetyo D, Priadjati A, Purnomo RA, Russon AE, Santika T, Sihite J, Spehar S, Struebig M, Sulbaran-Romero E, Tiiu A, Wells J, Wilson KA, Kuhl HS (2018) Global demand for natural resources eliminated more than 100,000 Bornean Orangutans. Curr Biol 28:761–769

Willcox D, Nguyen MDT, Gomez L (2016) An assessment of trade in bear bile and gall bladder in Viet Nam. TRAFFIC. Petaling Jaya, Selangor, Malaysia

Wong R, Krishnasamy K (2019) Skin and Bones Unresolved: an analysis of tiger seizures from 2000–2018. TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia

World Animal Protection (WAP) (2020) Cruel cures: the industry behind bear bile production and how to end it. https://www.dropbox.com/s/2kzpdkfjn4vh347/Bear%20Bile%20Report_Cruel%20Cures_FINAL_compressed.pdf?dl=0 (Accessed 1 March 2020)

WWF (2018) Living Planet Report - 2018: Aiming Higher. Grooten, M. and Almond, R.E.A.(Eds). WWF, Gland, Switzerland

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An analysis of the illegal bear trade in India

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ABSTRACT

Throughout the range of bears in Asia, a combination of threats - loss of suitable habitat, increasing human conflict, illegal wildlife trade - are pushing bear populations towards extinction. But studies in Asia are showing that indiscriminate poaching and illegal trade are increasingly becoming the main driver of species extinctions. Here we examine seizure data and poaching incidents involving India's bear species from 2009 to 2019 to assess the extent illegal wildlife trade is impacting bear populations in the country. The Wildlife Protection Society of India (WPSI) systematically collects data on poaching and seizures of protected species which is collated, categorised and stored in WPSI's database on wildlife crime. Using this data, we assessed bear species impacted by trade, mapped out important trade and poaching hubs, and trade dynamics involving bears in India. Seizure data indicated the exploitation of Asiatic black bears for traditional medicine use while sloth bears were coveted for their skins. Poaching incidents predominantly involved sloth bears and steadily increased over the study period. However, it is unclear whether this is a result of targeted hunting of bears for trade, a threat possibly exacerbated by declining bear species elsewhere in Asia where demand still persists for bear gall bladder and parts; or in response to growing levels of human-bear conflict which is on the rise in India due to loss of suitable habitat and increasing human encroachment into forested areas. This study shows that despite being a strictly protected species in India, there is still a threat to bears from illegal trade. Greater effort is needed to protect bear habitat and reduce retaliatory killing of bears which impedes conservation efforts to reduce the illegal exploitation of bears for trade. Enforcement capacity and resources also need to be improved and must encompass intelligence-led investigations and cross-border cooperation between enforcement agencies to target buyers and traders. The trade in bears and their parts should be consistently monitored on a national scale to support effective law enforcement interventions and conservation initiatives to reduce the levels of poaching of bears in India.

1. Introduction

Widespread poaching for illegal trade has been described as a major driver in the decline of bear populations throughout Asia (Shepherd and Nijman, 2007; Foley et al., 2011; Burgess et al., 2014; Lee et al., 2015; Willcox et al., 2016; Nijman et al., 2017;

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Or et al., 2017; Crudge et al., 2018; Gomez and Shepherd, 2018). Bears are in high demand as they are hunted for their gall bladders and bones used in traditional medicine; meat and paws that serve the exotic food industry; claws, teeth, skin and skull coveted as trophies; and cubs kept as pets or supplied to bear bile extracting facilities (Foley et al., 2011; Burgess et al., 2014; Livingstone et al., 2018; Gomez and Shepherd, 2019). Apart from the giant panda *Ailuropoda melanoleuca*, all bear species found in Asia are at high risk from illegal trade. Three of these species, the Asiatic black bear *Ursus thibetanus*, sun bear *Helarctos malayanus* and sloth bear *Melursus ursinus* are currently listed as Vulnerable on the IUCN Red List of Threatened Species with populations considered to be in decline across their range (Garshelis and Steinmetz, 2016; Scotson et al., 2017; Dharaiya et al., 2020), while the brown bear *Ursus arctos* is listed as Least Concern with populations considered to be stable for the most part (McLellan et al., 2017).

The poaching and exploitation of wildlife in India for illegal trade is considerable and widespread (WWF, 2014). Seizures of live animals and parts are reported daily throughout the country involving a long list of species including deer, elephants, leopards, mongoose, pangolins, tortoises and freshwater turtles, tigers, rhinos, seahorses, snakes and monitor lizards (WWF, 2014; Arun, 2019; Badola et al., 2019; Chatterjee, 2019; UNEP, 2019; Wong and Krishnasamy, 2019). Bears are no exception (Sethy and Chauhan, 2011; Burgess et al., 2014; Gupta et al., 2007; Sathyakumar et al., 2012; Zaugg and Suri, 2019). India is home to four of the world's eight bear species, the Asiatic black bear, sun bear, sloth bear and the Himalayan brown bear *Ursus arctosisa bellinus* (Fig. 1).

The main threat to bears in India is habitat loss, degradation and fragmentation due to rapid development throughout the country. This is exacerbated by retaliatory killings due to human-bear conflict and targeted hunting of bears to supply a black-market trade in their parts coveted as trophies or for traditional medicine, and their meat consumed in some parts of India (Sethy and Chauhan, 2011; Sathyakumar et al., 2012). Bear cubs, predominantly sloth bears, are also captured to be trained as dancing/performing bears. In the mid-1990s, it was estimated that there were more than 1200 performing bears on the streets of India. Sloth bears have been exploited and traded for this use for hundreds of years, although it has decreased as a threat in recent years (D'Cruze et al., 2011; Wildlife Protection Society of India, unpublished data).

A survey of bear parts in trade in the state of Arunachal Pradesh between 2007 and 2009 revealed open sale of carcasses, skulls, canines, paws, claws, skins, gall bladders and derivatives (Sethy and Chauhan, 2011). During an analysis of seizure data involving bears across Asia between 2000 and 2011, India reported 23 seizure incidents that involved live bears and gall bladders (Burgess et al., 2014). There have also been reports of international trafficking of bear gall bladders from India into Japan as far back as 1981 as well as into Singapore and Taiwan (Mills and Servheen, 1991), China and Myanmar (Sethy and Chauhan, 2011) and Nepal (Burgess et al., 2014). In 2012, a National Bear Conservation and Welfare Action Plan was developed to address State specific needs for the conservation of all four bear species in India covering a 5-year period (Sathyakumar et al., 2012). The aim of the Plan was to ensure stable status of all bear species through enhanced protection of bears from illegal trade, mitigation of bear-human conflicts, habitat management, increased research and monitoring, enhanced capacity development, increased awareness and education on bears, and stronger policy and legislation.

Yet, a recent arrest of a notorious wildlife poacher in October 2019 exemplified that the illegal trade of bears in India is still a persistent threat to bear populations (Zaugg and Suri, 2019). However, the extent of the illegal trade in bears in India remains poorly documented as do the results of efforts made to counter this trade. In this study we attempt to address this knowledge gap through an analysis of seizure and poaching data in an effort to understand the impact of illegal trade on wild bear populations and identify/prioritise enforcement and conservation efforts to end the illegal exploitation of bear species in India.

2. Protection status

Wildlife protection in India falls under the Indian Wild Life (Protection) Act 1972, which has been amended several times i.e. 1991, 2002, 2003 and 2006 to include new species, higher penalties, stronger protection for tigers, among other things.

All four bear species found in India are protected. The sun bear and sloth bear are listed in Schedule I of the Act, Asiatic black bear in Part II of Schedule II, while the brown bear is listed in both Schedule I and Part II of Schedule II (likely due to an error). Nevertheless, the same regulations apply to both Schedules with respect to penalties and fines. Listing on both/either Schedules essentially prohibits hunting, killing, unlicensed possession, unlicensed transport, and any mode of transfer, apart from inheritance, of the listed species or products thereof, i.e. trophies, meat, animal articles, etc. Domestic and international trade or commerce, in these species and their derivatives is therefore prohibited. Schedule I and II listed species can only be hunted in very special circumstances. With Schedule I species this is only authorised by the Chief Wildlife Warden if they are a threat to human life or are diseased/disabled beyond recovery. The same applies to Schedule II species with the addition that hunting may also be allowed by the Chief Wildlife Warden or an authorised officer if the animal poses a threat to property such as standing crops. Permits can also be issued by the Chief Wildlife Warden to hunt (hunt is defined to include any capture) bears for the purpose of education, scientific research or scientific management (without killing animals). However, for these permits, prior Central Government approval is required for Schedule I species and State Government approval is required for Schedule II species. Offences related to wildlife listed in Schedule I and Part II of Schedule II are punishable with imprisonment between a minimum of 3 years and a maximum of 7 years as well as a fine of no less than INR10K (USD140). In the case of a second of subsequent offences, the imprisonment term remains the same but the fine increases to a minimum of INR25K (USD349).

Captive breeding of bears is only allowed if it is conducted by recognised zoos as per the rules that apply to them. It is theoretically possible for a private individual to legally own/possess a bear if a declaration was made and ownership certificate obtained when the species were first listed in the Schedules (1986 for Himalayan brown bear and sloth bear, 1980 for sun bear

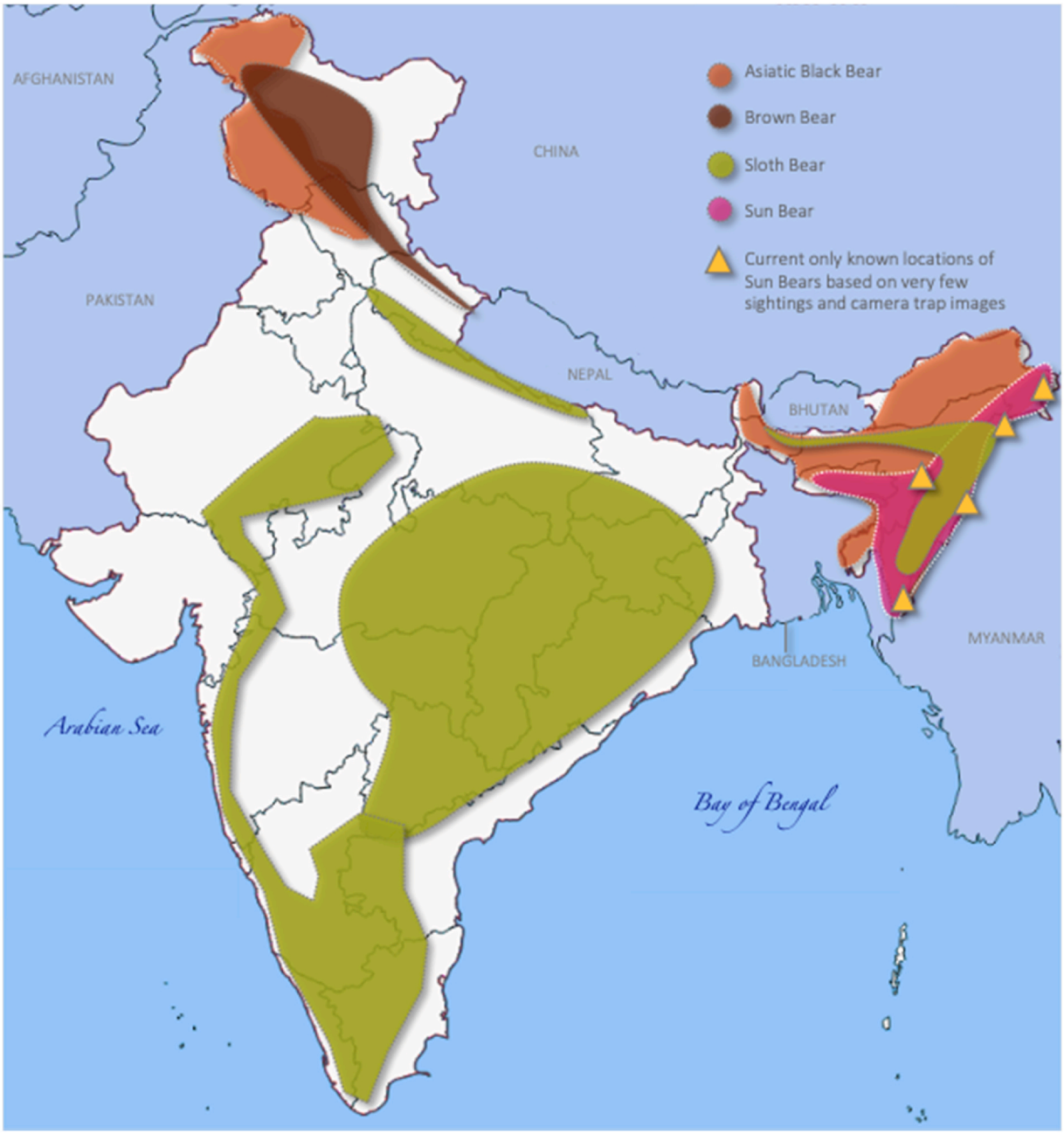

Fig. 1. Approximate distribution range of the Asiatic black bear, brown bear, sloth bear and sun bear in India based on IUCN Red List of Threatened Species (Dharaiya et al. 2020; Garshelis and Steinmetz, 2016; McLellan et al., 2017; Scotson et al., 2017) and unpublished data from Wildlife Protection Society of India (WPSI).

and Himalayan black bear) or during a subsequent immunity period granted in 2003. However, any offspring born to such a bear cannot be declared and legalised. Hence, captive breeding of bears by private individuals is effectively illegal.

India is also a Party to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) which regulates international trade of wildlife. The Asiatic black bear, sun bear and the sloth bear are listed in Appendix I of CITES, and as such international commercial trade in these bears, their parts or derivatives is completely prohibited; while the brown bear (barring populations in Bhutan, China, Mexico and Mongolia) is listed in Appendix II allowing for regulated international commercial trade provided it is permitted by national CITES management authorities. That said, no international commercial trade to or from India in Himalayan brown bears is permitted by the Indian Import/Export Policy in line with the Wild Life (Protection) Act, 1972, except for the trade of animals between recognised zoos.

3. Methods

Seizure and poaching incidents involving bears in India for the period 2009–2019 were collated and analysed. A seizure is defined as an incident involving the arrests of individuals and/or confiscation of live bears or their parts (e.g. claws, skins, paws, gall bladder) illegally in their possession. A poaching incident is when a bear is found dead either in traps, or electrocuted, or killed by other anthropogenic means, with or without body parts removed. The Wildlife Protection Society of India (WPSI) systematically collects data on poaching and seizures of protected species which is collated, categorised and stored in WPSI's database on wildlife crime. Primary information is from a network of field-staff, local NGOs and concerned citizens. WPSI also liaises with enforcement agencies, including the Forest Department, Police and Customs, to collect or verify information on wildlife crime. Information is also obtained from sources such as newspapers and other media, both local and regional, which is verified with the relevant agencies before entry into the database. Wherever possible, documents relating to incidents are obtained. A large amount of information has also been acquired by WPSI as part of wildlife trade studies conducted with state governments in India and the Right to Information Act 2005 has been used to elicit information about incidents of crime. We also requested seizure data from the Indian CITES Management Authority, but there was no response.

Using this data, we mapped out important trade hubs and centres where trade exists. We have estimated a minimum number of bears recorded in trade from commodities seized, by either counting whole or near-whole specimens seized (e.g. live animals, skins, carcasses), or by tallying quantities of body parts seized (e.g. gall bladders, claws, teeth, paws) that form one whole individual per seizure record. In terms of tallying body parts, each bear (regardless of species) is assumed to have four paws, one gall bladder, 20 claws and 40 teeth (or four canines if this is specifically mentioned). For example, a seizure of an adult skull and skin would be counted as one, as these could potentially have been derived from the same individual and similarly a seizure of two paws, 20 teeth and five gall bladders would be counted as a minimum of five individuals. Where quantities of seized commodities were not provided, we estimated at minimum that one bear was involved. We have quantified the volumes of bears seized from the trade over a set period to determine if there are any trends in trade.

Due to inherent biases in the way seizure data are reported, given varying levels of law enforcement, reporting and recording practices between the various states in India, language biases, etc., this dataset is interpreted with caution. Reported incidents are likely to represent only a fraction of the illegal trade and so under-estimate the full extent of poaching and illegal trade (Nijman 2015; Burgess et al., 2014).

4. Results

Between 2009 and 2019, there were a reported 149 incidents involving the poaching and seizure of bears in India amounting to a minimum of 264 bears. This encompassed 73 poaching incidents representing an estimated 82 bears, and 76 seizure incidents representing an estimated 182 bears. The number of incidents involving bears since 2009 appears to be on the rise in India, largely attributed to rising number of poaching cases. The highest number of incidents were reported in 2017 (n = 22), followed by 2018 (n = 20) and 2019 and 2016 (n = 17 respectively) (Fig. 2).

At least two species of bears were identified in these incidents, Asiatic black bear and sloth bear, equally represented in reported incidents (Table 1). That said, the majority of poaching incidents involved the sloth bear (n = 97%) which amounted to 80 bears, while with seizures, slightly more than half of incidents were of Asiatic black bears (n = 55.3%), which represented about 70% of the estimated number of bears based on commodities seized.

Various types of bear commodities were seized and included live bears and their parts (bones, claws, gall bladder, meat, paws, skin, skull and teeth) (Table 2). Gall bladder was the most frequent and abundant bear part seized (n = 42 incidents; 129 gall bladders), the majority of which were reportedly Asiatic black bear. For sloth bears, the most frequent bear part seized were skins (n = 11 incidents; 12 skins) followed by live bears (n = 8 incidents; 26 individuals) and claws (n = 6 incidents; 27 claws). Of the 26 live bears seized, 20 were cubs.

The seizure of bear gall bladders has been relatively constant throughout the study period, although quantities peaked quite substantially in 2017 (Fig. 3). Similarly, while seized in small quantities, the seizure of skins has also been relatively constant throughout the study period. There appears to be a reduction in the seizure of live bears. Incidents involving the poaching of bears increased over the study period.

Incidents involving the poaching and seizure of bears and their parts occurred throughout the country encompassing 78 districts within 19 states (Fig. 4). Most incidents were reported in the states of Uttarakhand (24%) and Madhya Pradesh (23%), followed by Chhattisgarh (12%) and Maharashtra (7%). Uttarakhand had the highest number of reported seizures which were primarily bear gall bladders (n = 33 seizures, 63 gall bladders), although the number of seizures here decreased over the study period. Assam with only four reported incidents was second, after Uttarakhand, in terms of estimated number of bears involved (n = 45 bears) largely attributed to the seizure of 42 gall bladders followed by three skins and a skull. Madhya Pradesh and Chhattisgarh had the highest number of reported poaching incidents (n = 29 incidents, 33 bears; 16 incidents, 20 bears respectively) and appears to have increased over the study period.

5. Discussion

Asian bear species are declining across their range (Dharaiya et al. 2020; Garshelis and Steinmetz, 2016; McLellan et al., 2017; Scotson et al., 2017). While this is largely attributed to habitat loss, destruction and fragmentation, bears are also

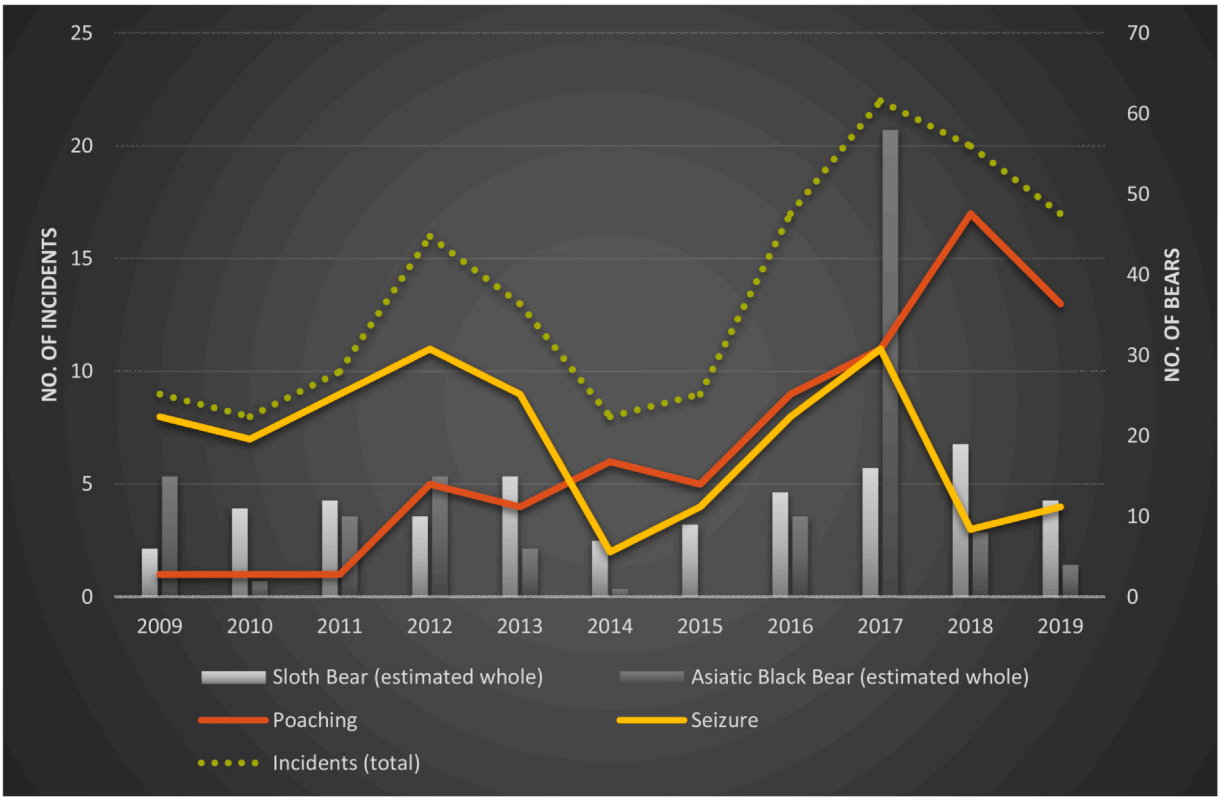

Fig. 2. The total number of incidents involving the illegal exploitation of bears in India reported from 2009 to 2019 with a breakdown of the type of incidents reported (i.e. seizures or poaching), bear species and the estimated number of bears represented in these incidents combined per year.

Table 1
Bear species reported in poaching and seizure incidents in India from 2009 to 2019 with minimum estimated number of bears involved.

Species	Poaching		Seizure		Total (Bears)
	Incidents (#)	# of Bears (Est.)	Incidents (#)	# of Bears (Est.)	
Asiatic black bear	2	2	42	127	129
Sloth bear	71	80	34	55	135
Total	73	82	76	182	264

Table 2
The various types of bear commodities seized in India from 2009 to 2019 including the species of bear, the number of times each commodity was seized and quantities. Note: the data represented here does not include poaching which amounted to 73 incidents and 82 bears (sloth bear = 80, Asiatic black bear = 2).

Commodity seized	Asiatic black bear		Sloth bear	
	Seizures (#)	Quantity	Seizures (#)	Quantity
Bone	–	–	1	2
Canine	–	–	2	2
Claws	–	–	6	27
Fat (kg)	–	–	1	2
Gall bladder	38	123	4	6
Hair	–	–	2	Unknown
Jaws	–	–	1	Unknown
Legs	–	–	1	Unknown
Live	–	–	8	26
Meat (kg)	–	–	3	26
Paws	–	–	3	5
Skin	3	3	11	12
Skull	2	2	–	–

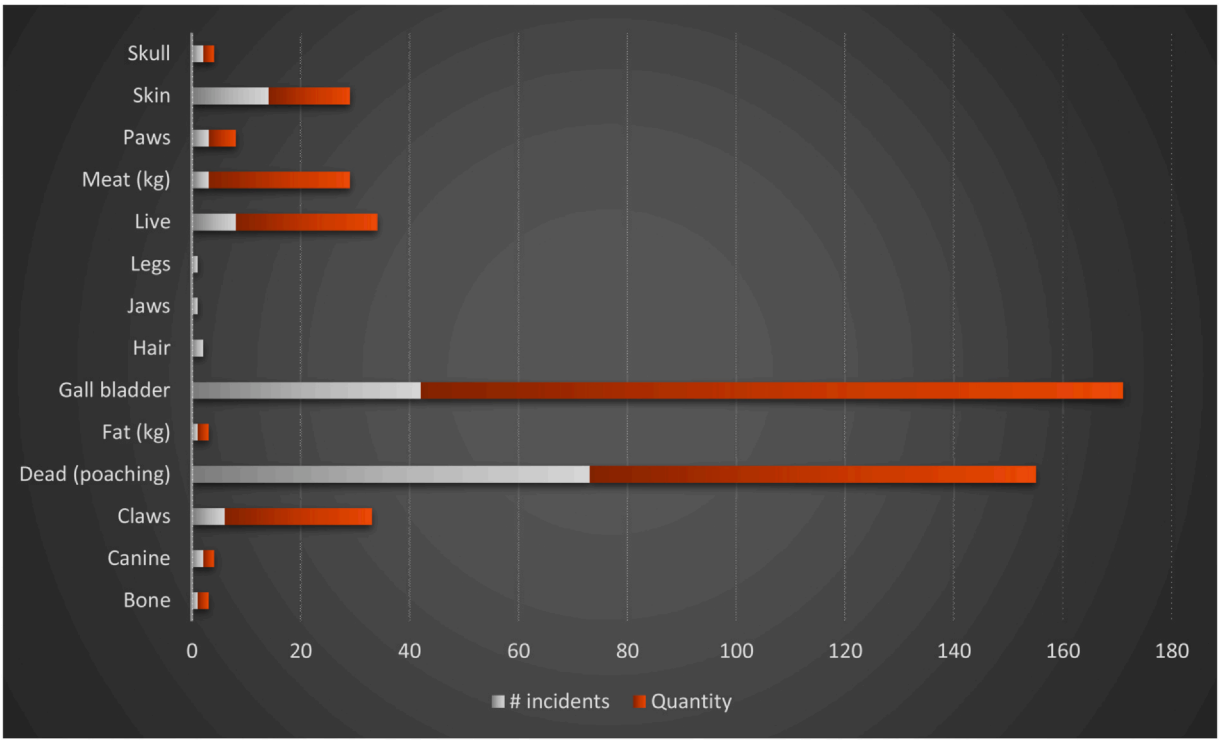

Fig. 3. Incidents involving poaching of bears (labelled 'dead') as well as seizure of live bears and bear parts (bone, canines, claws, gall bladders, paws, skin and skull) reported in India from 2009 to 2019. Note that quantities of bear meat and fat seized are provided in unit of kg; and although bear hair, jaws and legs were seized in one incident, quantities were not reported.

persistently targeted for the illicit trade in their parts prized as talismans and trophies, gall bladders for traditional medicine, meat and paws for consumption and live for use as pets, performance animals, replacement stock in bear farms, and more. Seizure data obtained for this study indicates that there is an ongoing illegal trade of bears in India that appears to be targeted at two species, the Asiatic black bear and the sloth bear. This is not surprising considering that of all the four species of bears found in India, these two are the most common and widespread. That said, both species are at risk of extinction having been assessed as Vulnerable by the IUCN Red List of Threatened Species, with populations in decline across their range due to habitat loss, increasing human conflict and illegal exploitation for trade (Garshelis and Steinmetz, 2016; Dharaiya et al., 2020).

Analysis of seizure data revealed that bears are predominantly being trafficked for traditional medicine use (based on the high frequency and abundance of gall bladders seized) and, to a lesser extent, trophies (based on seizures of claws and skins). This is further supported by the decreasing number of seizures involving live bears over the study period. Past studies indicate that live bears, mostly cubs, are primarily harvested to be trained as dancing/performing bears in India, a practice that was made illegal in 1998 and has since been, to a large extent, eradicated (D'Cruze et al., 2011). Far more Asiatic black bear parts were seized in comparison to sloth bears, revealing that Asiatic black bears are predominantly targeted for their gall bladders. This is the case across Asia in Asiatic black bear range states (Feng et al., 2009; Kikuchi, 2010; Livingstone and Shepherd, 2014), as this species produces especially high levels of tauroursodeoxycholic acid, a compound prized in traditional Chinese medicine (TCM) and considered rare in other bear species (Crudge et al., 2019). It is also the reason more Asiatic black bears are found in bear bile extracting facilities than any other bear species. Seizures involving sloth bears were primarily of skins (~33% of seizures involving sloth bears) suggesting they are coveted more as trophies. Nevertheless, the gall bladders of sloth bears were also seized in four incidents indicating they are not exempt from being exploited for traditional medicine. Live sloth bears (mostly cubs) were seized in the first half of the study period (2009–2015) and it is assumed these were destined for the pet/performing trade. While the seizure incidents analysed offer insufficient detail on the end destinations of product seized (i.e. local or international markets), we do know that bear parts are in high demand in East Asia and Southeast Asia mostly for traditional medicine and trophies (Shepherd, 2007; Foley et al., 2011; Burgess et al., 2014; Gomez, 2019). The highest number of bear seizures in this study was reported in Uttarakhand (n = 33 seizures) the majority of which were of gall bladders. This is unsurprising considering Uttarakhand shares a long and porous border with Nepal, a known trade route through which gall bladders (and other wildlife products e.g. big cat skins) reach China. In at least one seizure incident, two Bhutanese nationals were arrested with bear gall bladders in West Bengal that were likely being smuggled to China through Bhutan.

Aside from seizures, there was a steady rise in poaching incidents, predominantly involving sloth bears, in India over the study period. In poaching incidents, the bears were found dead in traps, electrocuted, or killed by other means by poachers, with body parts (i.e. canines, claws, gall bladder, paws, etc) usually removed. The removal of body parts suggests that there is a

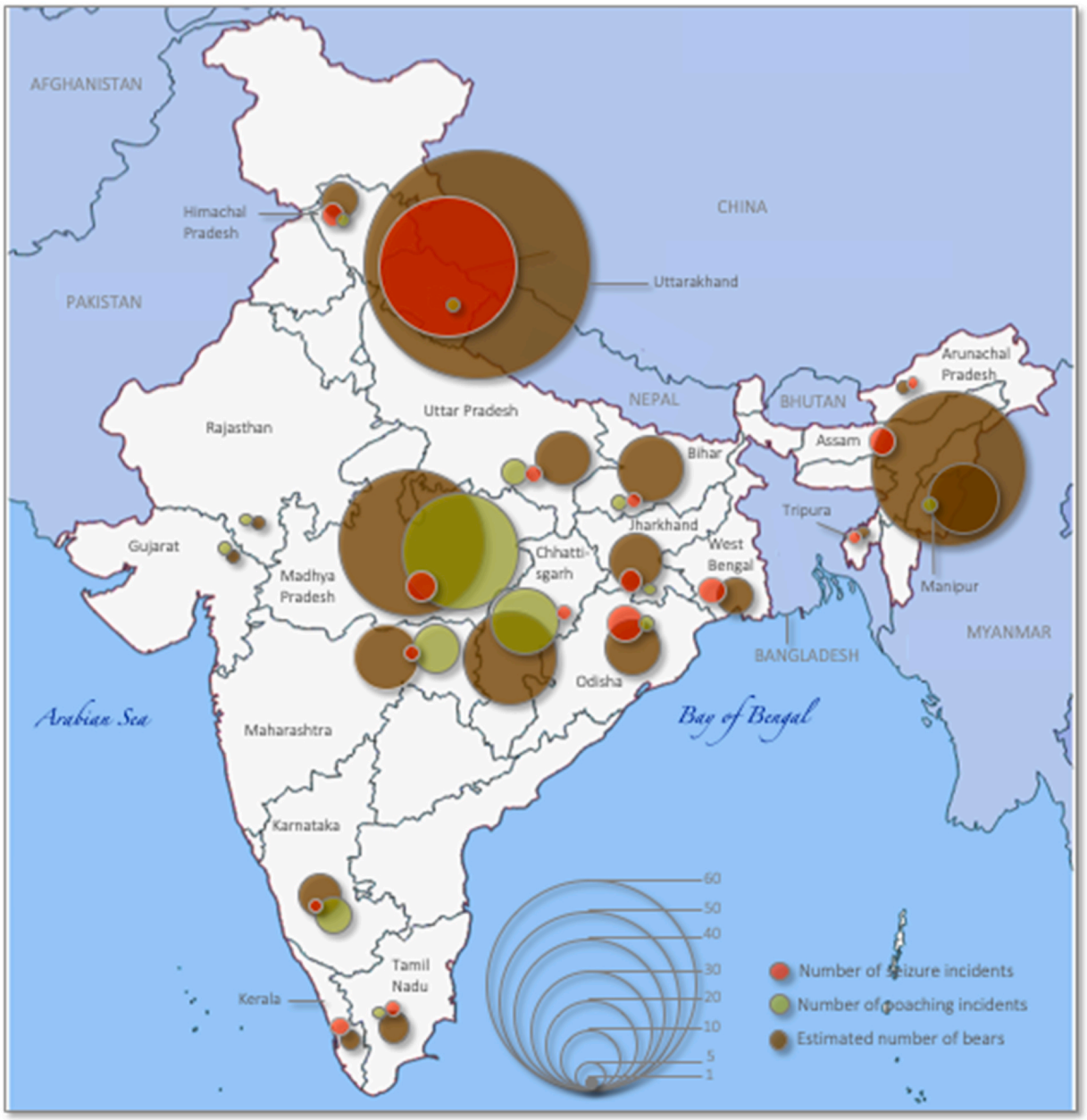

Fig. 4. Bear seizure and poaching hotspots in India based on incidents analysed for the period 2009–2019. A total of 149 incidents were obtained; 73 poaching incidents and 77 seizure incidents which was estimated to amount to 264 bears. The location of each incident has been grouped by States in India.

demand and trade in such commodities, although again, it remains unclear whether this feeds a local demand and/or international market. It is also unclear whether the rise in poaching incidents is targeted hunting of bears for trade or retaliatory killing of bears. Incidents of poaching were reported mainly in Madhya Pradesh and Chhattisgarh which have good populations of sloth bears (WPSI, unpublished data). There has been growing levels of human-bear conflict in India due to loss of suitable habitat and increasing human encroachment into forested areas (Debata et al., 2016; Garcia et al., 2016); and it is suspected that this conflict may be resulting in rising poaching levels. Sloth bears are perceived as a significant threat as conflict cases cause serious human injury or death that has adverse impacts on a family's livelihood. Retaliatory killing of bears has grown as a result - from 2009 to 2019, at least 112 bears were found dead due to human conflict where bears were killed by villagers using guns, poisoning, electrocution, burning and stoning or culled by Forest Officials or Police as they posed a danger to the public (Wildlife Protection Society of India, unpublished data). This figure also includes a few unnatural deaths due to road and train accidents and accidental electrocution (Wildlife Protection Society of India, unpublished data). This considering, the root cause of killing a sloth bear is generally considered to be in retaliation rather than trade although parts may be removed opportunistically as

trophies or traded for extra income. That said, it is also possible that wildlife poachers are exploiting conflict situations to procure bear parts for trade as exemplified by the number of seizures in this study. Just last year (2019), a wildlife trader was arrested in India for hunting sloth bears for their gall bladders and parts, and other wildlife (e.g. tigers) that he reportedly supplied to international smuggling syndicates in China and Southeast Asia for nearly a decade (Zaugg and Suri, 2019). In China, research has shown that the poaching of bears is linked more significantly with trade in their valuable parts in comparison to human-bear conflict (Liu et al., 2010). The fact is, bear gall bladder is a highly valued commodity in the traditional medicine industry, with China and Viet Nam the main drivers of demand. This demand has been the reported cause for bear declines in Cambodia, Lao PDR, Myanmar and Viet Nam (Scotson, 2012; Crudge et al., 2016, 2019; Nijman et al., 2017). Moreover, it is not uncommon for wildlife traders/poachers to adapt to depleting population in one country by targeting areas/countries where populations are still abundant e.g. India. A case in point is the international trafficking of pangolins for traditional medicine and wild meat that is highly sought after in China and Viet Nam. When pangolin populations were depleted in East Asia, a greater increase in the poaching of pangolins from Southeast Asia was noted, particularly Indonesia and Malaysia (Semiadi et al., 2009; Challender, 2011). As populations started dwindling in the Southeast Asian region, there was a notable shift in the trafficking of pangolins from South Asia (e.g. India, Nepal) and Africa (Challender et al., 2016; Gomez et al., 2016; Heinrich et al., 2016) to meet demand.

This study shows that despite being a strictly protected species in India, there is still a threat to bears from illegal trade. Clearly, enforcement capacity and resources need to be improved in relation to crimes involving bears. Between 2009 and 2019, 287 individuals were investigated in relation to bear trade, of which only 20 were convicted. While there have been some arrests, these have been confined to local poachers and mid-level traders, and there has been little effort dedicated to intelligence gathering or sustained investigation on actual buyers, end consumers, illegal cross-border trade, and the higher levels of the poaching and trafficking syndicate(s). For high profile species like tigers and more recently pangolins, there appears to be greater effort, but perhaps growing levels of human-bear conflict has rendered bears a considerable threat rather than in need of conservation attention. Throughout the range of bears in Asia, a combination of threats - loss of suitable habitat, increasing human conflict, illegal wildlife trade - are pushing bear populations towards extinction. But studies in Asia are showing that indiscriminate poaching and illegal trade are becoming the main driver of species extinctions, more so than deforestation (Brodie et al., 2015; Harrison et al., 2016; Gray et al., 2018; Symes et al., 2018; Voigt et al., 2018; Tilker et al., 2019). As such, while critical bear habitats must be preserved, greater efforts are also needed to reduce human-bear conflict and the threat of the illegal trade. Given the number of reported poaching and seizure incidents in India, enforcement efforts must be enhanced to include intelligence-led investigations and cross-border cooperation between enforcement agencies to target buyers and traders. Government authorities and conservation organisations should continue monitoring the trade in bear parts on a national scale, with findings analysed on a regular basis to support action-oriented strategies and effective law enforcement interventions. We also recommend research be carried out to better identify the end destinations of the parts and derivatives sourced from India's bears. Once clarified, targeted strategies should be developed and implemented to reduce consumption and demand and ultimately reduce levels of poaching of bears in India.

Declaration of Competing Interest

There is no conflict of interest.

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References

Arun, T., 2019. Red Sand Boa Worth $71,000 Seized, One Person Arrested. International Business Times. ⟨https://www.ibtimes.com/red-sand-boa-worth-71000-seized-one-person-arrested-2860081⟩. (Accessed 11 November 2019).

Badola, S., Choudhary, A.N., Chhabra, D.B., 2019. Tortoises and Freshwater Turtles in illegal trade in India (2019). TRAFFIC India.

Brodie, J.F., Giordano, A.J., Zipkin, E.F., Bernard, H., Mohd-Azlan, J., Ambu, L., 2015. Correlation and persistence of hunting and logging impacts on tropical rainforest mammals. Conserv. Biol. 29 (1), 110–121.

Burgess, E.A., Stoner, S.S., Foley, K.E. 2014. Bring to bear: an analysis of seizures across Asia (2000–2011). TRAFFIC, Petaling Jaya, Selangor, Malaysia.

Challender, D., 2011. Asian pangolins: increasing affluence driving hunting pressure. TRAFFIC Bull. 23 (3), 92–93.

Challender, D., Baille, J., Waterman, C., Pietersen, D., Nash, H., Wicker, L., Parker, K., Thomson, P., Nguyen, T.V., Hywood, L., Shepherd, C.R., 2016. On scaling up pangolin conservation. TRAFFIC Bull. 28 (1), 19–21.

Chatterjee, B., 2019. 650 mongooses killed for 29,166 fur paint brushes seized across Maharashtra: WCCB. Hindustan Times Online: ⟨https://www.hindustantimes.com/mumbai-news/650-mongooses-killed-for-29–166-fur-paint-brushes-seized-across-maharashtra-wccb/story-xG8MRq4BTfvNxjp2uGHIeN.html⟩. (Accessed 11 November 2019).

Crudge, B., O'Connor, D., Hunt, M., Davis, E.O., Browne-Nunez, C., 2016. Groundwork for effective conservation education: an example of in situ and ex situ collaboration in South East Asia. Int. Zoo Yearb. 50, 1–15.

Crudge, B., Nguyen, T., Cao, T., 2018. The challenges and conservation implications of bear bile farming in Viet Nam. Oryx 1–8.

Crudge, B., Lees, C., Hunt, M., Steinmetz, R., Fredriksson, G., Garshelis, D. (Eds.), 2019. Sun bears: global status review and conservation action plan, 2019–2028. IUCN SSC Bear Specialist Group/IUCN SSC Conservation Planning Specialist Group/Free the Bears/TRAFFIC.

D'Cruze, N., Sarma, U.K., Mookerjee, A., Singh, B., Louis, J., Mahapatra, R.P., Jaiswal, V.P., Roy, T.K., Kumari, I., Menon, V., 2011. Dancing bears in India: a sloth bear status report. Ursus 22 (2), 99–105.
Debata, S., Swain, K.K., Sahu, H.K., Palei, H.S., 2016. Human-sloth bear conflict in human dominated landscape of northern Odisha, India. Ursus 27 (2), 90–98.
Dharaiya, N., Bargali, H.S., Sharp, T., 2020. Melursus ursinus. The IUCN Red List of Threatened Species 2016: e.T13143A45033815. http://dx.doi.org/10.2305/IUCN.UK.2016–3.RLTS.T13143A45033815.en. (Downloaded 08 November 2019).
Feng, Y., Siu, K., Wang, N., Ng, K., Tsao, S., Nagamatsu, T., Tong, Y., 2009. Bear bile: dilemma of traditional medicinal use and animal protection. J. Ethnobiol. Ethnomed. 5, 2.
Foley, K.E., Stengel C.J., Shepherd. C.R., 2011. Pills, powders, vials and flakes: The bear bile trade in Asia. TRAFFIC, Petaling Jaya, Selangor, Malaysia.
Garcia, K.C., Joshi, H.M., Dharaiya, N., 2016. Assessment of human-sloth bear conflicts in North Gujarat, India. Ursus 27 (1), 5–10.
Garshelis, D., Steinmetz, R., 2016. Ursus thibetanus (errata version published in 2017). The IUCN Red List of Threatened Species 2016: e.T22824A114252336. http://dx.doi.org/10.2305/IUCN.UK.2016–3.RLTS.T22824A45034242.en. (Downloaded 08 November 2019].
Gomez, L., Shepherd, C.R., 2018. Trade in bears in Lao PDR with observations from market surveys and seizure data. Glob. Ecol. Conserv. 15 (2018), e00415.
Gomez, L., Shepherd, C.R., 2019. Bearly on the radar – an analysis of seizures of bears in Indonesia. Eur. J. Wildl. Res. 65 (6), 89. https://doi.org/10.1007/s10344-019-1323-1
Gomez, L., Leupen, B.T.C., Tian, K.H., 2016. The trade of African pangolins to Asia: a brief case study of pangolin shipments from Nigeria. TRAFFIC Bull. 28 (1), 3–5.
Gomez, L., 2019. An update on the bear bile trade in Peninsular Malaysia. TRAFFIC Southeast Asia, Petaling Jaya, Malaysia.
Gray, T.N.E., Hughes, A.C., Laurance, W.F., Long, B., Lynam, A.J., O'Kelly, H., Ripple, W.J., Seng, T., Scotson, L., Wilkinson, N.M., 2018. The wildlife snaring crisis: an insidious and pervasive threat to biodiversity in Southeast Asia. Biodivers. Conserv. 27, 1031–1037.
Gupta, B.K., Singh, R., Satyanarayan, K., Seshamani, G., 2007. Trade in bears and their parts in India: threats to conservation of bears. In: Williamson, D. (Ed)., Proceedings of the Fourth International Symposium on the Trade in Bear Parts. TRAFFIC East Asia-Japan.
Harrison, R.D., Sreekar, R., Brodie, J.F., Brook, S., Luskin, M., O'Kelly, H., Rao, M., Scheffers, B., Velho, N., 2016. Impacts of hunting on tropical forests in Southeast Asia. Conserv. Biol. 30, 972–981.
Heinrich, S., Wittmann, T.A., Prowse, T.A.A., Ross, J.V., Delean, S., Shepherd, C.R., Cassey, P., 2016. Where did all the pangolins go? International CITES trade in pangolin species. Glob. Ecol. Conserv. 8, 241–253.
Kikuchi, R., 2010. Captive bears in human-animal welfare conflict: a case study of bile extraction on Asia's bear farms. J. Agric. Environ. Ethics 25, 55–77. https://doi.org/10.1007/s10806-010-9290-2
Lee, S.L., Burgess, E.A., Chng, S.C.L., 2015. Hard to bear: an assessment of trade in bear bile and gall bladder in Malaysia. TRAFFIC. Petaling Jaya, Selangor, Malaysia.
Liu, F., McShea, W.J., Garshelis, D.L., Zhu, X., Wang, D., Shao, L., 2010. Human-wildlife conflicts influence attitudes but not necessarily behaviours: factors driving the poaching of bears in China. Biol. Conserv. 144 (2011), 538–547.
Livingstone, E., Gomez, L., Bouhuys, J., 2018. A review of bear farming and bear trade in Lao People's Democratic Republic. Glob. Ecol. Conserv. 13, e00380.
Livingstone, E., Shepherd, C.R., 2014. Bear farms in Lao PDR expand illegally and fail to conserve wild bears. Fauna & Flora International, Oryx, 1–9.
McLellan, B.N., Proctor, M.F., Huber, D., Michel, S., 2017. Ursus arctos (amended version of 2017 assessment). The IUCN Red List of Threatened Species 2017: e.T41688A121229971. http://dx.doi.org/10.2305/IUCN.UK.2017–3.RLTS.T41688A121229971.en. [Downloaded 08 November 2019].
Mills, J.A., Servheen, C., 1991. The Asian Trade in Bears and Bear Parts. World Wildlife Fund, Inc., USA.
Nijman, V., 2015. Pangolin seizure data reported in the Indonesian media. TRAFFIC Bull. 27 (2), 44–46.
Nijman, V., Oo, H., Shwe, N.M., 2017. Assessing the illegal bear trade in Myanmar through conversations with poachers: topology, perceptions and trade links to China. Human Dimensions of Wildlife. http://dx.doi.org/10.1080/10871209.2017.1263768.
Or, O.C., Gomez, L., Lau, C.F., 2017. Recent reports of sun bear seizures and poaching in Malaysia. International Bear News, Summer 2017, vol. 26, no. 2.
Sathyakumar, S., Kaul, R., Ashraf, N.V.K., Mookerjee, A., Menon, V., 2012. National Bear Conservation and Welfare Action Plan. Ministry of Environment and Forests, Wildlife Institute of India and Wildlife Trust of India.
Scotson, L., 2012. Status of Asiatic Black Bears and Sun Bears in Xe Pian National Protected Area, Lao PDR. International Bear News, February 2012, vol. 21, no. 1.
Scotson, L., Fredriksson, G., Augeri, D., Cheah, C., Ngoprasert, D., Wai-Ming, W., 2017. Helarctos malayanus (errata version published in 2018). The IUCN Red List of Threatened Species 2017: e.T9760A123798233. http://dx.doi.org/10.2305/IUCN.UK.2017–3.RLTS.T9760A45033547.en. (Downloaded on 08 November 2019).
Semiadi, G., Darnaedi, D., Arief, A.J., 2009. Sunda Pangolin Manis javanica conservation in Indonesia: status and problems. In: Pantel, S., Chin, S.Y. (Eds). Proceedings of the Workshop on Trade and Conservation of Pangolins Native to South and Southeast Asia: 30 June–2 July 2008, Singapore Zoo. TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia.
Sethy, J., Chauhan, N.P.S., 2011. Use and trade of bear body parts: impact and conservation in Arunachal Pradesh State of India. Int. J. Bioresour. Stress Manag. 2 (4), 409–415 2011.
Shepherd, C.R., Nijman, V., 2007. The trade in bear parts from Myanmar: an illustration of the ineffectiveness of enforcement of international wildlife trade regulations. Biodivers. Conserv. 17, 35–42.
Shepherd, C.R., 2007. Bear trade in Southeast Asia: the status of protection for Southeast Asia's bears. In: Williamson, D. (Ed)., Proceedings of the Fourth International Symposium on the Trade in Bear Parts. TRAFFIC East Asia-Japan.
Symes, W.S., Edwards, D.P., Miettinen, J., Rheindt, F.E., Roman, C., 2018. Combined impacts of deforestation and wildlife trade on tropical biodiversity are severely underestimated. Nat. Commun. 9, 4052. https://doi.org/10.1038/s41467-018-06579-2
Tilker, A., Abrams, J.F., Mohamed, A., Nguyen, A., Wong, S.T., Sollmann, R., Niedballa, J., Bhagwat, T., Gray, T.N.E., Rawson, B.M., Guegan, F., Kissing, J., Wegmann, M., Wilting, A., 2019. Habitat degradation and indiscriminate hunting differentially impact faunal communities in the Southeast Asian tropical biodiversity hotspot. Commun. Biol. 2, 396. https://doi.org/10.1038/s42003-019-0640-y
UNEP, 2019. Spotlight on India's soaring wildlife crime. ⟨https://www.unenvironment.org/news-and-stories/story/spotlight-indias-soaring-wildlife-crime⟩. Accessed 11 November 2019.
Voigt, M., Wich, S.A., Ancrenaz, M., Meijaard, E., Abram, N., Banes, G.L., Campbell-Smith, G., d'Arcy, L., Delgado, R.A., Erman, A., Gaveau, D., Goosens, B., Heinicke, S., Houghton, M., Husson, S.J., Leiman, A., Llano, S., Makinuddin, N., Marshall, A., Meididit, A., Miettinen, J., Musnanda R., Mundry, Nardiyono, Nurcahyo, A., Odom, K., Panda, A., Prasetyo, D., Priadjati, A., Purnomo, Rafiastanto, A., Russon, A.E., Santika, T., Sihite, J., Spehar, S., Struebig, M., Sulbaran-Romero, E., Tiiu, A., Wells, J., Wilson, K.A., Kuhl, H.S., 2018. Global demand for natural resources eliminated more than 100,000 Bornean Orangutans. Curr. Biol. 28, 761–769.
Willcox, D., Minh, N.D.T., Gomez, L., 2016. An assessment of trade in bear bile and gall bladder in Viet Nam. TRAFFIC, Petaling Jaya, Selangor, Malaysia.
Wong, R., Krishnasamy, K., 2019. Skin and Bones Unresolved: An Analysis of Tiger Seizures from 2000–2018. TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia.
WWF, 2014. Illegal Wildlife Trade in India (Special Issue). ⟨http://awsassets.wwfindia.org/downloads/traffic_panda_8_oct.pdf⟩. Accessed 8 November 2019.
Zaugg, J., Suri, M., 2019. Poacher manhunt exposes murky world of Indian wildlife trafficking, where bear bile is big business. CNN Online: ⟨https://edition.cnn.com/2019/10/25/asia/bear-bile-trafficking-intl-hnk/index.html⟩. Accessed 8 November 2019.

PANGOLINS

A10. Gomez, L., Leupen, B.T.C. and Tian, K.H. 2016. The trade of African pangolins to Asia: a brief case study of pangolin shipments from Nigeria. TRAFFIC Bulletin 28(1):3–5.

A11. Gomez, L., Leupen, B.T.C., Heinrich, S. 2016. Observations of the illegal pangolin trade in Lao PDR, 2016. TRAFFIC Southeast Asia Regional Office, Petaling Jaya, Selangor, Malaysia.

A12. Gomez, L., Leupen, B.T.C., Krishnasamy, K. and Heinrich, S. 2017. Scaly nexus: mapping Indonesian pangolin seizures (2010-2015). TRAFFIC, Petaling Jaya, Malaysia.

A13. Gomez, L. and Sy, E. 2018. Illegal pangolin trade in the Philippines. TRAFFIC Bulletin 20(1): 37-39.

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A15. Gomez, L. and Krishnasamy, K. 2019. A rapid assessment of the trade in Saiga Antelope horn in Peninsular Malaysia. TRAFFIC Bulletin 31(1): 35-38

A16. Heinrich, S., Toomes, A. and Gomez, L. 2020. Valuable stones: The trade in porcupine bezoars. Global Ecology and Conservation 24 (2020) e01204

A17. Shepherd, C.R., Gomez, L. and Nijman, V. 2020. Illegal wildlife trade, seizures and prosecutions: a 7.5 year analysis of trade in pig-nosed turtles *Carettochelys insculpta* in and from Indonesia. Global Ecology and Conservation 24 (2020) e01249

A18. Gomez, L. 2021. The illegal hunting and exploitation of porcupines for meat and medicine in Indonesia. Nature Conservation 43: 109-122 (2021).

A19. Gomez, L. and Shepherd, C.R. 2021. The illegal exploitation of the Javan Leopard (Panthera pardus melas) and Sunda Clouded Leopard (Neofelis diardi) in Indonesia. Nature Conservation 43: 25–39 (2021). DOI: 10.3897/natureconservation.43.59399

Global Ecology and Conservation 24 (2020) e01204

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Valuable stones: The trade in porcupine bezoars

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ABSTRACT

Old-world porcupines (Order: *Rodentia* Family: *Hystricidae*) face many threats, including an increasing demand for their different body parts such as meat, quills, hairs and bezoars. Bezoars are masses of undigested organic and inorganic material that are occasionally formed in an animal's gastrointestinal tract. Bezoars of a variety of species, especially porcupines, have been used for medicinal purposes for centuries and have high commercial value. Demand for bezoars appears to have increased substantially in recent years. We monitored e-commerce websites in Singapore, Malaysia, and Indonesia to estimate the extent of porcupine bezoars for sale. We found 121 listings (excluding listings advertising supply ability instead of specific bezoars) advertising approximately 680–1332 bezoars and likely representing ten-fold as many porcupines within our three month study period. Most listings were from sellers located in Indonesia, followed by sellers from Malaysia, and Singapore. The mean adjusted price per gram was 151.8 USD, which is substantially lower than previously reported prices in the literature. Porcupines have an important ecological role and highly developed social structures. Current trade levels are likely unsustainable and we predict that porcupine species may become threatened in the future should current trade levels continue. We urge source and consumer countries to: (i) review the species' conservation status in range countries; (ii) regulate domestic trade through legislative changes in countries where trade is most prominent; and (iii) ensure existing laws are enforced. Additionally, the Hystricidae may benefit from a CITES Appendix II listing to monitor and regulate the international trade.

1. Introduction

Millions of people globally are dependent on wildlife for their livelihoods, either through direct use or as a source of income (Spenceley, 2012; Robinson, 2016; Sinovas et al., 2017; Stone and Nyaupane, 2018). The trade in wildlife species can be sustainable (Bodmer and Lozano, 2001; Natusch et al., 2016); however, some species are more vulnerable to persistent harvesting pressure than others (Sigouin et al., 2017). If wildlife trade is not consistently monitored and regulated in order to detect and prevent potential negative impacts on populations, even abundant species can quickly become depleted before protective measures are taken (Harrison, 2011; Nijman and Shepherd, 2015). This was the case, for example, for pangolins

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(Order: *Pholidota*, Family: *Manidae*), which were once widespread, but are now heavily threatened, largely due to unsustainable exploitation and illegal trade (Newton et al., 2008; Heinrich et al., 2016).

Old-world porcupines (Order: *Rodentia*, Family: *Hystricidae*) are often encountered in trade. There are eleven species of Hystricidae, eight of which are native to Asia, and three to Africa (Rovie-Ryan et al., 2017). Porcupines and their parts and derivatives have been used and traded for centuries – their meat is consumed as an important source of protein, their quills and hairs are used for decorative purposes, and their inner organs and derivatives are used for medicinal purposes (Sodeinde and Soewu, 1999; Chevallier and Ashton, 2006; Brooks et al., 2010; Duffin, 2013; Barthelmess, 2016; Altaf et al., 2018). Porcupines are among the most frequently encountered animals in surveyed markets across Asia (Luskin et al., 2014; Cantlay et al., 2017) and Africa (Fa et al., 2000; Basa et al., 2017).

Some animals, including porcupines, occasionally produce a stone-like structure in their gastrointestinal tract due to a high intake of non-digestible food materials (Yew et al., 2018). These so called 'bezoars', are masses of undigested organic and inorganic material, and have been used for medicinal purposes for centuries (Duffin, 2013). The word 'bezoar' is derived from the Persian 'padzhar' which literally translates to 'antidote' (Duffin, 2013). Bezoars were first reported to be used as far back as 968 AD in Arabia and Persia, from where it was adopted by Europeans (Duffin, 2013). By the 16th century, porcupine supply had come under such pressure, that fake bezoars and bezoars of a variety of other animal species had flooded the market. During the 16th to late 19th century, the European market value for porcupine bezoar was as high as forty times its own weight in gold (Duffin, 2013). Early supplies reportedly came predominantly from Asia, and today, bezoars continue to be used in traditional medicines to cure a variety of ailments, including cancer, inflammation, and dengue fever (Wong and AbuBakar, 2013; Yew et al., 2018).

Bezoars can reportedly be derived from a variety of animals, including goats, cattle, monkeys or porcupines (Yew et al., 2018). *Calculus bovis*, for example, the bezoar derived from ox/cattle, is reported to be frequently used in traditional Chinese medicine (TCM) (Yew et al., 2018; Dan et al., 2016). To obtain a bezoar the animal has to be killed and, at least in the case of porcupines, only a small proportion of killed animals in fact contain the valuable stone. It is unknown what exact percentage of porcupines actually contain bezoar, however, the formation is believed to be incidental (Mori and Sforzi, 2013; Tan et al., 2019).

To our knowledge, no study to date has focussed specifically on the trade in porcupine bezoars and its conservation implications. In recent years, the trade in wildlife has increasingly moved from physical to e-commerce marketplaces (Lavorgna, 2014; Siriwat and Nijman, 2018, 2020; Nijman, 2020). While the magnitude and rate of this transition inevitably differs between countries, study taxa and use-types, the surveillance of e-commerce trade in wildlife is essential for anticipating emergent trade-based threats. Considering the increasing shift to online markets, here we investigate the trade in porcupine bezoar on e-commerce platforms and provide evidence for online bezoar trade in Indonesia, Malaysia and Singapore. Our aims are three-fold: (i) to raise awareness about the potentially unsustainable trade in porcupines throughout Asia; (ii) to call for further research into, and monitoring of, this trade; and (iii) to recommend informed legislative management strategies to alleviate the threat posed by this trade.

2. Methods

We conducted preliminary online searches of e-commerce platforms known or suspected *a priori* to facilitate the trade of porcupine bezoars across May–June 2019, in order to (i) examine the frequency of bezoar trade on each platform, (ii) generate a list of specific keywords, and (iii) develop inclusion/exclusion criteria for relevant websites selling porcupine bezoars. Based on our preliminary study, we used selected search terms, followed by the phrase 'for sale', to select a candidate list of e-commerce sites on the Google search engine (https://www.google.com). The selected search terms, in English, Malay, Indonesian, and Chinese/Mandarin, were: porcupine bezoar/date/stone, lord of the herbs, Hao Zhu Zhao, 豪猪枣, batu landak and geliga landak. Only the first ten results for each Google search were included in our candidate list. Candidate sites were excluded if (i) no evidence of porcupine bezoar trade was identified, (ii) fewer than three new listings were added during the preliminary study, and (iii) at least some listings advertised a specific quantity of bezoar product (wholesale or powdered) rather than supply capacity. If candidate sites had multiple sub-sites (for different countries, e.g., Shopee), the total number of listings across sub-sites was considered as an inclusion/exclusion criterion.

We selected 11 e-commerce sites where porcupine bezoar appeared to be widely available: i) Alibaba, ii) Shopee (Malaysia, Singapore, Indonesia), iii) Borneo Porcupine Bezoar, iv) Lazada (Malaysia, Singapore), v) Instagram, vi) Bukalapak, vii) Asia-Porcupine (Malaysia), viii) Carousell (Singapore), ix) MiracleMedicine (Malaysia), x) Mudah (Malaysia) and xi) Qoo10 (Singapore). We sampled these sites for listings pertaining to the sale specifically of porcupine bezoars from July–October 2019. If we observed more than five new listings on a site during the preliminary study, monitoring took place on a weekly basis, otherwise monitoring was conducted monthly. If listings advertised porcupine bezoars among other wildlife-derived products (e.g., cow bezoars), we excluded the listing. We also excluded listings that advertised supply capacity rather than individual products, and it should be noted that some of these excluded listings advertised implausibly high quantities of bezoars per year (2000 tons in one instance). In total, our criteria led to the exclusion of seven listings on the monitored websites.

For all included listings, we assumed the supplied information in regards to taxa, quantity and authenticity to be accurate, a caveat associated with most e-commerce trade studies. We acknowledge that this limitation may potentially result in inaccuracies. However, given that the trade in porcupine derived products is currently poorly regulated, we assume there

would be relatively low incentive to falsely declare the intention to sell porcupine bezoars. We have taken several steps to preserve the anonymity of online traders. We recorded trader usernames in order to help identify potential duplicate products, then de-identified usernames after data collection was complete. The username information will remain anonymous and confidential. Additionally, any figures displaying trader activity were modified to remove identifiable information.

There are five general classifications of so called 'phytobezoars' (i.e., bezoars that consist of primarily plant and organic material); these include i) blood date, ii) grassy date, iii) powdery date, iv) black date, and v) kernel date. These subtypes differ in their appearance and structure (for more details see Yew et al. (2018)). While it was deemed beyond the scope of our study to determine whether bezoar classes truly differ in medicinal efficacy, we noted during our preliminary study that there was a perceived difference in quality and price between bezoar types and hypothesised that this perception may affect trade dynamics. As such, we classified the bezoars accordingly based on the description and the pictures provided in the listings.

If listings provided a price range, we recorded the highest price. If no specific information about shipping was provided, the product was considered not to be shipped internationally, unless advertised on an international e-commerce site with access to international customers. For listings advertising powdered forms of porcupine bezoar, if no quantity units (i.e., individual bezoars) were specified, we assumed quantity referred to grams. Conversely, for wholesale bezoar listings, we assumed quantity referred to the total number of bezoars for sale. Based on listings that provided both bezoar wholesale quantity and overall weight (n = 53), we calculated the mean bezoar weight in grams from a total of 159 individual bezoars. Prior to analysis, all listings that provided quantity only were converted into 'adjusted' number of bezoars, using the mean bezoar weight that was calculated earlier.

Indonesian Rupiah, Malaysian Ringgit and Singapore Dollars were standardised to US Dollars (USD; www.xe.com) on the day of recording. For listings where price per bezoar was provided, the mean weight per bezoar was used to standardise all listing price information to adjusted price per gram prior to analysis.

Bezoar price was compared between country of sale and bezoar type using two-way ANOVA. The data were analysed in the R software environment (version 3.6.1; R Core Team (2019)). The map was created using the 'leaflet' package (Cheng et al., 2018).

3. Results

A total of 121 listings were found on 11 websites during the three month study period (Table 1).

The search term languages that resulted in the most listings were in Malay/Indonesian (n = 71 listings), followed by English (n = 69) and Chinese/Mandarin (n = 26). Most of the 77 sellers (84%) only had a single listing online. Only 12 sellers had more than one listing, with 17 being the maximum number of listings per seller. In 24 of the listings (19%) the sellers also specifically indicated that international shipping was available.

There were a total of 63 listings from Indonesia, 41 from Malaysia, six from Singapore, and 11 where no country could be assigned to the seller (e.g., a listing from an international site with deficient seller information). Most listings were from sellers located in Java, followed by the Malay Peninsula, Borneo, Sumatra, and the Riau Islands (Fig. 1). On Java, 77% of listings (n = 24) indicated the location of the seller in Jakarta, but additional listings also came from West-, East- and Central-Java, and Banten. In Peninsular Malaysia, most listings came from the province of Selangor (n = 21), but other provinces were also involved, i.e., Kuala Lumpur, Johor, Melaka, Negeri Sembilan, and Perlis. On Borneo we found listings in West Kalimantan (n = 12) and Sabah (n = 4).

The most commonly advertised type of bezoar was blood bezoar (51), followed by powdery (24), black (19), and grassy bezoar (15). There were 16 listings that did not specify a bezoar type, nor could a type be derived from product images (e.g., when in powdered form).

Table 1
Number of listings on the monitored websites, and the corresponding quantity (whole bezoars) and weight (in grams) of advertised bezoars. Grams and whole bezoars are independent of each other.

Website	# Listings	Grams (if specified)	Bezoars (if specified)
Instagram	48	3623	98
Shopee Malaysia	16	3328	95
Alibaba	14	13279	95
Bukalapak	14	505	28
Shopee Indonesia	6	168	4
Lazada Malaysia	4	83.1	3
Borneo Porcupine Bezoar	3	772	46
AsiaPorcupine Malaysia	3	–	3
Carousell Singapore	3	48.6	3
MiracleMedicine Malaysia	3	1115	24
Mudah Malaysia	3	19.6	18
Qoo10 Singapore	2	10	20
Lazada Singapore	1	10	–
Shopee Singapore	1	10	6
Total	**121**	**22971.12**	**443**

A total of 443 individual bezoars were identified for sale over the study period. The mean weight per bezoar was 44.25 g (95% CI: 18.6–69.9). Based on this estimate of mean weight per bezoar, sales of bezoars in powdered form represent an additional 237 to 889 total bezoars, assuming powdered products contained no additional products as advertised. The cumulative number of bezoars detected over the study period is approximately 680–1332.

The mean adjusted price per gram was 151.8 USD (95% CI: 105.5–198.2). Bezoar price (±SE) was higher in Malaysia (USD 182.8 ± 35.57) compared with Indonesia (USD 124.6 ± 37.08) and Singapore (USD 119.31 ± 72.6) (Fig. 2). Blood (USD 188.9 ± 36.83) and powdery (USD 229.5 ± 82.35) bezoar prices were higher than other bezoar types. However, we found no statistically significant differences in price per gram between countries of sale ($F = 0.658$, $P = 0.524$) nor bezoar types ($F = 0.779$, $P = 0.545$).

4. Discussion

4.1. Bezoar trade

Porcupines are perceived as a 'common' taxa. Yet, in reality, they face many threats, including habitat destruction, persecution as agricultural pests, and unsustainable exploitation (Brooks et al., 2010; Manzar and Nehvi, 2012; Talukdar et al., 2019). Their different body parts have been consumed for centuries, for decoration, traditional medicines, and meat. Currently, demand for bezoars appears to be on the rise and is putting additional pressure on all porcupine species. Here we show that there is considerable porcupine bezoar trade in Southeast Asia and, as we only monitored individual bezoar sales and excluded listings that advertised supply ability, our results are certainly underestimating the true extent of this trade.

There are several limitations to our study including the relatively short data collection period and the fact that it is impossible to determine with certainty whether or not the advertised bezoars are genuine or fake from the pictures alone, and whether the advertised quantities are correct, as the bezoars and stocks could not be physically examined. For the purpose of this study we had to assume that the provided information is correct, but we acknowledge that this may potentially result in inaccuracies. Even if stocks could be physically examined it can be challenging to determine whether a bezoar is fake or authentic. Consequently, it is also possible that especially bezoars sold in powdered form contain other

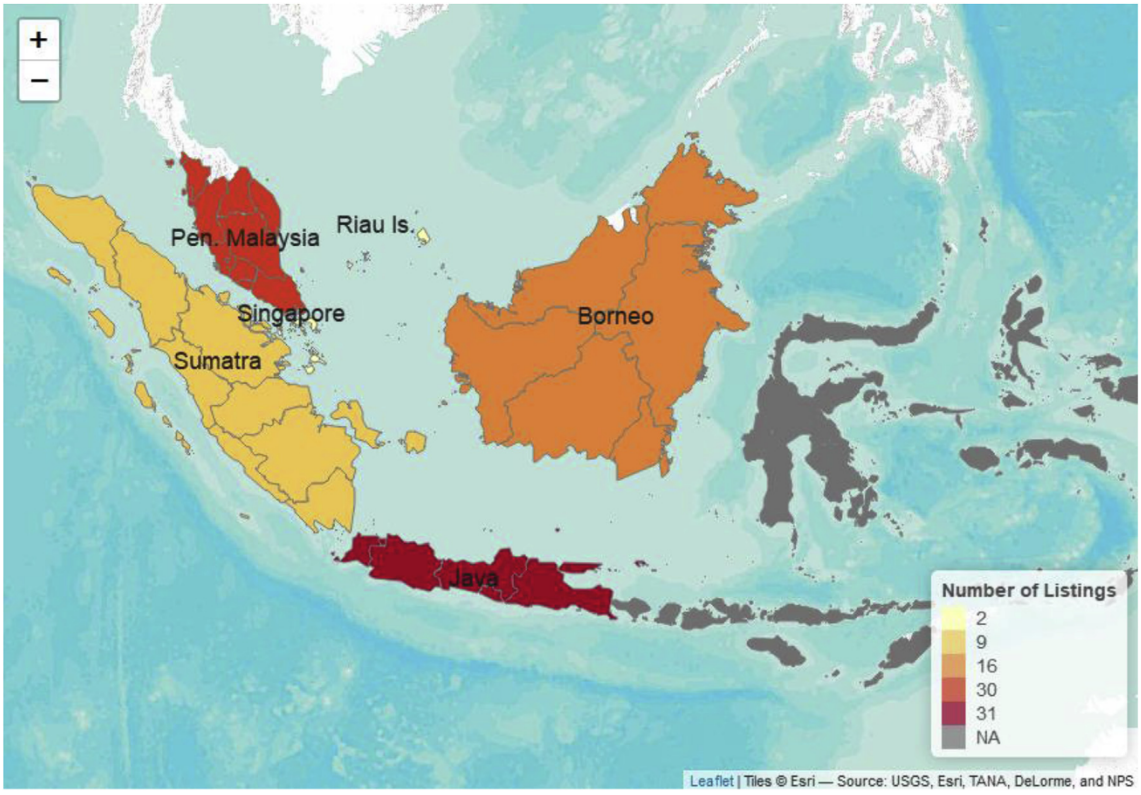

Fig. 1. Distribution of the number of listings found online. The number of listings was summed per island (Borneo, Java, Riau Islands, and Sumatra), the Malay Peninsula, and Singapore and it should be noted that we did not detect advertisements in every province. The political boundaries on Borneo between Malaysia, Indonesia and Brunei Darussalam are not displayed separately; rather we treat the island as a geographical unit. Four listings from Malaysia, and nine listings from Indonesia are not included in this map, as they could not be assigned to individual provinces/islands.

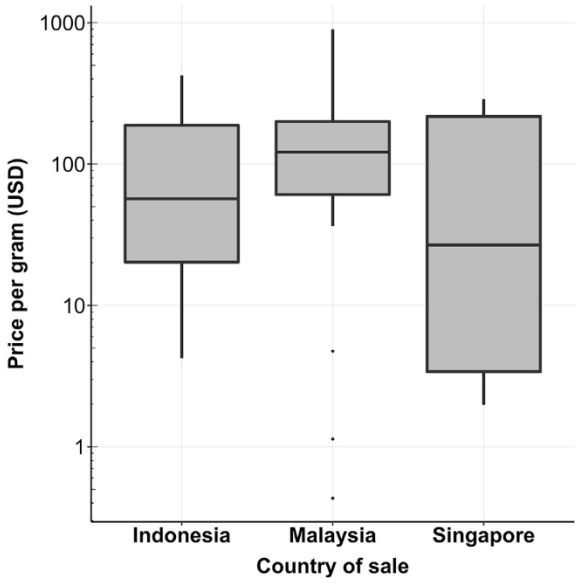

Fig. 2. Median bezoar price per gram, including upper and lower quartiles for each country of sale.

substances, as has been observed for other types of medicines (e.g., mixed bear bile; Gomez et al. (2020)). Further, it is nearly impossible to identify bezoars to the species level solely based on visual cues, and further methods (e.g., using genetic markers) may need to be considered in future studies for forensic authentication. Further, we noted during our preliminary online searches that there was a perceived difference among traders between the different types of bezoars, which was also observed during physical market surveys in Malaysia (Gomez, L., personal observation). We found no statistical differences among prices in this study, but future research should take into account potential implications that the distinction of these different bezoar types may have.

Chung et al. (2016) noted that increasing demand and high commercial value of porcupine bezoar may present one of the leading causes for overhunting and a decline of the Malayan porcupine (*Hystrix brachyura*) in Singapore and throughout its range. Borschberg (2006; as cited in Chung et al., 2016) estimated the price of porcupine bezoars at approximately 7000 USD per gram in Singapore in 2005. This is much higher than our results for prices in Singapore, which we estimate at an average of USD 119.3 ± 72.6 per gram. Comparable prices were observed during market surveys in Malaysia in 2020, which ranged from 300 to 2700 Malaysian Ringgit (i.e., 73–650 USD; Gomez, L., personal observation). Our results indicate similar prices per gram; i.e., USD 182.8 ± 35.57 in Malaysia. We found a comparatively small amount of listings in Singapore, but it is possible that customers buy bezoars directly from sellers in other countries, e.g., Malaysia or Indonesia. We found ~20% of bezoar listings available for international shipping, and it appears common practice to send bezoars via postal services, domestically, as well as internationally. Bezoars reportedly sourced from Indonesia and Thailand were also found for sale in traditional medicine shops during market surveys in Malaysia in 2020, confirming the international nature of this trade (L. Gomez, personal observation).

We discovered 16 bezoar listings of sellers located in Borneo. Most of them (75%) were located in Kalimantan (Indonesian Borneo). It is possible that Kalimantan appears prominent in trade due to other factors, such as differing internet accessibility across geographic locations, the short data collection period of our study, etc. It is further important to note that physical markets may follow different dynamics than online markets. However, Nijman (2005) also reported a population decline of 50–80% of Hose's langur (*Presbytis hosei*) over a 7-year period on Kalimantan, due to relentless hunting for their bezoars. It is possible that Kalimantan may represent a hotspot for bezoars from Borneo, but further research is required to establish these findings. Porcupine bezoars from Borneo are highly coveted, as consumers believe that Borneo still contains a particularly well-preserved flora, including a high proportion of medicinal plants which the animals eat, thus making their bezoars particularly valuable. One website (www.porcupinebezoar.com), which was not monitored during this study as it offered continuous supply as opposed to individual bezoars for sale, states for example:

> "*The most valuable for the porcupine bezoars are procured from porcupines in the rainforest of Indonesia or Borneo. The porcupines here eat unpolluted herbs that have high medicinal value causing the bezoars produced here to be of the rarest and highest value. The price is very high and has collection, medicinal and stockpiling value*".

Apart from Borneo, mainland Malaysia has been reported to be heavily involved in porcupine bezoar trade (Tan et al., 2019) and our findings confirm this. In particular, Selangor appeared to be heavily involved in Malaysia, with the most

advertisements per province. However, we found Indonesia to have more listings (n = 63) compared to Malaysia (n = 41), thus making Indonesia another important source country for porcupine bezoars.

Even though most information is available for the Malayan porcupine (*H. brachyura*), there are a total of six porcupine species native to Indonesia, Malaysia, and Singapore (*H. javanica*, *H. brachyura*, *H. sumatrae*, *H. crassispinis*, *Atherurus macrourus* and *Trichys fasciculata*), and it is likely that all six of them are found in trade to varying extents. Our results indicate that most records of bezoar listings came from sellers based in Jakarta. The Malayan porcupine has a wide range and is believed to be common, though decreasing (Lunde et al., 2016). Its range extends from mainland Southeast Asia to Indonesian Borneo, and Sumatra. It does not occur, however, on Java, where Jakarta is located. We thus believe that it is possible that the only Javan native porcupine species (*H. javanica*), may be considerably involved in this trade. However, it is also possible that bezoars of other species were obtained elsewhere prior to the listing of the advertisements.

4.2. Legal situation

Different species of porcupines are protected to varying degrees in Indonesia, Malaysia and Singapore (Table 2). Singapore is reportedly home to one species (*H. brachyura*), which is considered protected and cannot be harvested without a permit. In Malaysia, the protection of porcupines falls under different wildlife laws that govern Peninsular Malaysia, Sabah and Sarawak. Generally, all porcupine species are listed as 'Protected' with the exception of the Long-tailed porcupine (*T. fasciculata*), which is listed as a 'Totally Protected' species in Peninsular Malaysia. Essentially, the hunting and trade of protected species is possible with a permit, while hunting and trade in totally protected species is strictly prohibited. However, this difference in protection status complicates enforcement efforts in identifying and determining the source of the species in trade. In Indonesia, five porcupine species exist, but only one (*H. javanica*; endemic to Java, Bali and surrounding islands) is protected (Table 2). This leaves the remaining species vulnerable to exploitation. Further, the Thick-spined porcupine (*H. crassispinis*, endemic to the island of Borneo) is protected in Sabah and Sarawak, but not in Indonesia's Kalimantan, which further complicates enforcement efforts to monitor uptake and trade of the species. That said, the harvest of wild non-protected species in Indonesia are generally governed by annually set quotas dedicated for domestic use and/or export. Currently no quotas exist for porcupines, which technically means that trade in any porcupine species is illegal in Indonesia. In addition, as none of the porcupine species are currently listed on the Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the international trade in porcupines is likely to be neither detected nor regulated, rendering determination of uptake for trade much more difficult.

There are also farms that breed porcupines, for example in Vietnam, Indonesia, Malaysia and Thailand. However, there is also anecdotal evidence of some illegitimate porcupine farms that supply captive bred or wild animals, or a mix of both, for the meat and bezoar trade (Brooks et al., 2010; C. Shepherd, pers. Comm.). It is uncertain how many of the advertised bezoars from our study came from farmed animals, and how many from wild-caught animals. The low average quantity of bezoars for sale per seller might suggest that they do not come from porcupine farms. One Instagram seller, for example, also indicated they regularly visit the local communities who hunt porcupines in the wild and purchase the bezoars to stockpile them for later sale. Another seller posted images of both dead porcupines and harvested bezoars (Fig. 3).

4.3. Trade impacts and threats to the hystricidae

The Malayan porcupine is likely the main species of Asian porcupines in trade, both for its meat, but also its bezoar, mainly due to its wide distribution. Hystricidae in general, and specifically *H. brachyura* have been shown to be overrepresented in illegal trade in Cambodia (Heinrich et al., 2020) and the species is often encountered in trade elsewhere in Asia (Norsuhana et al., 2012). It was once widespread in Singapore, but populations have been greatly reduced (Chung et al., 2016). Populations have also been reduced by 20% in the 1990s in Vietnam, where it is often farmed (Nowak, 1999). The farming reportedly does not have a positive conservation impact, as wild Malayan porcupines are usually caught to re-stock existing captive populations, and demand for porcupines is on the rise (Brooks et al., 2010). Norsuhana et al. (2012) also found that consumers in Malaysia preferred wild over captive bred porcupine meat. Concerns have been raised about potential population declines, largely due to overhunting, for different species of Asian porcupines, including *H. javanica* (Mustikasari et al., 2019), *A. macrourus* (Dhendup and Dorji, 2017), and *H. brachyura* (Farida et al., 2019). In contrast to other parts of Asia, *H. brachyura* appears to have increased in Hong Kong (Chung and Corlett, 2006), although this information, from over 14 years ago, may be outdated by now due to increasing demand for porcupine parts throughout Asia. Unfortunately, we were unable to distinguish between species in this study, but the geographic distribution of the trade suggests that more species than just *H. brachyura* are involved in this trade.

The main threats all species of porcupine face are habitat loss and unsustainable exploitation, and porcupines may be more susceptible to these threats than previously assumed. The IUCN classifies all Asian porcupine species as Least Concern, with the exception of *H. pumila* (Clayton, 2018). Given that in the current IUCN Redlist assessments international trade is generally not considered a threat to most Asian porcupine species, their status may need updating, potentially to a higher threat category, to reflect this. As some species can reach fairly high densities in certain areas, they are also often persecuted as agricultural pests (Alkon and Saltz, 1985; Barthelmess, 2016). Further to the threats of habitat loss, preventative or retaliatory killings, and targeted hunting, porcupines are, like many other animals in the region, increasingly threatened by the widespread use of snares in Southeast Asia. Snares are non-selective and cheap to replace, and their use is depleting native species

Table 2
Protection status of the different porcupine species native to Indonesia, Malaysia, and Singapore.

Country	Species	IUCN Red List Assessment	Protection Status	Law	Notes
Indonesia	Long-tailed porcupine (*T. fasciculata*)	LC Hunted for food but unlikely to have impact on populations	Not protected	–	–
	Malayan porcupine (*H. brachyura*)	LC Hunted for food and medicinal use but not considered a threat to populations	Not protected	–	–
Endemic to Sumatra	Sumatran porcupine (*H. sumatrae*)	LC No major threats described/no data on use and trade	Not protected	–	Used to be protected under the old species protection list, prior to 2018
Endemic to Java, Bali, Sumbawa, Flores, Lombok, Madura, and Tonahdjampea	Sunda porcupine (*H. javanica*)	LC No major threats described/no data on use and trade	Protected	Act of the Republic of Indonesia no. 5 of 1990 concerning conservation of living resources and their ecosystems; & Government Regulation no. 7 of 1999 on preservation of flora and fauna (GR 7/1999)	No harvesting/trade is allowed without a permit
Endemic to Borneo Island	Thick-spined porcupine (*H. crassispinis*)	LC No major threats described/no data on use and trade	Not protected	–	–
Country	**Species**	**IUCN Red List Assessment**	**Protection Status**	**Law**	**Notes**
Malaysia	Asiatic Brush-tailed porcupine (A. macrourus)	LC Threatened by habitat loss and harvesting for food/no data on use and trade	Protected Protected	PM: Wildlife Conservation Act 2010 SK: Wildlife Protection Ordinance 1998	Unlicensed hunting/trade in 'protected' species is illegal while hunting/trade in 'totally protected 'species is strictly prohibited
	Long-tailed porcupine (*T. fasciculata*)	LC Hunted for food but unlikely to have impact on populations	Totally Protected Protected Protected	PM: Wildlife Conservation Act 2010 SA: Wildlife Conservation Enactment SK: Wildlife Protection Ordinance 1998	
	Malayan porcupine (*H. brachyura*)	LC Hunted for food and medicinal use but not considered a threat to populations	Protected Protected	PM: Wildlife Conservation Act 2010 SK: Wildlife Protection Ordinance 1998	
Endemic to Borneo Island	Thick-spined porcupine (*H. crassispinis*)	LC No major threats described/no data on use and trade	Protected Protected	SA: Wildlife Conservation Enactment SK: Wildlife Protection Ordinance 1998	
Singapore	Malayan porcupine (*H. brachyura*)	LC Hunted for food and medicinal use but not considered a threat to populations	Protected	Wild Animal and Bird Act 1965	Prohibits the hunting/trade of any wild animal or bird without a permit

(PM: Peninsular Malaysia (mainland), SA: Sabah (Borneo Island), SK: Sarawak (Borneo Island)).

populations in Southeast Asia's forests at alarming rates (Gray et al., 2018; Heinrich et al., 2020). Further, Asian porcupines show a high rate of endemism, with half of all Asian porcupine species endemic to islands: the Sumatran porcupine (*H.sumatrae*) and Sunda porcupine (*H.javanica*) are endemic to different islands in Indonesia; the Philippine porcupine (*H. pumila*) endemic to small islands in the Philippines; and the Thick-spined porcupine (*H.crassispinis*) endemic to Borneo (Barthelmess, 2016). We found listings from sellers on Borneo, Java, and Sumatra, suggesting that species endemic to these islands may also be involved in this trade. Island endemic species face a greater risk of extinction than mainland species and the effect of hunting and associated trade urgently requires further research.

Another interesting feature is that species of Hystricidae, e.g., Cape porcupine (*H. africaeaustralis*), Crested porcupine (*H. cristata*), Indian porcupine (*H. indica*), and potentially Asiatic Brush-tailed porcupine (*A. macrourus*) and other Asian species are monogamous (Lovari et al., 2013; Barthelmess, 2016). Parental care is long, intense, and generally well developed among species of Hystricidae (Gosling, 2009; Barthelmess, 2016). Further, Old-world porcupines are long lived with reports of captive individuals living over 20 years (Barthelmess, 2016). The average generation length is indicated at 7 years (IUCN, 2019). Depending on the species, Asian porcupines bear between one and (seldom) six offspring per year (Gosling, 2009;

Fig. 3. Instagram profile of anonymised individual advertising porcupine bezoars for sale.

Barthelmess, 2016; IUCN, 2019) and African Brush-tailed porcupines (*A. africanus*) only reach sexual maturity at 2 years of age (Barthelmess, 2016). All of these factors (i.e., longevity, well developed and long-lasting parental care, well-developed social structures, and monogamy) suggest that unsustainable exploitation and associated disruptions in their social structure could have negative impacts on their breeding success and long-term survival. There is currently no information available on the social structure or breeding ecology of any of the four island endemic species and only limited information on the remaining four Asian species, all of which urgently needs to be addressed. Further, porcupines are prey species (Kawanishi and Sunquist, 2004; Barthelmess, 2016) and some species of Hystricidae are ecosystem engineers (Barthelmess, 2016), providing habitat for a variety of species. Thus, unsustainable exploitation of porcupines may ultimately also impact other potentially endangered species of a variety of taxa.

5. Conclusion

We found porcupine bezoars for sale on online platforms in Indonesia, Malaysia and Singapore. Our study highlights the occurrence of this trade, likely across borders, in Southeast Asia and the potential threat that the different porcupine species face should they continue to be overexploited. Due to the apparent high demand for porcupine bezoars, but also their meat and other body parts, we urge consumer and source countries to monitor and regulate the domestic and international trade in all porcupine products. Indonesia must take action against porcupine trade taking place outside their quota system, which is technically illegal. In all countries, the enforcement of existing legislation regulating the domestic trade should be enhanced and stronger legislation should be considered to prevent overexploitation at national levels. To monitor and regulate international trade the Hystricidae would potentially benefit from a listing on CITES Appendix II, to avoid them declining at such rates that they may become threatened in the future. For this, further research is necessary to estimate the extent of the international, but also the domestic trade, and the impact it has on porcupine populations. An analysis of seizures may be warranted to gauge the extent of illegal trade and identify potential legislative loopholes. Forensic tools for rapid identification and authentication of porcupine bezoars may need to be developed.

Declaration of competing interest

The authors declare 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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References

Alkon, P.U., Saltz, D., 1985. Patterns of crested porcupine (Hystrix indica) damage to cultivated potatoes. Agric. Ecosyst. Environ. 14 (3—4), 171—183.
Altaf, M., Umair, M., Abbasi, A.R., Muhammad, N., Abbasi, A.M., 2018. Ethnomedicinal applications of animal species by the local communities of Punjab, Pakistan. J. Ethnobiol. Ethnomed. 14 (1), 55.
Barthelmess, E.L., 2016. Family Hystricidae (Old world porcupines). In: Wilson, D.E., Larcher, T.E., Mittermeier, R.A. (Eds.), *Handbook Of the Mammals Of the World*. 6 (Lagomorphs and Rodents I): 304-330. Lynx Edicions, Barcelona.

Basa, O., Nebesse, C., Kaswera, C., Tsongo, J., Gambalemoke, S., 2017. Bush meat sold on the markets in Kisangani: analysis addressed to the right on species conservation in the Democratic Republic of the Congo. Int. J. Environ. Agri. Biotech. 2 (2).
Bodmer, R.E., Lozano, E.P., 2001. Rural development and sustainable wildlife use in Peru. Conserv. Biol. 15 (4), 1163–1170.
Borschberg, P., 2006. The trade, forgery and medicinal use of porcupine bezoars in the early Modern Period (c. 1500–1750). Orient 14, 60–78.
Brooks, E.G.E., Roberton, S.I., Bell, D.J., 2010. The conservation impact of commercial wildlife farming of porcupines in Vietnam. Biol. Conserv. 143 (11), 2808–2814.
Cantlay, J.C., Ingram, D.J., Meredith, A.L., 2017. A review of zoonotic infection risks associated with the wild meat trade in Malaysia. EcoHealth 14 (2), 361–388.
Cheng, J., Karambelkar, B., Xie, Y., 2018. Leaflet: Create Interactive Web Maps with the JavaScript "Leaflet" Library. R Package Version 2.0.2. https://CRAN.R-project.org/package=leaflet.
Chevallier, N., Ashton, B., 2006. A Report on the Porcupine Quill Trade in South Africa. IFAW.
Chung, K.P., Corlett, R.T., 2006. Rodent diversity in a highly degraded tropical landscape: Hong Kong, South China. Biodivers. Conserv. 15 (14), 4521–4532.
Chung, Y., Lim, N., Shunari, M., Wang, D., Chan, S., 2016. Records of the malayan porcupine, Hystrix brachyura (mammalia: Rodentia: Hystricidae) in Singapore. Nat. Singapore 9, 63–68.
Clayton, E., 2018. Hystrix Pumila. https://doi.org/10.2305/IUCN.UK.2018-1.RLTS.T10753A22231557.en. Viewed 19 November 2019.
Dan, Y., Qian, Z.Z., Peng, Y., Chen, C.Q., Liu, Y.Z., Tai, W., Qi, J.W., 2016. Revision and improvement of criterion on traditional Chinese medicines in Chinese pharmacopoeia 2015. Chin. Herbal Med. 8 (3), 196–208.
Dhendup, T., Dorji, R., 2017. First record of the asiatic brush-tailed porcupine Atherurus macrourus linnaeus, 1758 (mammalia: Rodentia: Hystricidae) from western Bhutan. J. Threat. Taxa 9 (11), 10959–10960.
Duffin, C.J., 2013. Porcupine stones. Pharm. Hist. 43 (1), 13–22.
Fa, J.E., Yuste, J.E.G., Castelo, R., 2000. Bushmeat markets on Bioko Island as a measure of hunting pressure. Conserv. Biol. 14 (6), 1602–1613.
Farida, W.R., Sari, A.P., Inayah, N., Nugroho, H.A., 2019. Observations of behavioral development on common Porcupines (Hystrix brachyura) undergoing domestication. IOP Conf. Ser. Earth Environ. Sci. 308.
Gomez, L., Shepherd, C.R., Khoo, M.S., 2020. Illegal trade of sun bear parts in the Malaysian states of Sabah and Sarawak. Endanger. Species Res. 41, 279–287. https://doi.org/10.3354/esr01028.
Gosling, L., 2009. Reproduction of the Himalayan porcupine (Hystrix hodgsom) in captivity. J. Zool. 192, 546–549.
Gray, T.N.E., Hughes, A.C., Laurance, W.F., Long, B., Lynam, A.J., O'Kelly, H., Ripple, W.J., Seng, T., Scotson, L., Wilkinson, N.M., 2018. The wildlife snaring crisis: an insidious and pervasive threat to biodiversity in Southeast Asia. Biodivers. Conserv. 27 (4), 1031–1037.
Harrison, R.D., 2011. Emptying the forest: hunting and the extirpation of wildlife from tropical nature reserves. Bioscience 61 (11), 919–924.
Heinrich, S., Ross, J.V., Gray, T.N.E., Delean, S., Marx, N., Cassey, P., 2020. Plight of the commons: 17 years of wildlife trafficking in Cambodia. Biol. Conserv. 241.
Heinrich, S., Wittmann, T.A., Prowse, T.A., Ross, J.V., Delean, S., Shepherd, C.R., Cassey, P., 2016. Where did all the pangolins go? International CITES trade in pangolin species. Glob. Ecol. Conser. 8, 241–253.
IUCN, 2019. The IUCN Red List of Threatened Species, Version 2019-2.
Kawanishi, K., Sunquist, M.E., 2004. Conservation status of tigers in a primary rainforest of Peninsular Malaysia. Biol. Conserv. 120 (3), 329–344.
Lavorgna, A., 2014. Wildlife trafficking in the Internet age. Crime Sci. 3 (5) https://doi.org/10.1186/s40163-014-0005-2.
Lovari, S., Sforzi, A., Mori, E., 2013. Habitat richness affects home range size in a monogamous large rodent. Behav. Process. 99, 42–46.
Lunde, D., Aplin, K., Molur, S., 2016. Hystrix Brachyura (Errata Version Published in 2017). The IUCN Red List of Threatened Species. Viewed 19 November 2019.
Luskin, M., Christina, E., Kelley, L., Potts, M., 2014. Modern hunting practices and wild meat trade in the oil palm plantation-dominated landscapes of Sumatra, Indonesia. Hum. Ecol. 42 (1), 35–45.
Manzar, A., Nehvi, F., 2012. Indian crested porcupine Hystrix indica Kerr (Rodentia: Hystricidae): an emerging threat to saffron cultivation in Jammu and Kashmir. IV Int. Symposium Saffron Biol. Technol. 1200, 133–138.
Mori, E., Sforzi, A., 2013. Structure of phytobezoars found in the stomach of a crested porcupine, Hystrix cristata L., 1758. Folia Zoologica 62 (3), 232–235.
Mustikasari, I.A., Withaningsih, S., Megantara, E.N., Husodo, T., Parikesit, P., 2019. Population and distribution of Sunda porcupine (Hystrix javanica F. Cuvier, 1823) in designated area of cisokan hydropower, west Java, Indonesia. Biodiver. J. Biol. Div. 20 (3), 762–769.
Natusch, D.J., Lyons, J.A., Riyanto, A., Shine, R., 2016. Jungle giants: assessing sustainable harvesting in a difficult-to-survey species (Python reticulatus). PloS One 11 (7), e0158397.
Newton, P., Nguyen, T.V., Roberton, S., Bell, D., 2008. Pangolins in peril: using local hunters knowledge to conserve elusive species in Vietnam. Endanger. Species Res. 6, 41–53.
Nijman, V., 2005. Decline of the endemic hose's langur Presbytis hosei in kayan mentarang national park, East Borneo. Oryx 39 (2), 223–226.
Nijman, V., Shepherd, C.R., 2015. Adding up the Numbers: an Investigation into Commercial Breeding of Tokay Geckos in Indonesia. TRAFFIC, Petaling Jaya, Selangor, Malaysia.
Nijman, V., 2020. Illegal trade in Indonesia's National Rare Animal has moved online. Oryx 54, 12–13 (Cambridge University Press).
Norsuhana, A., Shukor, M., Aminah, A., 2012. Perceptions on captive malayan porcupine (Hystrix brachyura) meat by Malaysian urban consumers. Health Environ J 3 (1), 67–78.
Nowak, R.M., 1999. Hystricidae: Old world porcupines. In: Nowak, R.M., Walker, E.P. (Eds.), Walker's Mammals of the World, vol. 2. JHU press.
Rovie-Ryan, J.J., Khan, F.A.A., Zahari, Z., Zainuddin, A.H.A., Gani, M., Julaihi, A.M., Saaban, S., 2017. Molecular phylogeny of the Old world porcupines (family Hystricidae) using mitochondrial cytochrome B gene. J. Sustain. Sci. Manag. 12 (1), 1–11.
Sigouin, A., Pinedo-Vasquez, M., Nasi, R., Poole, C., Horne, B., Tien, M., 2017. Priorities for the trade of less charismatic freshwater turtle and tortoise species. J. Appl. Ecol. 54 (2).
Siriwat, P., Nijman, V., 2018. Illegal pet trade on social media as an emerging impediment to the conservation of Asian otters species. J. Asia Pac. Bus. 11, 469–475.
Siriwat, P., Nijman, V., 2020. Wildlife trade shifts from brick-and-mortar markets to virtual marketplaces: a case study of birds of prey trade in Thailand. J. Asia Pac. Bus. https://doi.org/10.1016/j.japb.2020.03.012 in press.
Sodeinde, O., Soewu, D., 1999. Pilot Study of the Traditional Medicine Trade in Nigeria. TRAFFIC Bulletin, vol. 18. TRAFFIC International, Cambridge (UK), pp. 35–40.
Talukdar, N.R., Choudhury, P., Singh, B., 2019. Current records of porcupine in northeast India: distribution, habitat preference and conservation. Trop. Ecol. 60 (1), 41–51.
Tan, C.S., Ng, C.H., Loh, Y.C., Yam, M.F., 2019. A traditional folk medicine in Malaysia: porcupine bezoar. Orient. Pharm. Exp. Med. 19 (2), 131–136.
Wong, L.P., AbuBakar, S., 2013. Health beliefs and practices related to dengue fever: a focus group study. PLoS Neglected Trop. Dis. 7 (7), e2310.
Yew, P.N., Goh, B.H., Lim, Y.Y., Lee, W.L., 2018. Gastrointestinal bezoar stones: current knowledge and future perspective on the potential of plant-derived phytobezoar in cancer treatment. In: Akhtar, M.S., Swamy, M.K. (Eds.), Anticancer Plants: Natural Products and Biotechnological Implements:, vol. 2. Springer Singapore, Singapore, pp. 19–39.

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Original Research Article

Illegal wildlife trade, seizures and prosecutions: A 7.5-year analysis of trade in pig-nosed turtles *Carettochelys insculpta* in and from Indonesia

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ABSTRACT

The illegal wildlife trade is increasingly recognised as a major threat to biodiversity conservation, and one way of curbing it is to properly enforce existing legislation and where appropriate to prosecute to the full extent of the law. One of the taxa that suffers greatly from unregulated trade are the tortoises and freshwater turtles, with collection for trade currently being the most significant threat for most Asian species. Illegal trade in pig-nosed turtles from Indonesia to supply international demand for pets, and to a lesser degree for meat and use in traditional medicines, continues on a large scale. We examined 26 reported seizures over the period 2013 to 2020, of which 20 took place in Indonesia and the remaining five in other parts of Asia with the turtles being trafficked from Indonesia. In total, this amounted to the seizure of 52,374 pig-nosed turtles. Pig-nosed turtles are totally protected in Indonesia, and nine of the 26 cases we examined were successfully prosecuted though never to the full extent of the law. Trade in and trafficking of pig-nosed turtles is in violation of Indonesia's Fisheries and Customs Acts, yet these legal instruments were not used for prosecutions. In addition to the illegal trade, the Indonesia CITES Management Authority reported the export of 5415 pig-nosed turtles, 95% of which were declared as wild-caught, in direct contravention of Indonesia's own protected species legislation. We strongly recommend a strategy be developed and implemented to more effectively tackle this trade from point of collection through to point of sale, with improved use of all relevant pieces of national legislation to serve as a strong deterrent, and ultimately to protect this species from over-exploitation.

1. Introduction

Wildlife trade is increasingly recognised as a major threat to biodiversity conservation. One of the taxa that suffers greatly from unregulated trade are the tortoises and freshwater turtles, with collection for trade currently being the most significant threat for most Asian species (van Dijk et al., 2000; Cheung and Dudgeon, 2006; Rhodin et al., 2018; Stanford et al., 2020). Many of the traded species are considered globally threatened, are protected at the national level and/or are listed on one of the CITES Appendices. A special resolution on the conservation of, and the trade in, tortoises and freshwater turtles was

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adopted during CITES' 11th Conference of the Parties, which requests the involved countries to faithfully enforce their policies in order to conserve these species. Tortoises and freshwater turtles are collected and traded for a variety of purposes; the animals are kept as pets, used for consumption or used for the production of traditional Asian medicine. The exploited populations are increasingly depleted by illegal collection, causing local declines and extirpations. To continue the supply, regular shifts in collection areas are necessary, eventually leading to the disappearance of these animals throughout Asia (van Dijk et al., 2000). We here focus on the trade in pig-nosed turtle *Carettochelys insculpta.*

The pig-nosed turtle has a disjunct distribution on the island of New Guinea and northernmost Australia, covering three countries (Australia, Indonesia and Papua New Guinea). It appears to be found in all major and some of the smaller south-flowing rivers of Papua New Guinea and the Indonesian province of Papua, although the exact boundaries of its distribution are not clear (Georges et al., 2008). In Australia, it is found in the northern territories, east to the East Alligator River and west to the Victoria River, though, as on the island of New Guinea, the full extent of its Australian distribution is unclear (Georges et al., 2008). Pig-nosed turtle are unique among freshwater turtles as the genus is monotypic with no recognised subspecies (Georges et al., 2008).

The major threats to pig-nosed turtles include the international wildlife trade, collection of eggs and the turtles for local consumption within its native range and destruction of habitat (Georges et al., 2008; Burgess and Lilley, 2014; Eisemberg et al., 2018). Of these, demand for pets in the international market may pose the greatest and most immediate threat (Burgess and Lilley, 2014). While the species is protected throughout its range and all international trade is regulated a substantial illicit trade persists. Indonesia, the epicentre of illegal harvest and trade, is the greatest source of this species entering into illegal trade, both domestically to western Indonesia and internationally to a wide range of countries. Burgess and Lilley (2014) provided a comprehensive overview of the harvest and trade in this species. They examined the harvest of eggs that are hatched for sale, the smuggling of eggs and hatchlings within Indonesia and related aspects of the illegal trade in this species. They also reported that from 2003 to 2012, 32 seizures of pig-nosed turtles, including more than 80,000 individual turtles took place, with three-quarters of these seizures taking place early in the calendar year (between January–March) towards the end of the nesting season for pig-nosed turtles, suggesting that traders are moving shipments as soon as the turtles are hatched (Burgess and Lilley, 2014). Seizures involved large numbers of turtles, with consignments of up to 12,000 individuals per seizure, illustrating the commercial scale of the trade. In the period up to 2012 most seizures occurred at points of export from Indonesia, though some seizures outside of Indonesia were made, viz. in the United States of America (four cases), Hong Kong (two cases) and Thailand (one case) (Burgess and Lilley, 2014).

We here build upon the work of Burgess and Lilley (2014) and we examine seizures made of pig-nosed turtles involving Indonesia from January 2013–June 2020 to determine current trafficking levels; we explore contemporary trade networks and trade hubs, map routes, assess successful prosecutions, and comment on the release of confiscated turtles back into the wild. Finally, based on our finding we make a series of explicit recommendations to catalyze and support future enforcement and/or conservation interventions.

Given that trade has long been recognised as a threat to pig-nosed turtles in Indonesia a number of legislative measures are in place to protect the species, to prevent the species from illegal exploitation and to regulate any trade that is allowed. Pig-nosed turtles are totally protected in Indonesia, under the Government Regulation No. 20 of 2018 and prior to that under Government Regulation No 8 of 1999. Guidance on how to implement this regulation and what penalties to impose are given in Regulation 8 of 1999 and Act Number 5 of 1990. Violation of the law carries a maximum five-year prison sentence and a fine of USD7,132 (all prices are presented here in USD using June 2020 conversion rates of 14,000 Indonesian rupiah to the dollar; where appropriate prices are corrected for inflation). Protected species are not allowed to be traded, but an exception is made for a limited number of species for which it is permitted to trade individuals that are captive bred second (F2) and subsequent generations. Pig-nosed turtles are included on this list and typically less than 500 captive-bred individuals are allowed to be exported per year.

According to Indonesia's Fisheries Act No 31 (2004, amended in 2009) 'fish' is defined as all organisms that occur in water for all or a part of their life cycle. 'Fish' thus also includes pig-nosed turtles. Commercial fishing requires a licence, but small-scale fishers are exempt provided they are registered as such. Transporting fish (including pig-nosed turtles) always requires a licence. Operating a fishing business without a licence is punishable by eight years imprisonment and a fine of USD106,975 and illegally transporting fish (again, including pig-nosed turtles) can lead to a prison term of five years and a USD106,975 fine. Transporting animals from one area in Indonesia to another, as for instance from the province of Papua to the province of West Java, or exporting or importing animals, is subject to the rules and regulations as stipulated in Law 16 (1992) concerning the Quarantine of Animals, Fish and Plants. Violation of this can be penalised by three years imprisonment and a USD10,698 fine.

At an international level, pig-nosed turtles have been listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) since 2005. This means that any export has to be approved by the CITES Management Authorities (CITES MA) of the exporting country, normally after a Non-detriment Finding (NDF) has shown that the export does not negatively affect the source population. Indonesia, as the main source of pig-nosed turtles entering the illegal global market has been a Party to CITES since 1979. Australia and Papua New Guinea, as the other range countries of this species, have both been Party to CITES since 1976, and export of this species from these two countries is prohibited by law. CITES itself cannot impose fines to individuals when its rules and intentions are violated as it is up to the countries that are Party to CITES to enact domestic legislation that allows for the enforcement of the Convention. When pig-nosed turtles are exported from Indonesia without declaring them or intentionally declaring them incorrectly this is in violation of the Customs

Law 10 of 1995 (amended in 2006). This is a criminal offence and carries a maximum penalty of imprisonment for up to 10 years and a fine of USD356,583.

2. Methods and materials

2.1. Seizure reports

We collected records of seizures involving pig-nosed turtles in Indonesia for the period January 2013–June 2020 from a variety of sources, including open access media reports, published literature, the CITES Trade Database and the Indonesian Government's Case Search Information System (*Sistem Informasi Penelusuran Perkara*, SIPP), which is an online information database of the courts for each district in Indonesia. Cases involving this species were searched for and downloaded from the SIPP database for every district in Indonesia. In January 2020 we requested data regarding seizures and associated prosecutions related to pig-nosed turtle from the Indonesian CITES MA but as of August 2020 we did not receive a response to our request. To determine trade routes in the illegal trafficking of pig-nosed turtles from Indonesia, we requested seizure data of pig-nosed turtles in neighboring countries (provided that Indonesia was the source) from the CITES MAs of China, Malaysia, Papua New Guinea, the Philippines, Singapore, Thailand and Vietnam. Only the Malaysian CITES MA in Peninsular Malaysia (viz. the Department of Wildlife and National Parks Peninsular Malaysia), responded positively with the seizure data. We carried out an online search for seizures of pig-nosed turtles in English (using search words: pig-nosed turtle, seizures, confiscations) and Bahasa Indonesia (search words: kura kura moncong babi, sita, bksda, bea cukai) for the period January 2013 to June 2020 and made every effort to determine the location of each seizure, the known source and destinations of the shipments and the volumes of pig-nosed turtles in each seizure and known destination. When more than one report was located on the same seizure and conflicting data was presented, we relied on the source with the most detailed information.

2.2. Prosecution of offenders and release of confiscated pig-nosed turtles

For each of the seizure reports we searched for follow-up reports on successful prosecution, including those reported in the SIPP database. Details of focus were the number of individuals in each seizure, other protected species seized, the location of the seizure and the intended destination (allowing us to contrast domestic from intended international trade), the number of people arrested or apprehended, their nationalities, and resulting penalties relating to each seizure.

For each seizure report we tried to find publicly available data on whether or not the confiscated animals in Indonesia were released, and if so, in what numbers, when and where. In addition, reports from seizures made outside Indonesia referred to the (future) release of turtles back into the wild. We compiled this information similar to that of the seizure reports. In addition, for the same time period, we searched for reports in English (search words: pig-nosed turtle, release) and Bahasa Indonesia (search words: kura kura moncong babi, dilepasliarkan, bksda) to add to our database.

2.3. Analysis

We expect a high degree of alignment between the seizures as reported in the media and levels of prosecution, certainly in cases where large quantities of pig-nosed turtles are seized. We expect seizures to occur at all months of the year; we compare the observed seizures (incidents and number of turtles involved) with what would be expected if these were distributed equally over the year with χ^2 tests and Pearson's correlation coefficients. We tested for differences in seizures and the number of turtles in the seizure between the nesting (September–February) and non-nesting (March–August) period (Burgess and Lilly, 2014) using t-tests. Were appropriate data were log-transformed prior to statistical analysis to approach a normal distribution more closely. All tests were two-tailed and we expect significance when $P < 0.05$.

3. Results

From January 2013 to June 2020, 26 reported seizure incidents of pig-nosed turtles involving Indonesia were analysed (Fig. 1). All incidents were of live animals at the time of seizure amounting to 52,374 individuals. Of the 26 incidents, 20 occurred within Indonesia i.e. the island of Bali, Greater Jakarta, and the provinces of Papua and West Java. Most of these incidents occurred in Papua Province (seven incidents) and Greater Jakarta (9 incidents); the latter including eight incidents involving seized shipments at the Soekarno Hatta International Airport. The numbers in Papua amounted to the highest number of pig-nosed turtles seized at 19,700 individuals. This was followed by Java (11 incidents in total) encompassing Greater Jakarta, West Java and Soekarno Hatta International Airport, with 10,034 individuals seized, and Bali (two incidents) with 7684 individuals seized. The remaining six incidents occurred outside of Indonesia i.e. mainland China (one incident), Hong Kong (three incidents) and Malaysia (two incidents) with Indonesia reported as the source country amounting to 10,956 pig-nosed turtles seized.

The number of pig-nosed turtles seized varied considerably between years, with highs of 15,855 in 2014 and lows of 687 in 2013 and 160 in 2017, but no clear temporal pattern is apparent (Fig. 2). Comparing the number of turtles that were seized in the first six months of the year (to make them comparable with 2002 for which we only have data from the first six months) shows no increase or decrease over time (Pearson's $R = 0.184$, $P = 0.663$). The 12-months running mean over this period

Fig. 1. Seizures and release of confiscated of pig-nosed turtles *Carettochelys insculpta* as reported in the Indonesian media.

varies from 12,000 or more individuals being seized in 2014, 2015 and 2019 and less than 2000 individuals in 2016, 2017 and 2020 (Fig. 1). The number of seizures varies from one in 2013 to six in 2018, but no temporal pattern emerges. In years when there are more seizures, not more individual pig-nosed turtles are confiscated (Pearson's $R = 0.5363$, $P = 0.171$). It is unclear if the higher number of seizures in one year is the result of more stringent enforcement and an intensification of inspections or if it just a matter of chance or pure luck.

Seizures occurred during all months of the year but with a clear preponderance for the months of January to March (Fig. 3). Directly comparing the nesting vs the non-nesting period (i.e. September to February vs March to August) shows that there were fewer seizures during the non-nesting period (mean of 1.7 per month vs 2.6 per month) but the difference was not statistically different (*t*-test, $t = 0.819$, $P = 0.432$). The number of pig-nosed turtles included in the seizures was lower in the non-nesting period than in the nesting period (mean of 1649 vs 2118) but again the difference in not significant ($t = 0.782$, $P = 0.442$). The mean number of turtles seized was not homogeneously distributed over the 12 months of the year ($\chi^2 = 15284$, $P < 0.0001$), with only June having the number of turtles seized as expected if they were homogeneously

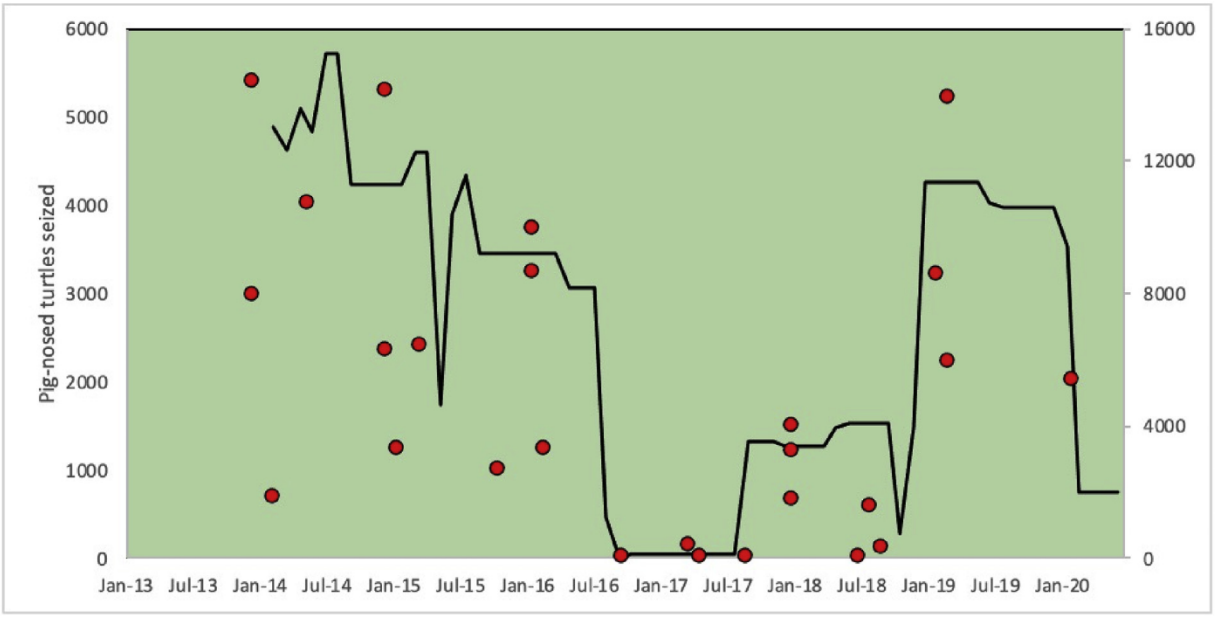

Fig. 2. Seizures of pig-nosed turtles *Carettochelys insculpta* in and from Indonesia over the period January 2013 to June 2020. Red dots represent individual seizures and the black line represent a 12 month running average. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

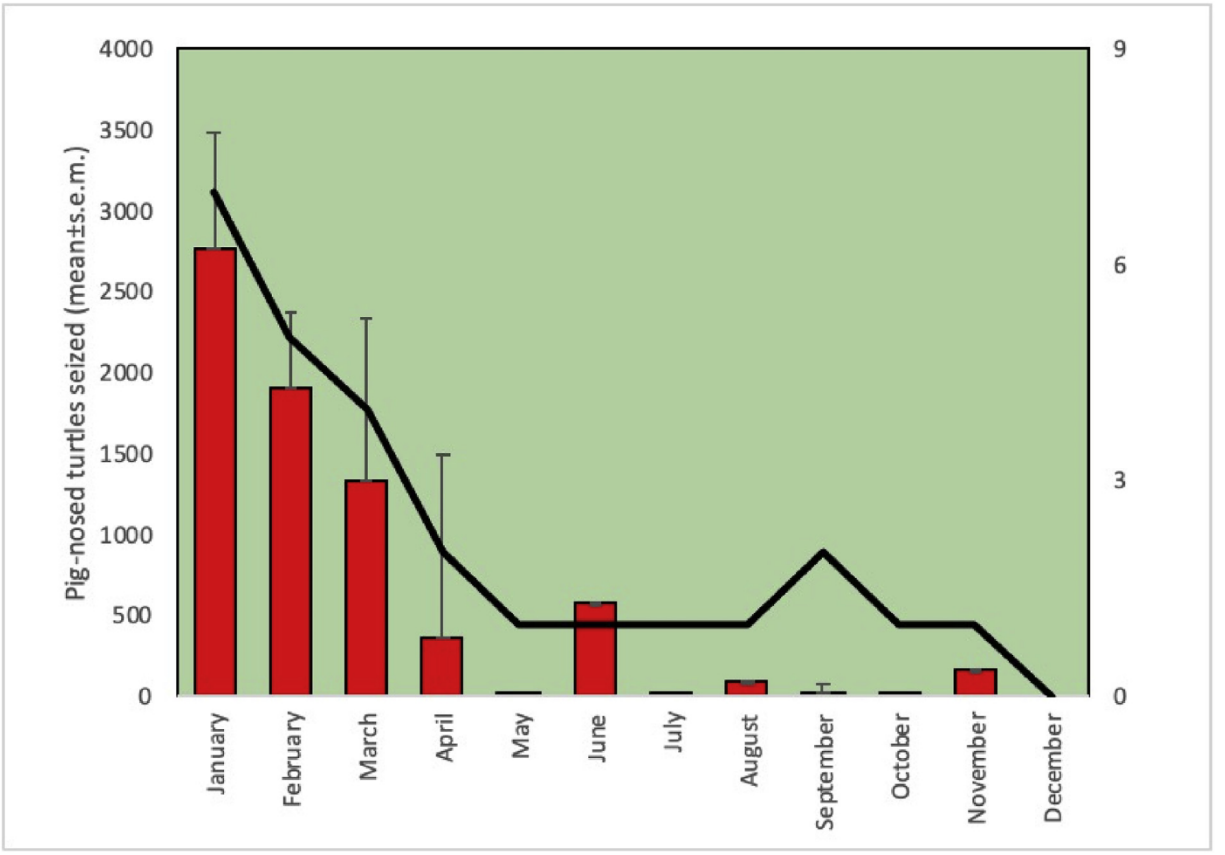

Fig. 3. Seizure incidents (black line) and mean number of individuals seized (red bars) of pig-nosed turtle *Carettochelys insculpta* by month for the period January 2013 to June 2020 showing a preponderance of seizures in the later part of the breeding season which last from September to February. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

distributed. The number of seizures, likewise, was not homogeneously distributed over the 12 months of the year ($\chi^2 = 21.99$, $P < 0.0001$), but here only January and February differed from the other months combined ($\chi^2 = 11.76$, $P = 0.0006$ and $\chi^2 = 4.04$, $P = 0.044$, for January and February respectively).

About three quarters of incidents involved shipments seized at airports and ports/offshore including one incident in Bali, six incidents at the Soekarno Hatta International Airport near Jakarta, four incidents in Papua (i.e. three at airports and one at the port in Ambon), all three incidents in Hong Kong and one in China were at the international airports; and both incidents in Malaysia occurred in coastal waters. Based on the seizure data obtained, at least seven countries were implicated in the trafficking of pig-nosed turtles from Papua (Fig. 4). Mainland China, Hong Kong, Singapore and Malaysia were directly implicated with the seizure (seven incidents) of shipments that originated from Indonesia. In the case of mainland China and Hong Kong, seized shipments came directly from Jakarta's Soekarno Hatta International Airport. For Malaysia, one incident occurred off the waters of Johor, which was reportedly smuggled by boat from Bengkalis Island (part of Riau province, Indonesia) to Peninsular Malaysia; and one incident occurred off the coast of Sabah, part of Malaysian Borneo, near Tawau, which was intercepted by the Malaysian military police. Aside from this, there were another six incidents that occurred at the Soekarno Hatta International Airport which implicated mainland China (two incidents), Japan (one incident), Saudi Arabia (one incident) and Thailand (one incident) as destination countries and one incident in Jakarta that implicated Hong Kong and Taiwan. In four of these incidents, a foreign national from China, Japan, Saudi Arabia and Thailand respectively were arrested.

Of the 26 seizure records obtained, we found successful prosecution records for nine cases (41%) (Table 1). The highest sentence was given to a Japanese national and two Indonesians that were arrested in one case for trying to smuggle several turtles, one of which was a live pig-nosed turtle, to Japan in 2017 (Table 1). The Japanese national was sentenced to 2.5 years while the Indonesian nationals were sentenced to two years. The lowest penalty (four months jail and a fine of USD314 or additional two months jail) was given to an individual arrested for trying to smuggle 1195 pig-nosed turtles out of Papua Province. For six of the nine successful prosecutions it was clear what the specifics were of the charge - in four cases it was of violation of protected species legislation (Law 5 of 1990 and Regulation 20 of 2018; maximum fine five years in prison and a fine of USD7,132); in one case it was of violation of quarantine legislation (Quarantine Law 16 of 1992; maximum sentence three years in prison and USD10,698); and in one case it was both. As far as we can assess no one was charged for customs violations and failing to declare their export (Customs Law 10 of 1995; maximum sentence 10 years in prison and USD356,583

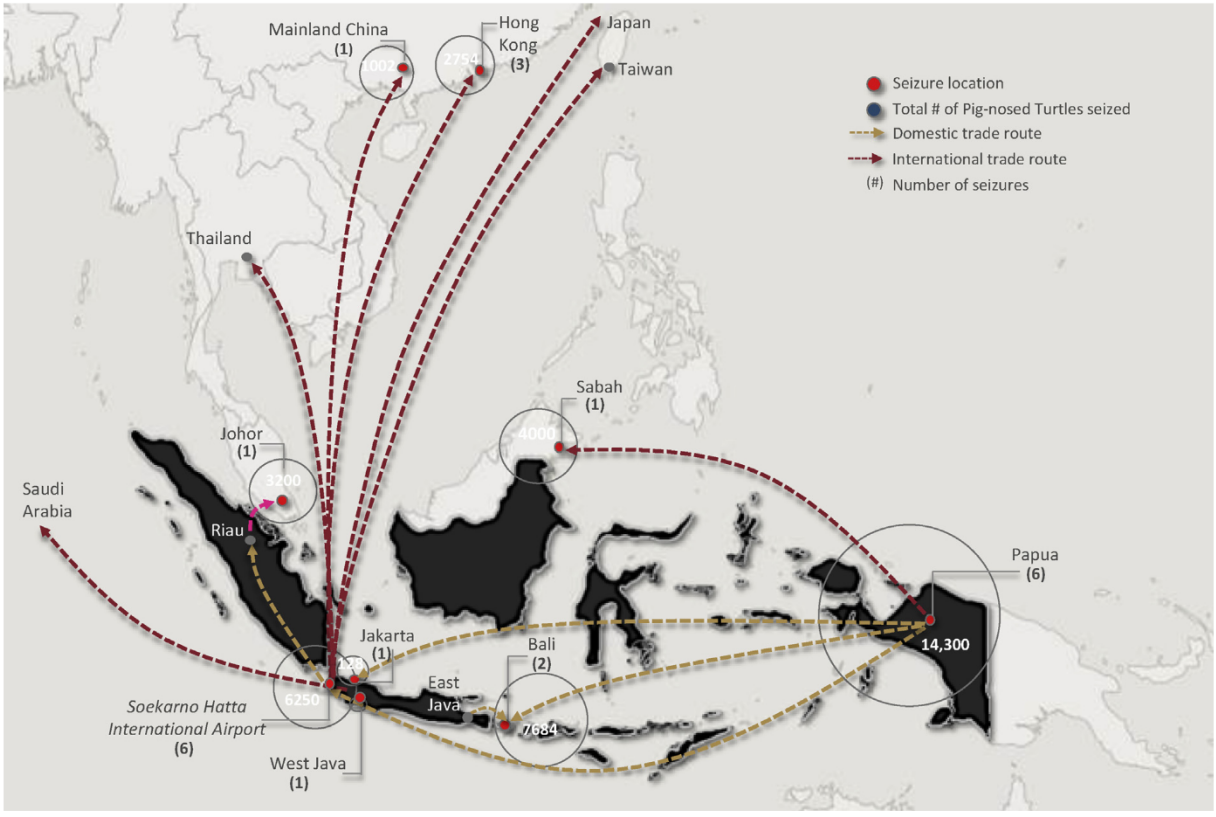

Fig. 4. The locations of pig-nosed turtle *Carettochelys insculpta* seizures that occurred in Indonesia, and several that occurred outside the country but reported Indonesia as the source; and quantities of individuals seized at each location. This is based on 26 seizure incidents obtained for the period January 2013 to June 2020.

Table 1
The number of seizures that resulted in arrests and convictions for the trafficking of pig-nosed turtles *Carettochelys insculpta* involving Indonesia from January 2013 to June 2020.

Date	Seizure Location	No. suspects	Evidence (all live)	Sentence
17-Jan-15	Soekarno Hatta International Airport	1 Indonesian	2350 pig-nosed turtles	6 months jail and USD627 fine (or additional 1 month jail)
16-May-17	Soekarno Hatta International Airport	1 Japan national, 2 Indonesians	1 pig-nosed turtle	Japan national: 2 years and 5 months jail and USD3,137 fine (or additional 2 months jail) for smuggling and 6 months jail and USD 627 fine (or additional 1 month jail) for not providing legal health/quarantine documents; Indonesian nationals: 2 years jail and USD6275 fine (or additional 3 months jail)
26-Jan-17	West Java	1 Indonesian	1 pig-nosed turtle	5 months jail and USD31 (or additional 1 month jail)
09-Jan-18	Mopah Merauke Airport	2 Indonesians	1195 pig-nosed turtles	1 person sentenced: 4 months jail and USD314 fine (or additional 2 months jail)
25-Aug-18	Hong Kong Airport	unknown	596 pig-nosed turtles	USD2,322 fine
26-Sep-18	Jakarta	9 Indonesians	128 pig-nosed turtles	1 person sentenced: 6 months jail and USD1255 fine (or additional 1 month jail)
26-Jul-18	Soekarno Hatta International Airport	1 Indonesian	3 pig-nosed turtles	1 year and 6 months jail and USD6,275 (or additional 2 months jail)
14-Mar-19	Papua Province	1 Indonesian	2227 pig-nosed turtles	1 year and 2 months jail and USD627 fine (or additional 2 months jail)
26-Mar-19	Papua Province	2 Indonesians	5202 live pig-nosed turtles (327 dead when seized)	1 year and 4 months jail and USD3,137 fine (or additional 3 months jail)

fine) or illegally transporting 'fish' (Fisheries Act 31; maximum prison term of five years and an USD106,975 fine). While three out of four seizures where foreign nationals were involved led to a successful prosecution and only six out of 11 cases where Indonesian nationals were involved led to a successful prosecution, the difference is not statistically different (Fisher's exact probability test, $P = 0.604$). When sentenced the mean jail time given to foreigners was 19.7 months and that to Indonesians 11.5 months, the difference not being statistically significant ($t = 0.946$, $P = 0.375$).

Finally we found one case of a penalty given to an Indonesian fined for the illegal trafficking of 596 pig-nosed turtles from Indonesia to Hong Kong. The Hong Kong authorities handed down a fine of USD2,322, and there were no details on suspects apprehended.

Indonesia reported exporting 5442 pig-nosed turtles for commercial purposes during this period (2013–2019) in the CITES Trade Database (Table 2). According to Indonesian law, pig-nosed turtles may only be exported for commercial purposes if captive bred to the second generation and beyond. Nine exports were reported, involving 5442 individual pig-nosed turtles. Of these, two exports totalling 50 turtles were declared as captive-bred (F2), three exports were declared as captive-born (F1) totalling 127 turtles, and three were declared as wild-caught totalling 5240 individual turtles. The vast majority of the turtles were destined for mainland China ($n = 3025$) and Hong Kong ($n = 2160$), with the remainder being exported to Japan ($n = 103$), the US ($n = 80$), the United Kingdom ($n = 48$) and the Philippines ($n = 26$).

We were able to find precise data on seized pig-nosed turtle release for five seizure incidents. Of the 8860 pig-nosed turtles seized in two seizures in Jakarta and Denpasar in January 2015, 6350 were released on 8 February 2015 in the Baki swamps, Asmat regency, Papua province. On 26 February 2016 it was announced that the 3250 pig-nosed turtles seized at Timika airport earlier that month were to be released in the Maurepan Mile 21 area of Freeport. On 20 August 2018,599 pig-nosed turtles that were part of two seizures in Hong Kong totalling 2158 individuals were released in the Kao River, Boven Digur regency. Finally, on 13 September 2018 1195 pig-nosed turtles were released in the Vreenskap River, Asmat regency; they were confiscated on 9 January 2018 at Merauke Airport.

In addition, we found several reports of pig-nosed turtles that were released in Papua over the period January 2013 to June 2020, but it was less clear when and where the individuals were seized. In 2013, 26,000 pig-nosed turtles were released in various parts of Papua and in early 2014, 2534 pig-nosed turtles were released in Otakwa River system, East Mimika district and 5553 pig-nosed turtles were released in the Baki swamps, Asmat regency (Anonymous, 2015). In 2015, according the Ministry of Forestry, a total of 8860 pig-nosed turtles were released in various parts of Papua (Anonymous, 2016), but this probably refers to the 6350 out of 8860 referred to above. On 6 April 2019, 2140 out of 2227 confiscated pig-nosed turtles were

released in the Bover Digul regency. All in all then, over the last seven and a half years almost 50,000 pig-nosed turtles were released in different parts of Papua, typically around 3000 individuals at a time.

4. Discussion

The international wildlife trade is a direct cause for the declines and extinctions of an increasingly long list of species due to continuing demand for wildlife as food, traditional medicines, luxury goods and pets. The trade in live animals involves more species than other drivers of the trade, with much of it being illegal and unsustainable (Stengel et al., 2011; Eaton et al., 2015). Among the groups of species most threatened by this trade are the tortoises and freshwater turtles, yet the trade in many of these species is poorly known and receives little attention (Samedi and Iskandar, 2000; van Dijk et al., 2000; Schoppe, 2009; Stengel et al., 2011). Globally, more than half of currently recognised tortoise and freshwater turtle species are threatened with extinction and over 35% are listed as Endangered or Critically Endangered on the IUCN Red List of Threatened Species (Stanford et al., 2020). In 2017, the pig-nosed turtle was reassessed as Endangered on the IUCN Red List of Threatened Species from a previous assessment of Vulnerable in 2000 (Eisemberg et al., 2018). Populations of this species are described as being in decline due to unsustainable exploitation for the international demand for pets, and for food, which if not urgently curtailed, could drive the species to a Critically Endangered status (Eisemberg et al., 2011, 2018). The interest in pig-nosed turtle has intensified over the years due to its taxonomic distinctiveness (only surviving species of a once widespread family of turtles) and increasing rarity (Burgess and Lilley, 2014), and this combined with new hunting methods and technologies, is leading to increasing and likely unsustainable harvest of the species (Eisemberg et al., 2018). Our study's findings are therefore concerning as, like Burgess and Lilley (2014), it shows that the international trade in pig-nosed turtles originating in Indonesia continues on an enormous scale regardless of legislation in place to prevent this.

4.1. Contemporary pig-nosed turtle trade

The seizure data presented here shows the persistent pressure on pig-nosed turtles with seizures occurring all year round though more prominently during the nesting season. When comparing our study period with previous years, there's been an increase in seizures of pig-nosed turtles between 2013 and 2019 (average of 3.5 incidents/year) in comparison Burgess and Lilley (2014) which covered the period between 2003 and 2012 (average of 2.3 incidents/year). This suggests that there may have been improved enforcement effort, monitoring and/or reporting of crimes related to pig-nosed turtles in Indonesia. That said, the average quantities of the turtles being seized in each incident (~2014 turtles/seizure; 6983 turtles/year) appears to have decreased slightly in comparison to Burgess and Lilley (2014) (~3139 turtles/seizure; 7178 turtles/year) with the exception of Bali (Fig. 5). The reduced quantities being seized could be due to several factors including the possibility that improved enforcement has made traders more discreet and are reducing size of shipments being smuggled; or, more concerningly, perhaps it is indicative of the impact that unsustainable exploitation and illegal trade is having on pig-nosed turtle populations in Indonesia.

The seizure data also implicates several countries/territories in the international trafficking of pig-nosed turtles from Indonesia – mainland China, Hong Kong, Japan, Malaysia, Saudi Arabia, Singapore, Taiwan and Thailand (Fig. 4). This is unsurprising considering similar findings were reported by Burgess and Lilley (2014). They note major domestic destinations and likely transit locations of pig-nosed turtles out of Papua as Jakarta, Surabaya, Probolinggo, Makassar and Bali from which the turtles are smuggled to mainland China, Hong Kong, Malaysia, Singapore and Thailand. In our study, about three quarters of incidents took place at airports and ports as well as coastal waters indicating that a large part of the trade in pig-nosed turtles are destined for international markets. Pig-nosed turtles have been found available for sale online in countries such as Malaysia (Krishnasamy and Stoner, 2016) and Thailand (Phassaraudomsak and Krishnasamy, 2018), though according to these studies, volumes are very low. Some of these countries are also likely to be transit points for trade and trafficking bound for further destinations. Malaysia at least is clearly a transit point for the trade of pig-nosed turtles coming from Indonesia and as recent as February 2020, a shipment of 4000 pig-nosed turtles was seized in Malaysian waters, coming from Indonesia.

There does not appear to be a significant trade in this species for pets within Indonesia, despite Indonesia being a major trade hub for other species of tortoises and freshwater turtles to meet local demand. Pig-nosed turtles have been recorded in shops where pet tortoises and freshwater turtles are sold in Jakarta (Shepherd and Nijman, 2007; Stengel et al., 2011), but in small numbers compared to the volumes seized destined for international markets, further indicating that domestic demand for pet pig-nosed turtles in Indonesia is not the greatest driver of the illegal trade in this species.

4.2. Reported origins of pig-nosed turtles in trade

Our examination of CITES Trade Data reveals a shortcoming in the CITES permitting system as applied by the Indonesian authorities and as accepted by importing countries. The pig-nosed turtle is protected in Indonesia and can only be traded if bred in captivity to at least F2 generation. Yet, Indonesia reported nine exports of pig-nosed turtles to the CITES Secretariat in 2017 and 2018, involving over 5000 individual turtles, of which only 50 were declared as being captive bred. Information provided to the authors suggests that one registered reptile exporter in Indonesia has been granted permission to export and unknown number of farmed/captive-born (F1) pig-nosed turtles. If this is correct this would account for the 127 individual pig-nosed turtles in the CITES trade database that were declared by Indonesia as farmed. Given the time and resources it

Table 2
CITES trade records involving the export of pig-nosed turtles *Carettochelys insculpta* from Indonesia from 2013 to 2019, extracted from the CITES Trade Database (June 2020); all trade concerned live turtles and was labelled as commercial. Values in italics and underlined are those reported by Indonesia; and values in normal font are those reported by the importing country. Captive-born (F1) refers to first generation offspring born in a captive setting out of wild-caught parents; captive-bred (F2) refers to second generation offspring born in a captive setting out of parents that themselves were born in captivity; ranched refers to eggs taken from nest then reared in a secure facility with a proportion of the hatched turtles being released back into the wild.

Year	Importing country/territory	Quantity	Source
2013 to 2016, and 2019: none reported			
2017	Japan	*101*	Captive-born
	Philippines	*24*	Captive-born
2018	Japan	2	Captive-born
	Philippines	*2*	Captive-bred
	China	25	Ranched
	China	*3000*	Wild-caught
	Hong Kong	*2160*	Wild-caught
	US	*80*	Wild-caught
	UK	*48*	Captive-bred

would require in breeding pig-nosed turtles in captivity to the second generation, it is extremely unlikely any exported specimens truly are captive bred to F2 (or even to F1). It is more likely these individuals are all wild caught or ranched, and falsely declared as being captive bred to circumvent restrictions and enable export to countries where the checking of the source of the imported animals is lax. According to Burgess and Lilley (2014), none of the ex-situ hatcheries they came across in Papua were legitimate captive-breeding facilities as they relied on illegally harvested wild pig-nosed turtle eggs. Laundering wild-caught reptiles under the guise of being captive bred in Indonesia is well known and well documented (e.g. Lyons and Natusch, 2011; Nijman and Shepherd, 2015) and in the case of pig-nosed turtles, should be investigated further by authorities in Indonesia and in importing countries. Of greater concern is the 5240 turtles that were exported as wild-caught which is in violation of Indonesia's own legislation. Considering pig-nosed turtles are fully protected species in Indonesia, it is unclear how exports of wild caught specimens were allowed, and this issue should be investigated by the. Further, of the 5240 wild caught turtles, 80 were imported into the US, which is clearly in violation of the US Lacey Act. As far as we can ascertain, no action on this has been taken by the US government, but we urged the US authorities to be cautious to ensure that no wild-caught pig-nosed turtles are imported into the US. The profile of this illegal trade should be raised amongst importing countries. Perhaps elevating this species from CITES Appendix II to Appendix I should be considered to assist all three range states in obtaining stronger cooperation from all other CITES Parties. Indonesia clearly remains a major source of

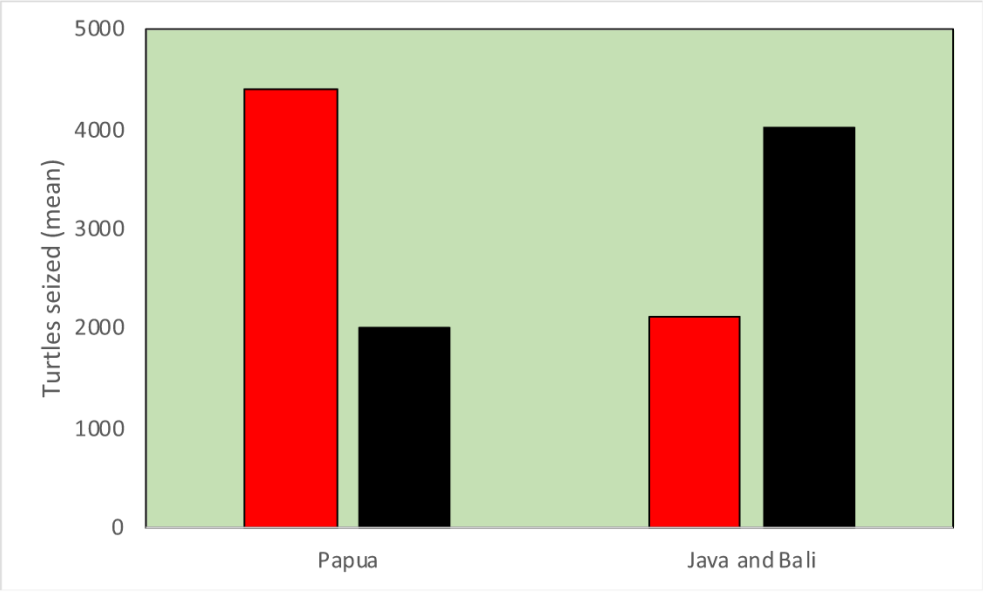

Fig. 5. A comparison of average quantities of pig-nosed turtle seized per incident between our study covering the period 2013–2020 (black bars) and Burgess and Lilley covering the period 2002–2012 (red) reported by the main islands of Indonesia (i.e. Bali and Java and Papua Province). It should be noted that the quantities seized in each incident varied greatly e.g. from as low a one turtle to as high as 5000 turtles. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

the illegal international trade in this species, despite it being totally protected by law. Further research should also be carried out in consumer countries to better understand the drivers behind the trade, the policies in place that could be used to prevent illegal trade trafficking in this species and to guide efforts to reduce demand.

4.3. Release of pig-nosed turtles back into the wild

The challenges of what to do with the large number of pig-nosed turtles that were seized in Indonesia was first raised by Arida and Ibarrondo (2007). We report on the release of around 50,000 pig-nosed turtles back into several river systems in Papua, following their seizure in either Papua, Java, Bali or indeed elsewhere. Individual seizures are typically in the order of 3000 pig-nosed turtles at a time. These numbers are very similar to those reported by Burgess and Lilly (2014), who document the release of around 49,000 pig-nosed turtles over a five year period.

Burgess and Lilley (2014) made a series of specific recommendations with regards to the release of pig-nosed turtles back into the wild, including (a) a proper health, condition and population origin examination should be conducted by the relevant authorities prior to release in order to minimise risks of disease transfer, disruption of population genetic integrity and negative effects on local fauna and flora; (b) release programmes should be organised in consultation with a range of experts and stakeholders, including government personnel, management agencies, non-government organisations, universities, veterinary institutions, zoos and funding bodies; and (c) individual pig-nosed turtles, or a proportion of them, should be tagged prior to release allowing them to be followed and studied to increase our understanding of the biology of the species. It appears from the reports were have located that few, if any, of these recommendations have been properly followed.

4.4. Enforcement and prosecutions

Indonesia is well known as a hub of illegal trade in tortoises and freshwater turtles (Samedi and Iskandar, 2000; Shepherd, 2000; Schoppe, 2009; Stengel et al., 2011; Nijman et al., 2012; Morgan, 2016). Illegal trade in Indonesia has been identified as being due in part to an inadequate understanding of the species being traded and is facilitated by inadequate resources, monitoring and enforcement, especially at key trade hubs (Natusch and Lyons, 2012).

While enforcement efforts that have been taken against the trafficking of pig-nosed turtles are commended, analysed records indicate that seizures continue to be made without offenders being prosecuted, thus failing to provide effective deterrents. Under the Act of the Republic of Indonesia No.5 of 1990 concerning conservation of living resources and their ecosystem, trafficking in pig-nosed turtles may result in a five-year prison sentence and a fine of USD7,132 and when pig-nosed turtles are trafficked or transported lawbreakers can be prosecuted under the Fisheries Act or the Customs Acts that carry the possibilities for significantly higher fines and jail time. Our research show, however, that offenders rarely receive penalties close to the maximum – the highest prison sentence given was approximately half the potential maximum. Furthermore, the reported estimated value of a seized shipment of 4000 pig-nose turtles in February 2020 was over USD200,000 yet given fines rarely reflect the value of trafficked wildlife to be a sufficient deterrent. Given the frequency and scale of the seizures, stronger deterrents, alongside proper announcements of the sentencing to the general public, would prove useful.

As the pig-nosed turtle is a seasonal breeder that nests in predictable and often well-known locations, enforcement efforts should be increased during this period and in strategic locations to disrupt the harvest of eggs and subsequent trafficking of hatchlings. Traffickers use airlines to move illicit shipments of pig-nosed turtles within Indonesia and internationally – as such relevant enforcement agencies in airports, such as Customs, health and quarantine and other authorities should be alerted to the large-scale smuggling of this species and encouraged to be more vigilant. In-situ conservation to protect these breeding grounds from poaching is crucial and further research should be carried out to develop a strategy that would involve local communities in conservation efforts for this species.

Declaration of competing interest

The authors declare 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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References

Anonymous, 2015. 6.350 Kura-Kura Moncong Babi (*Carettochelys insculpta*) Kembali Ke Asmat. PT Freeport, Timika, Indonesia.
Anonymous, 2016. Statistik Kementrian Lingkungan Hidup Dan Kehutanan Tahun 2015. Ministry of Forestry, Jakarta, Indonesia.
Arida, E.A., Ibarrondo, B.R., 2007. A need for urgent action for the conservation of *Carettochelys* in Indonesia. Turt. And Tortoise Newsl. 10, 26–27.

Burgess, E.A., Lilley, R., 2014. Assessing the Trade in Pig-Nosed Turtles *Carettochelys insculpta* in Papua, Indonesia. TRAFFIC, Petaling Jaya, Malaysia.
Cheung, S.M., Dudgeon, D., 2006. Quantifying the Asian turtle crisis: market surveys in southern China, 2000–2003. Aquat. Conserv. Mar. Freshw. Ecosyst. 16, 751–770.
Eaton, J.A., Shepherd, C.R., Rheindt, F.E., Harris, J.B.C., van Balen, S.B., Wilcove, D.S., Collar, N.J., 2015. Trade-driven extinctions and near-extinctions of avian taxa in Sundaic Indonesia. Forktail 31, 1–12.
Eisemberg, C.C., Rose, M., Yaru, B., Georges, A., 2011. Demonstrating decline of an iconic species under sustained indigenous harvest—The pig-nosed turtle (*Carettochelys insculpta*) in Papua New Guinea. Biol. Conserv. 144, 2282–2288.
Eisemberg, C., van Dijk, P.P., Georges, A., Amepou, Y., 2018. *Carettochelys insculpta. The IUCN Red List of Threatened Species* 2018: e.T3898A2884984. https://doi.org/10.2305/IUCN.UK.2018-2.RLTS.T3898A2884984.en. (Accessed 25 July 2020).
Georges, A., Doody, J.S., Eisemberg, C., Alacs, E.A., 2008. *Carettochelys insculpta* Ramsay 1886 – pig-nosed turtle, fly river turtle. Chelonian Res. Monogr. 5, 9.1–9.17.
Krishnasamy, K., Stoner, S., 2016. Trading Faces: A Rapid Assessment on the Use of Facebook to Trade Wildlife in Peninsular Malaysia. TRAFFIC, Petaling Jaya, Malaysia.
Lyons, J.A., Natusch, D.J.D., 2011. Wildlife laundering through breeding farms: illegal harvest, population declines and a means of regulating the trade of green pythons (Morelia viridis) from Indonesia. Biol. Conserv. 144, 3073–3081.
Morgan, J., 2016. Trade in illegally-sourced tortoises and freshwater turtles in Jakarta - the need for legal reform in Indonesia. J. Indones. Nat. Hist. 4, 10–15.
Natusch, D.J., Lyons, J.A., 2012. Exploited for pets: the harvest and trade of amphibians and reptiles from Indonesian New Guinea. Biodivers. Conserv. 21, 2899–2911.
Nijman, V., Shepherd, C.R., 2015. Adding up the Numbers: an Investigation into Commercial Breeding of Tokay Geckos in Indonesia. TRAFFIC, Petaling Jaya, Malaysia.
Nijman, V., Shepherd, C.R., Mumpuni, Sanders, K.L., 2012. Over-exploitation and illegal trade of reptiles in Indonesia. Herpetol. J. 22, 83–89.
Phassaraudomsak, M., Krishnasamy, K., 2018. Trading Faces: A Rapid Assessment on the Use of Facebook to Trade in Wildlife in Thailand. TRAFFIC, Petaling Jaya, Selangor, Malaysia.
Rhodin, et al., 2018. Global conservation status of turtles and tortoises (Order Testudines). Chelonian Conserv. Biol. 17, 135–161.
Samedi, Iskandar, D.T., 2000. Freshwater turtle and tortoise conservation and utilization in Indonesia. In: van Dijk, P.P., Stuart, B.L., Rhodin, A.G.J. (Eds.), Proceedings of a Workshop on Conservation and Trade of Freshwater Turtles and Tortoises in Asia. Chelonian Research Monographs. Number 2.
Schoppe, S., 2009. Status, Trade Dynamics and Management of the Southeast Asian Box Turtle in Indonesia. TRAFFIC Southeast Asia, Petaling Jaya, Malaysia.
Shepherd, C.R., 2000. Export of live freshwater turtles and tortoises from North Sumatra and Riau, Indonesia: a case study. In: van Dijk, P.P., Stuart, B.L., Rhodin, A.G.J. (Eds.), Asian Turtle Trade; Proceedings of a Workshop on Conservation and Trade of Freshwater Turtles and Tortoises in Asia. Chelonian Research Monographs. No. 2.
Shepherd, C.R., Nijman, V., 2007. An Overview of the Regulation of the Freshwater Turtle and Tortoise Pet Trade in Jakarta, Indonesia. TRAFFIC Southeast Asia, Petaling Jaya, Malaysia.
Stanford, C.B., et al., 2020. Turtles and tortoises are in trouble. Current Biology 3-, R721–R735. https://doi.org/10.1016/j.cub.2020.04.088.
Stengel, C.J., Shepherd, C.R., Caillabet, O.S., 2011. The Trade in Tortoises and Freshwater Turtles in Jakarta Revisited. TRAFFIC Southeast Asia, Petaling Jaya, Malaysia.
van Dijk, P.P., Iskandar, D.T., Palasuwan, T., Rhodin, A.G.J., Samedi, Sharma, D.S.K., Shepherd, C.R., Tisen, O.B., Genorupa, V.R., 2000. Turtle trade in southeast Asia: regional summary (Indonesia, Malaysia, Papua New Guinea, and Thailand). In: van Dijk, P.P., Stuart, B.L., Rhodin, A.G.J. (Eds.), Asian Turtle Trade: Proceedings of a Workshop on Conservation and Trade of Freshwater Turtles and Tortoises in Asia. Chelonian Research Monographs, pp. 145–147. No. 2.

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RESEARCH ARTICLE

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The illegal hunting and exploitation of porcupines for meat and medicine in Indonesia

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Abstract

Indonesia is home to five species of porcupines, three of which are island endemics. While all five species are currently assessed as Least Concern by the IUCN Red List of Threatened Species, impacts of harvest and trade have not been factored in. To gain a fuller understanding of the porcupine trade in Indonesia, this study examines seizure data of porcupines, their parts and derivatives from January 2013 to June 2020. A total of 39 incidents were obtained amounting to an estimated 452 porcupines. Various confiscated commodities revealed porcupines are traded for consumption, traditional medicine, trophies/charms as well as for privately run wildlife/recreational parks. Targeted hunting of porcupines for commercial international trade was also evident. Porcupines are also persecuted as agricultural pests and wildlife traffickers take advantage of such situations to procure animals for trade. What clearly emerges from this study is that porcupines are being illegally hunted and exploited throughout their range in Indonesia facilitated by poor enforcement and legislative weakness. Porcupines are in decline due to habitat loss, retaliatory killings and uncontrolled poaching. It is therefore crucial that effective conservation measures are taken sooner rather than later to prevent further depletion of these species. Including all porcupines as protected species under Indonesian wildlife laws and listing them in Appendix II of CITES to improve regulation, enforcement and monitoring of domestic and international trade trends involving porcupines in Indonesia would contribute significantly towards this end.

Keywords

Illegal wildlife trade, seizures, traditional medicine, wildlife consumption

Introduction

Commercial exploitation of wildlife for meat and medicine has become a significant threat to species globally (Byard 2016; Nijman and Bergin 2017; Ripple et al. 2019; Gomez et al. 2020; WAP 2020). The wildlife meat and traditional medicine industries are worth billions of dollars annually and have little to do with subsistence needs – case in point being the continued demand and illegal trade in tigers, rhinos and pangolins (C4ADS 2020; Four Paws 2020; WJC 2020). For example, the legal bear bile trade in China alone is valued at USD1 billion a year and a variety of bear bile products (pills, powders, ointments, wines, tea, etc) were created to stimulate market demand (WAP 2020). Viewed as highly valuable commodities, species are hunted to the brink of their existence and as one species dwindles, it is replaced by another e.g. with wild tigers in Asia near depletion, lions in Africa, jaguars in South America and leopards worldwide are increasingly targeted as traditional medicine substitutes (Coals et al. 2020; Morgan et al. 2021); similarly, pangolins in Asia have deteriorated significantly due to over harvesting for meat and medicine which has resulted in shifting poaching efforts to African pangolins to meet demand in Asia (Challender et al. 2016; Gomez et al. 2016). Exacerbating the issue is captive breeding of wildlife for commercial trade, such as tigers and bears, which is arguably of little conservation value as wild caught animals are known to be laundered and trafficked through such facilities, and further stimulates demand and trade in highly threatened species (Livingstone et al. 2018; Four Paws 2020; WFFT 2020).

Lesser-known species similarly exploited for the meat and medicine trade in Asia are porcupines. An increasing body of evidence reveals the heavy hunting and trade of porcupines in Asia that are resulting in population declines (Brooks et al. 2010; Lee et al. 2015; McEvoy et al. 2019; Yeung 2019; Loke et al. 2020). Wildlife trade surveys across markets in Southeast Asia have frequently encountered porcupines for sale including dead animals, live animals and body parts such as quills and bezoars (non–digestible food material that forms a stone like mass in the gut of an animal). Their meat is consumed as an alternative and important source of protein in parts of their range and their quills are used for decorative purposes. In traditional Chinese medicine, there is a particularly high demand for porcupine bezoar due to the perception that it has many healing properties (Brown 2015; Lee et al. 2015; Tan et al. 2019). A centuries old practice, the use of porcupine bezoars for medicine appears to have increased significantly in recent years (Lee et al. 2015; Heinrich et al. 2020a).

During a 2019 survey for porcupine bezoars on e-commerce websites in Indonesia, Malaysia and Singapore, 121 adverts selling approximately 680–1332 bezoars were obtained over a three-month period (Heinrich et al. 2020a). The majority of these adverts were located in Indonesia i.e. Kalimantan (Borneo), Java and Sumatra, although most of these occurred in Java. The study revealed the illegal exploitation of porcupines for bezoars both for domestic and international markets. This study takes a closer look at the trade of porcupines in Indonesia to assess the extent of the trade and whether it is a potential conservation concern that needs to be addressed.

Five species of porcupines exist in Indonesia–long-tailed porcupine (*Trichys fasciculata*) and Malayan porcupine (*Hystrix brachyura*) occur on the islands of Borneo and Sumatra, Sumatran porcupine (*H. sumatrae*), endemic to the island of Sumatra, Sunda porcupine (*H. javanica*) endemic to the islands of Java, Bali, Sumbawa, Flores, Lombok, Madura, and Tonahdjampea, and thick-spined porcupine (*H. crassispinis*) endemic to the island of Borneo (Figure 1). All five species are currently assessed as Least Concern by the IUCN Red List of Threatened Species with populations deemed stable with the exception of the Malayan porcupine which is described as having a decreasing population (Amori and Aplin 2016; Aplin 2016; Cassola 2016; Molur 2016; Lunde et al. 2016). That said, no population density details in any range state are provided in these assessments; just a line that describes the species as 'common and widespread' or 'common and prolific' or 'common in suitable habitat'. Further, no major threats to the species nor details on use and trade are listed. While hunting for food is described in parts of their range for the Long-tailed, Malayan and thick-spined porcupines, this is not thought to have a significant impact on populations.

Methods

I collected records of seizures and prosecutions relating to porcupine species in Indonesia for the period January 2013–June 2020. Data were extracted from the Indonesian government website, Sistem Informasi Penelusuran Pekara (SIPP) – an open access information database of the courts for each district in the country and from published online media articles. Searches for related seizures were conducted in both English (search terms: hunting, trapping, trade, illegal trade or wildlife trade in porcupine/*Hystrix*) and Indonesian (search terms: 'BKSDA', 'penyelundupan satwa landak/*Hystrix*', 'perdagangan satwa landak/*Hystrix*', 'polisi satwa landak/*Hystrix*', konservasi landak/*Hystrix*). All reported seizures were carefully checked to avoid duplication.

From each record obtained, I extracted information on date of seizure, species of porcupine seized, commodity (live animals, body parts, etc), quantities of each commodity, purpose of hunting/trade (i.e. for consumption, pets, trophies, etc), location of seizures and trafficking routes, suspects arrested and prosecution outcomes. Using this data, I have also mapped important trade hubs and centres where trade exists. Species identification is based on information extracted from seizure incidents obtained and it is assumed to be accurately reported. Generally, species identified as being seized fell within their distribution range in Indonesia with the exception of one incident where a live Sunda porcupine, which has a restricted distribution to Java and neighbouring islands, was reportedly seized from a 'wildlife recreational park' in West Kalimantan. I have conservatively estimated a minimum number of porcupines recorded in trade from commodities confiscated per seizure incident. Commodities seized generally consisted of live or dead animals and to a lesser extent, bezoar (assuming that one bezoar equates to one animal), and quills (3 incidents involving between 10 and 115 quills which I equate to being from one individual animal in each incident).

Results

From January 2013 to June 2020, I obtained 39 incidents in which porcupines were seized in Indonesia involving an estimated 454 porcupines (Figure 1). At least three species of porcupine were identified in 13 incidents – Malayan porcupine (8 incidents), Sunda porcupine (4 incidents) and Sumatran porcupine (1 incident). In the majority of incidents (67%) however, the species of porcupine involved was not identified/reported (Figure 1).

The most frequent and abundant commodity seized were of live animals (80% of incidents amounting to 429 estimated animals) (Table 1). To a much lesser extent, other commodities seized included quills (7% of incidents), dead specimens (5% of incidents) and in one incident each, meat (attached to skewers), bezoar stones and an internal organ (unspecified).

Of the 39 seizure incidents, 48.7% occurred in Sumatra, followed by Java and surrounding islands (43.6%) (Figure 2). In terms of quantity however, 89.6% of all commodities seized were in Sumatra, specifically involving the provinces of Aceh, North Sumatra and West Sumatra (Figure 2). A large number of incidents (n=12) that occurred in Sumatra involved targeted trading of porcupines (usually involving large numbers of porcupines i.e. on average approximately 32–33 animals per incident) where suspects were reportedly caught in the midst of transporting live porcupines from one location to another predominantly between Aceh, North Sumatra and West Sumatra; or local farmers/plantation owners caught trapping or in possession of porcupines intended to be sold to middlemen. In one incident which occurred in North Sumatra, it was reported that the seized animals (n = 56) were being transported to Aceh, from where they were to be shipped to China. In a few cases, porcupines were seized in general wildlife raids involving multiple species (3 incidents) such as bear and tiger body parts, dead pangolins or pangolin scales, muntjac, mousedeer, etc; or seized from individuals (3 incidents) that were keeping live wild animals without a legal permit including gibbons, sun bears, hawks, eagles, deer, crocodiles, etc.

In Java and surrounding islands, an estimated 44 porcupines were seized predominantly from individuals involved in the trade of live animals and parts (9 incidents, 13 estimated whole animals); or from individuals that were keeping/in possession of a

Table 1. Porcupine commodities seized per species from January 2013 to June 2020 and quantities seized in Indonesia.

Species	Seizures (#)	Estimated whole specimens	Commodity Seized					
			bezoar (piece)	dead (whole)	live (whole)	meat (skewers)	internal organ	quills
Unspecified	26	281	2	18	256	26	1	236
Malayan Porcupine	8	126			126			
Sumatran Porcupine	1	40			40			
Sunda Porcupine	4	7			7			
Total	39	454	2	19	429	26	1	236

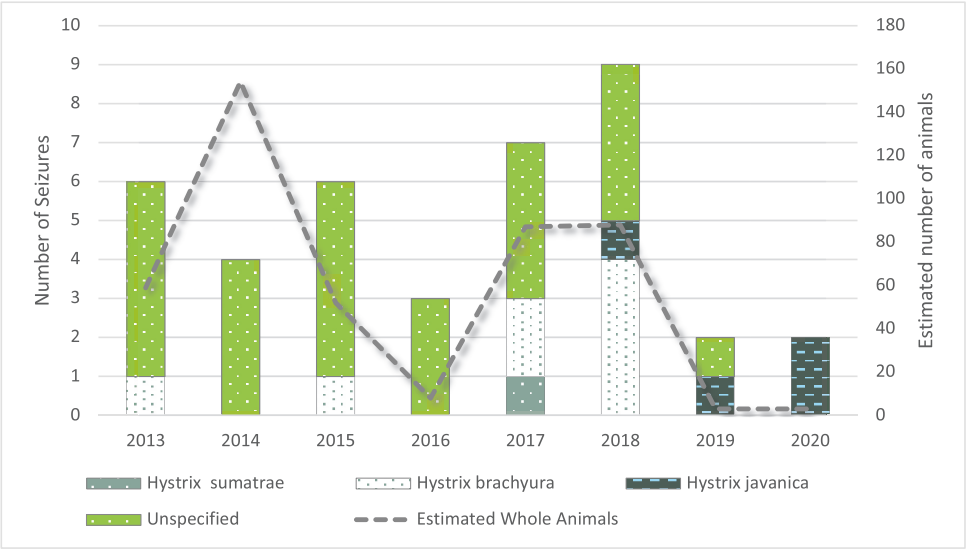

Figure 1. The number of seizure incidents involving porcupines in Indonesia from January 2013–June 2020, including species involved and estimated number of whole animals.

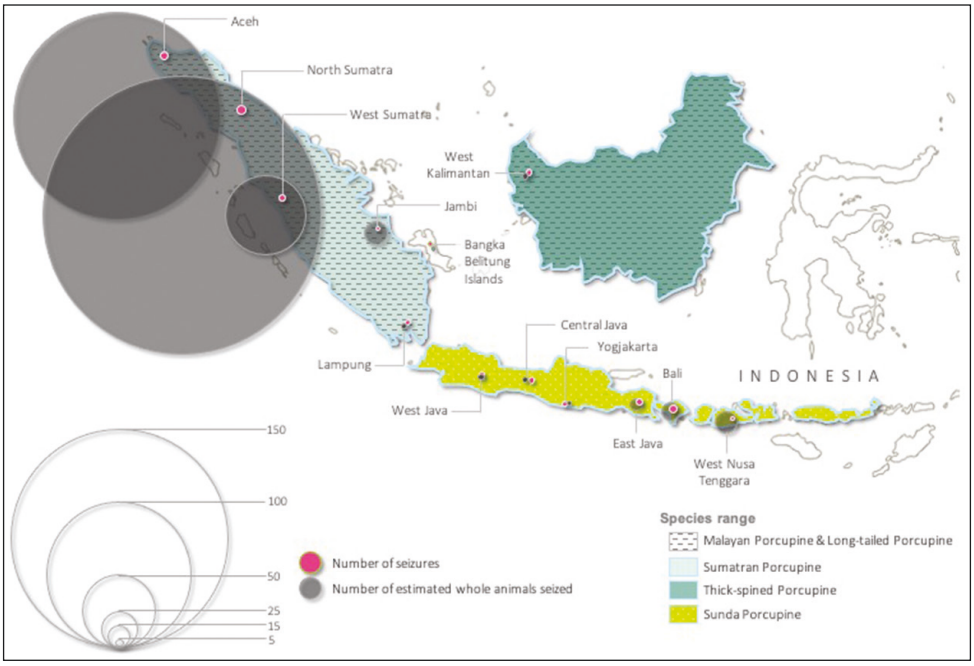

Figure 2. Location of porcupine seizure incidents by provinces in Indonesia including number of seizures at each location and estimated whole porcupines involved from January 2013 to June 2020; as well as the range of the five porcupine species that occur in Indonesia based on data extracted from the IUCN Red List of Threatened Species.

variety of wild animals without a legal permit (8 incidents, 31 estimated whole animals). Only in one of these incidents was it reported that a suspect was caught for illegally trapping and keeping wild porcupines which he subsequently used for breeding purposes.

There were only three incidents reported in Kalimantan (Indonesian Borneo) amounting to an estimated three porcupines (~2 live animals and 111 quills). In two incidents individuals were caught running a wildlife animal park/ mini zoo without a valid permit and involved multiple species including sun bears, birds, deer, slow loris, binturong, crocodiles, etc; and in one incident an accessory shop was raided and found to be illegally trading in protected wildlife parts including orangutan, sun bear, hornbill, muntjac, pangolin, sea turtles, deer and porcupine.

Discussion

Species in trade and legislative loopholes

In the majority of incidents (67%), despite predominantly involving live animals, the species of porcupine seized was not reported making it difficult to determine if specific species are being targeted or whether all species are exploited for trade. However, at least three species were seized which seems to suggest the latter. Further, considering the over-lapping distribution range of the various species (with the exception of the Sunda porcupine), it is safe to assume that trade could potentially encompass all five species. That said, studies have shown that the Malayan porcupine is likely the main species found in trade in Asia primarily due to its wide distribution (Heinrich et al. 2020a, b). The Malayan porcupine was the most frequently identified species confiscated between 2013 and 2018 (in 13 incidents). After 2018, there were fewer porcupine seizures and these incidents either involved the Sunda porcupine or it was unreported (Figure 1).

This can likely be explained by the protection status of different porcupine species in Indonesia. The Act of the Republic of Indonesia No.5 of 1990 concerning conservation of living resources and their ecosystems, widely known as the Conservation Act (No.5) 1990, is the principal legislation pertaining to the regulation of wildlife trade in Indonesia. Under this Act, species are categorized as “Protected” or “Unprotected”. Protected species are prohibited from being caught, injured, killed, kept, possessed, cared for, transported, or traded whether alive or dead, unless permitted by the Government; and are listed under Government Regulation No.7, 1999, Concerning the preservation of flora and fauna. Prior to 2018, the only porcupine species protected in Indonesia was the Malayan porcupine. The only time the protected species list has been revised, since it was gazetted, was in 2018, first in July and then again in September the same year. The amendments included the removal of the Malayan porcupine and the addition of the Sunda porcupine. Since then, seizures of the Malayan porcupine have not been reported. Removal of the Malayan porcupine from the protected species list is highly questionable considering it is the species most frequently confiscated and perhaps this is another indication of the lack of political will to combat the

trafficking of wildlife of commercial value. For example, the Indonesian government revising the protected species list twice within months of release in 2018 was the result of pressure from bird traders to remove certain species that were newly added to the list due to significant population declines (Armstrong and Chng 2020). Calls for stronger protection of otters in Indonesia for similar reasons led to the protection of the Smooth-coated Otter but not the Small–clawed Otter, the species most exploited for domestic and international commercial trade (Gomez and Bouhuys 2018; Gomez and Shepherd 2018).

Technically, the trade and collection of unprotected species in Indonesia is regulated by harvest quotas that are established annually under the Decree of the Minister of Forestry Number 447/Kpts-II/2003 concerning the administration directive of harvest and capture and distribution of the specimens of wild plant and animal species. For the duration of this study period (2013–2020) no harvest quotas were established for the five porcupine species found here and therefore any porcupine in trade are of illegal origins. Having said that, there are no provisions in any of these laws regarding penalties or fines against those violating harvest quotas or/and trading in unprotected species, rendering enforcement action pointless. Notably, porcupine seizures in Indonesia peaked in 2018 with nine seizures (involving an estimated 88 animals) and subsequently dropped to two seizures in 2019 (involving an estimated 3 animals). The inadequate regulation of harvest quotas has been raised countless times with regards to Indonesian species in trade and is seen as a deliberate impediment to conservation of its species (Gomez and Bouhuys 2018; Janssen and Chng 2018; Armstrong and Chng 2020; Latinne et al. 2020; Janssen and Gomez 2021). A clear example of this is the hunting and trade of Tokay geckos (*Gekko gecko*) in Indonesia – whereby studies have shown established harvest quotas being greatly exceeded and fraudulent captive-breeding claims through the years (Caillabet 2013; Nijman and Shepherd 2015). Due to declining populations throughout its range, in 2019 the Tokay Gecko was added to Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in a bid to regulate and monitor international trade. Following this, the Indonesian government significantly increased harvest quotas in 2020, from 50,000 individuals/year prior to 1,800,000 individuals/ year, not only undermining conservation efforts but showcasing the dubious nature in which harvest quotas are determined (Janssen and Gomez 2021).

Porcupine use and trade hotspots

This study revealed a local demand for live porcupines and their parts. In one incident, actual porcupine meat on skewers was seized. Locally, porcupine meat is consumed as an alternative source of protein, as a medicinal cure for asthma and improving one's vitality, and as an aphrodisiac (Farida 2013; Farida 2015; Mustikasari et al. 2019; Nurliani et al. 2020). Quills were seized in three separate incidents in Aceh, Bali and West Kalimantan. These are reportedly used in local traditional medicine, as hairpins by pregnant women, and as souvenirs or talismans against black magic

(Mustikasari et al. 2019). Live porcupines were also confiscated from privately run wildlife/recreational parks or mini zoos along with a host of other protected species due to the lack of a valid permit to either operate such facilities or for possession of protected species. This was particularly evident in Java. Trade of porcupines for traditional medicine use was also evident in two seizure cases in West Sumatra. In one incident, porcupine bezoars were confiscated along with tiger and bear body parts that were reportedly bought from traders around Medan. In another incident, involving 64 live pangolins, the suspect arrested confessed to keeping porcupines in stressful conditions to induce the formation of bezoars which takes place after approximately 6–7 months at which point the porcupines are killed, the bezoar extracted and sold for IDR150K (~USD11). While there were few seizures involving porcupine bezoars, Heinrich et al. (2020a), found a substantial number of porcupine bezoars for sale online in Indonesia. Based on seller location obtained, the majority of these were in Java (31 listings), followed by West Kalimantan (12 listings) and Sumatra (9 listings).

There was also evidence of targeted hunting of porcupines for commercial international trade, predominantly in Sumatra. In an incident that occurred in the province of North Sumatra, 56 live porcupines were seized. According to the suspects arrested, they were hired to transport the animals to Aceh from where they would then be shipped to China. This confirms previous anecdotal information concerning porcupines being shipped to China from Indonesia and other countries in Southeast Asia (C.R. Shepherd, pers. comm). Further, incidents in the provinces of Aceh, North Sumatra and West Sumatra, where the greatest number of porcupines were seized (on average approximately 32–33 animals per incident), have frequently revealed these areas to be important wildlife trade hubs where animals are smuggled out of Indonesia (USAID 2015; Tankandjandji and Sawitri 2016; Gomez et al. 2017). According to USAID (2015), there was a noticeable increase in poaching activities within Kerinci Seblat National Park in Sumatra around 2010 onwards reportedly driven by export markets. Porcupines were among the animals in demand, aside from tigers, Helmeted Hornbills and, pangolins. Heinrich et al. (2020a) also note the international nature of the trade in porcupine bezoars with ~20% of online adverts selling porcupine bezoars, offering international shipping. As none of the porcupine species native to Indonesia are listed in the appendices of the CITES, there is no data available for international trade, making it nearly impossible to monitor trade, regulate international trade and identify trends of concern.

Conservation implications

What clearly emerges from this study is that porcupines are being illegally hunted and exploited throughout their range in Indonesia for local subsistence and commercial trade. While it is difficult to determine the impact this has on porcupine populations, reports in Indonesia indicate the species are in decline due to habitat loss and conversion as well as uncontrolled poaching (Salviana et al. 2017; Farida et al. 2019; Mustikasari et al. 2019). Similar declines in porcupine populations due to over-hunt-

ing have been documented in other parts of their range including Malaysia (Loke et al. 2020), Myanmar (McEvoy et al. 2019), Singapore (Chung et al. 2016) as well as Vietnam and Lao PDR (Brooks et al. 2010). In Cambodia, porcupines are amongst the most frequently confiscated animals (Heinrich et al. 2020b). In Vietnam, porcupines are highly coveted for consumption which has decimated porcupine populations throughout the country (Brooks et al. 2010). Additionally, captive-breeding facilities were found to be laundering and trafficking wild animals causing local extirpations; and shifted poaching efforts to neighbouring Lao PDR to compensate for this (Brooks et al. 2010). Chevallier and Ashton (2006) note that the Cape porcupine in South Africa is widespread and easily adaptable to habitat changes and disturbances, but that this has contributed greatly to its demise as over the years it has come into increasing contact and therefore conflict with humans. Much the same is noted for the Sunda porcupine in Java (Mustikasari et al. 2019). Porcupines are also persecuted as agricultural pests, leaving them further exposed to wildlife traffickers taking advantage of these situations to procure animals for trade. Based on four seizure incidents, farmers or plantation owners were reported to be hunting and trapping porcupines to sell. In one of these incidents, a wildlife trader was arrested for smuggling 20 porcupines he had bought from plantation owners around West Aceh for IDR200K (~USD14)/animal and resold them at IDR450K (~USD32)/animal. He also provided traps for this purpose and asserted that porcupines had becomes pests destroying farmer's; oil palm plantations and would have been killed regardless. In another incident in West Sumatra, an individual was arrested for illegally trading porcupines he caught in his corn field near a forested area using ripe jackfruit as bait. This is concerning as, with the exception of the Malayan porcupine which has a wide range throughout much of Asia, the remaining four species have a more restricted range including three island endemics, the Sumatran porcupine, Sunda porcupine and thick-spined porcupine placing them at higher risk from unsustainable hunting and trade.

Commercialisation of the meat and traditional medicine trade is a key driver of species decline on a global scale (Shairp et al. 2016; Nijman and Bergin 2017; D'Cruze et al. 2020; Stanford et al. 2020; WAP 2020). In Indonesia, this has already resulted in the (near) depletion of several species encompassing tigers, pangolins, reptiles, freshwater turtles, etc (Lyons and Natusch 2011; Auliya et al. 2016; Shepherd et al. 2016; Janssen and Chng 2018; Morgan 2018; Wong and Krishnasamy 2019; Nijman et al. 2019; Rheint et al. 2019; Latinne et al. 2020, Shepherd et al. 2020). Lesser-known species are particularly vulnerable as trade often goes undetected (Alves et al. 2008; Nijman and Bergin 2017; Symes et al. 2018; Janssen and Gomez 2019; Janssen and Gomez 2021). Similarly, the commercial international trade in non-CITES listed species is also poorly documented, regulated or monitored; and this data gap presents a considerable conservation risk as understanding trade dynamics and its impact on these species is extremely difficult. A case in point - a study examining the trade of live reptiles from Indonesia to the US found that more than three quarters of exports were of non-CITES listed species than CITES listed species and encompassed nationally protected and endemic/range restricted species (Janssen and Gomez 2021).

Conclusion

As porcupines face a multitude of threats – habitat loss, retaliatory killings, targeted hunting for commercial trade – it is crucial that all porcupines be listed as protected species under Indonesian wildlife laws to improve regulation and enforcement against illegal trade. Greater resources should also be channelled to improving wildlife regulations, enforcement and scrutiny relating to the uptake of wild animals including species currently without formal protection. A thorough examination of the commercial trade of porcupines is warranted so that appropriate mitigation measures can be developed to protect porcupines from unsustainable and illegal exploitation. More in–depth research is similarly needed to understand porcupine population dynamics in Indonesia to improve understanding of their conservation status, to assess and establish harvest quotas essential for ensuring sustainable trade, and in general to monitor the overall impacts of commercial trade on wild populations. Echoing Heinrich et al. (2020a), greater efforts are also needed to monitor and regulate the international trade in porcupines. Listing these species in Appendix II of CITES should be considered as another means to potentially achieve this as it would require any international trade to take place through a supervisory system which would allow for regulation, and opportunities to track and analyze trends, thus providing an early warning system should wild populations begin to decline.

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References

Alves RR, da Silva Vieira WL, Santana GG (2008) Reptiles used in traditional folk medicine: Conservation implications. Biodiversity and Conservation 8(8): 2037–2049. https://doi.org/10.1007/s10531-007-9305-0

Amori G, Aplin K (2016) *Hystrix sumatrae*. The IUCN Red List of Threatened Species 2016: e.T10754A22231673. https://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T10754A22231673.en

Aplin K (2016) *Hystrix javanica*. The IUCN Red List of Threatened Species 2016: e.T10752A 22231749. https://doi.org/10.2305/IUCN.UK.2016-2.RLTS.T10752A22231749.en

Armstrong OH, Chng SCL (2020) Distancing the flock: Bird singing competitions fly online to avoid CoviD–19. Traffic Bulletin 32(2).

Auliya M, Altherr S, Ariano-Sanchez D, Baard EH, Brown C, Brown RM, Cantu J-C, Gentile G, Gildenhuys P, Henningheim E, Hintzmann J, Kanari K, Krvavac M, Lettink M, Lippert J, Luiselli L, Nilson G, Nguyen TQ, Nijman V, Parham JF, Pasachnik SA, Pedrono M, Rauhaus A, Córdova DR, Sanchez M-E, Schepp U, van Schingen M, Schneeweiss N, Seg-

niagbeto GH, Somaweera R, Sy EY, Türkozan O, Vinke S, Vinke T, Vyas R, Williamson S, Ziegler T (2016) Trade in live reptiles, its impact on wild populations, and the role of the European market. Biological Conservation 204: 103–119. https://doi.org/10.1016/j.biocon.2016.05.017

Brooks EGE, Roberton SI, Bell DJ (2010) The conservation impact of commercial wildlife farming of porcupines in Vietnam. Biological Conservation 143(11): 2808–2814. https://doi.org/10.1016/j.biocon.2010.07.030

Brown V (2015) Not a miracle cure. The Star Online. https://www.thestar.com.my/opinion/online-exclusive/behind-the-cage/2015/06/12/not-a-miracle-cure

Byard RW (2016) Traditional medicines and species extinction: Another side to forensic wildlife investigation. Forensic Science, Medicine, and Pathology 2016(12): 125–127. https://doi.org/10.1007/s12024-016-9742-8

C4ADS (2020) Tipping the scales: exposing the growing trade of African pangolins into China's traditional medicine industry. https://static1.squarespace.com/static/566ef8b4d8af107232d5358a/t/5f63b35ea44ed56361a512c4/1600369515449/Tipping+the+Scales.pdf

Caillabet OS (2013) The Trade in Tokay Geckos *Gekko gecko* in South-East Asia: With a Case Study on Novel Medicinal Claims in Peninsular Malaysia. TRAFFIC Southeast Asia, Petaling Jaya, Selangor.

Cassola F (2016) *Hystrix crassispinis*. The IUCN Red List of Threatened Species 2016: e.T10750A22232051. https://doi.org/10.2305/IUCN.UK.2016-2.RLTS.T10750A22232051.en

Challender D, Baille J, Waterman C, Pietersen D, Nash H, Wicker L, Parker K, Thomson P, Nguyen TV, Hywood L, Shepherd CR (2016) On scaling up pangolin conservation. Traffic Bulletin 28(1): 19–21.

Chevallier N, Ashton B (2006) A report on the porcupine quill trade in South Africa. http://media.withtank.com/477275f26c/porcupine_quill_trade.pdf

Chung Y, Lim N, Shunari M, Wang D, Chan S (2016) Records of the Malayan porcupine, *Hystrix brachyura* (Mammalia: Rodentia: Hystricidae) in Singapore. Nature in Singapore 9: 63–68.

Coals P, Moorhouse TP, D'Cruze NC, Macdonald DW, Loveridge AJ (2020) Preferences for lion and tiger bone wines amongst the urban public in China and Vietnam. Journal for Nature Conservation 57: e125874. https://doi.org/10.1016/j.jnc.2020.125874

D'Cruze N, Green J, Elwin A, Schmidt–Burbach J (2020) Trading Tactics: Time to Rethink the Global Trade in Wildlife. Animals (Basel) 10(12): e2456. https://doi.org/10.3390/ani10122456

Farida WR (2013) The physical and chemical characteristics of Sunda Porcupine meat (*Hystrix javanica* F. Cuvier, 1823) given additional concentrate feed. Jurnal Biologi Indonesia 9(2): 311–325.

Farida WR (2015) Diversity of feed plant, habitat, and use of porcupine (*Hystrix* sp.) in South Sumatra and East Kalimantan. Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia 1(3): 673–681. https://doi.org/10.1088/1755-1315/308/1/012076

Farida WR, Sari AP, Inayah N, Nugroho HA (2019) Observations of behavioural development on common Porcupines (*Hystrix brachyura*) undergoing domestication. IOP Conference Series: Earth and Environmental Science 308(012076).

Four Paws (2020) Europe's second class tigers: Revealing the out-of-control captive tiger numbers and commercial trade. https://media.4-paws.org/c/5/5/5/c555a6c3b7150e4bbcb672872796b28b7b2598d6/Report_Europes-second-class-tigers_EN_FP-2020.pdf

Gomez L, Bouhuys J (2018) Illegal Otter Trade in Southeast Asia. TRAFFIC, Petaling Jaya, Selangor.

Gomez L, Shepherd CR (2018) Smooth-coated otter *Lutrogale perspicillata* receives formal protection in Indonesia, but Small-clawed otter *Aonyx cinereus* does not. IUCN Otter Specialist Group Bulletin 35: 128–130.

Gomez L, Leupen BTC, Tian KH (2016) The trade of African pangolins to Asia: A brief case study of pangolin shipments from Nigeria. Traffic Bulletin 28(1): 3–5.

Gomez L, Leupen BTC, Krishnasamy K, Heinrich S (2017) Scaly Nexus: Mapping Indonesian Pangolin Seizures (2010–2015). TRAFFIC, Southeast Asia Regional Office, Petaling Jaya Selangor.

Gomez L, Shepherd CR, Khoo MS (2020) Illegal trade of sun bear parts in the Malaysian states of Sabah and Sarawak. Endangered Species Research 41: 279–287. https://doi.org/10.3354/esr01028

Heinrich S, Wittmann TA, Prowse TAA, Ross JV, Delean S, Shepherd CR, Cassey P (2016) Where did all the pangolins go? International CITES trade in pangolin species. Global Ecology and Conservation 8: 241–253. https://doi.org/10.1016/j.gecco.2016.09.007

Heinrich S, Toomes A, Gomez L (2020a) Valuable stones: The trade in porcupine bezoars. Global Ecology and Conservation 24: e01204. https://doi.org/10.1016/j.gecco.2020.e01204

Heinrich S, Ross JV, Gray TNE, Delean S, Marx N, Cassey P (2020b) Plight of the commons: 17 years of wildlife trafficking in Cambodia. Biological Conservation 241: e108379. https://doi.org/10.1016/j.biocon.2019.108379

Janssen J, Chng SC (2018) Biological parameters used in setting captive-breeding quotas for Indonesia's breeding facilities. Conservation Biology 32(1): 18–25. https://doi.org/10.1111/cobi.12978

Janssen J, Gomez L (2019) Common Sun Skink *Eutropis multifasciata* (Kuhl 1820) sold for Traditional Medicine in Indonesia and potential conservation implications. Ethnobiology and Conservation 19: 1–8. https://doi.org/10.15451/ec2019-11-8.14-1-8

Janssen J, Gomez L (2021) An examination of the import of live reptiles from Indonesia by the United States from 2000 to 2015. Journal for Nature Conservation 59: e125949. https://doi.org/10.1016/j.jnc.2020.125949

Latinne A, Saputro S, Kalengkongan J, Kowel CL, Gaghiwu L, Ransaleleh TA, Nangoy MJ, Wahyuni I, Kusumaningrum T, Safari D, Feferholtz Y, Li H, Hagan E, Miller M, Francisco L, Daszak P, Olival KJ, Pamungkas J (2020) Characterizing and quantifying the wildlife trade network in Sulawesi, Indonesia. Global Ecology and Conservation 21: e00887. https://doi.org/10.1016/j.gecco.2019.e00887

Lee SL, Burgess EA, Chng SCL (2015) Hard to bear: an assessment of trade in bear bile and gall bladder in Malaysia. TRAFFIC, Petaling Jaya, Selangor.

Livingstone E, Gomez L, Bouhuys J (2018) A review of bear farming and bear trade in Lao People's Democratic Republic. Global Ecology and Conservation 13: e00380. https://doi.org/10.1016/j.gecco.2018.e00380

Loke VPW, Lim T, Campos–Arceiz A (2020) Hunting practices of the Jahai indigenous community in northern peninsular Malaysia. Global Ecology and Conservation 21: e00815. https://doi.org/10.1016/j.gecco.2019.e00815

Lunde D, Aplin K, Molur S (2016) *Hystrix brachyura* (errata version published in 2017). The IUCN Red List of Threatened Species 2016: e.T10749A115099298.

Lyons JA, Natusch DJ (2011) Wildlife laundering through breeding farms: Illegal harvest, population declines and a means of regulating the trade of green pythons (*Morelia viridis*) from Indonesia. Biological Conservation 144(12): 3073–3081. https://doi.org/10.1016/j.biocon.2011.10.002

McEvoy JF, Connettea G, Huanga Q (2019) Two sides of the same coin – Wildmeat consumption and illegal wildlife trade at the crossroads of Asia. Biological Conservation 238: e108197. https://doi.org/10.1016/j.biocon.2019.108197

Molur S (2016) *Atherurus macrourus*. The IUCN Red List of Threatened Species 2016: e.T2354A 22231214. https://doi.org/10.2305/IUCN.UK.2016-2.RLTS.T2354A22231214.en

Morgan J (2018) Jakarta's flourishing trade in threatened turtles and tortoises under the spotlight again. TRAFFIC, Kuala Lumpur, Malaysia. https://www.traffic.org/publications/reports/slow-and-steady-the-global-footprint-of-jakartas-tortoise-and-freshwater-turtle-trade

Morgan KI, Ewart KM, Nguyen TQ, Sitam FT, Ouitavon K, Lightson AL, Kotze A, McEwing R (2021) Avoiding common numts to provide reliable species identification for tiger parts. Forensic Science International: Reports 3: e100166. https://doi.org/10.1016/j.fsir.2020.100166

Mustikasari IA, Withaningsih S, Megantara EN, Husodo T, Parikesit P (2019) Parikesit (2019) Population and distribution of Sunda porcupine (*Hystrix javanica* F. Cuvier, 1823) in designated area of Cisokan Hydropower, West Java, Indonesia. Biodiversitas (Surakarta) 20(3): 762–769. https://doi.org/10.13057/biodiv/d200321

Nijman V, Bergin D (2017) Reptiles traded in markets for medicinal purposes in contemporary Morocco. Contributions to Zoology (Amsterdam, Netherlands) 86(1): 39–50. https://doi.org/10.1163/18759866-08601003

Nijman V, Shepherd CR (2015) Adding up the numbers: An investigation into commercial breeding of Tokay Geckos in Indonesia. TRAFFIC Southeast Asia, Petaling Jaya, Selangor.

Nijman V, Nekaris KAI, Imron MA (2019) Asian Songbird Crisis also affects unprotected species. Oryx 53(1): 1–13. https://doi.org/10.1017/S0030605318001163

Nurliani A, Sasaki M, Budipitojo T, Tsubotas T, Suzuki M, Kitamura N (2020) An immunohistochemical study on testicular steroidogenesis in the Sunda porcupine (*Hystrix javanica*). The Journal of Veterinary Medical Science 81(9): 1285–1290. https://doi.org/10.1292/jvms.19-0167

Rheint FE, Baveja P, Ferasyi TR, Nurza A, Rosa TS (2019) Haminuddin, Ramadhan R, Gwee CY (2019) The extinction-in-progress in the wild of the Barusan Shama Copsychus (malabaricus) melanurus. Forktail 35: 30–37.

Ripple WJ, Wolf C, Newsome TM, Betts MG, Ceballos G, Courchamp F, Hayward MW, Van Valkenburgh B, Wallach AD, Worm B (2019) Are we eating the world's megafauna to extinction? Conservation Letters 12(3): e12627. https://doi.org/10.1111/conl.12627

Salviana M, Abdullah, Saputri M (2017) Habitat conditions of the Malayan Porcupine (*Hystrix brachyura*) in captivity at Deer Park Village Lamtanjong District of Aceh and Village Panton Luas, South Aceh Regency. Jurnal Ilmiah Mahasiswa Fakultas Keguruan dan Ilmu Pendidikan Unsyiah Vol 2, No 1 (2017).

Shairp R, Veríssimo D, Fraser I, Challender D, MacMillan D (2016) Understanding Urban Demand for Wild Meat in Vietnam: Implications for Conservation Actions. PLoS ONE 11(1): e0134787. https://doi.org/10.1371/journal.pone.0134787

Shepherd CR, Eaton JA, Chng SCL (2016) Nothing to laugh about – the ongoing illegal trade in laughing thrushes (*Garrulax* species) in the bird markets of Java, Indonesia. Bird Conservation International 26(4): 524–530. https://doi.org/10.1017/S0959270916000320

Shepherd CR, Gomez L, Nijman V (2020) Illegal wildlife trade, seizures and prosecutions: A 7.5-year analysis of trade in pig-nosed turtles *Carettochelys insculpta* in and from Indonesia. Global Ecology and Conservation 24: e01249. https://doi.org/10.1016/j.gecco.2020.e01249

Stanford CB, Iverson JB, Rhodin AG, van Dijk PP, Mittermeier RA, Kuchling G, Berry KH, Bertolero A, Bjorndal KA, Blanck TE, Buhlmann KA (2020) Turtles and tortoises are in trouble. Current Biology 30(12): R721–R735. https://doi.org/10.1016/j.cub.2020.04.088

Symes WS, McGrath FL, Rao M, Carrasco LR (2018) The gravity of wildlife trade. Biological Conservation 218: 268–276. https://doi.org/10.1016/j.biocon.2017.11.007

Tan CS, Ng CH, Loh YC, Yam MF (2019) A traditional folk medicine in Malaysia: Porcupine bezoar. Oriental Pharmacy and Experimental Medicine 19(2): 131–136. https://doi.org/10.1007/s13596-019-00370-4

Tankandjandji M, Sawitri R (2016) Analisis Penangkapan dan Perdagangan Trenggiling Jawa (*Manis javanica* Desmarest, 1822) di Indonesia (Analysis of capture and trade of Sunda Pangolin in Indonesia). Jurnal Analisis Kebijakan Vol. 13 No. 2. Agustus 2016: 85–101. https://doi.org/10.20886/jakk.2016.13.2.85-101

USAID (2015) Changed for Justice Project: Wildlife crime in Indonesia: a rapid assessment of the current knowledge, trends and priority actions. This publication was produced for review by the United States Agency for International Development. It was prepared for Chemonics International Inc. by the Indonesia Program of the Wildlife Conservation Society.

WAP (2020) Cruel cures: the industry behind bear bile production and how to end it. World Animal Protection, https://www.dropbox.com/s/2kzpdkfjn4vh347/Bear%20Bile%20Report_Cruel%20Cures_FINAL_compressed.pdf?dl=0

WFFT (2020) The Thai 'zoo' where tigers were seized has been on the radar of authorities for illegal wildlife trade. https://www.wfft.org/tigers/the-thai-zoo-where-tigers-were-seized-has-been-on-the-radar-of-authorities-for-illegal-wildlife-trade/

WJC (2020) Rapid assessment of the impact of COVID-19 on wildlife trafficking. https://wildlifejustice.org/wp-content/uploads/2020/04/WJC_Impact-of-COVID19-on-wildlife-trafficking_April2020.pdf

Wong R, Krishnasamy K (2019) Skin and Bones Unresolved: An Analysis of Tiger Seizures from 2000–2018. TRAFFIC, Petaling Jaya, Selangor.

Yeung P (2019) Porcupines are being poached for their stomach content. https://www.nationalgeographic.com/animals/2019/03/poachers-hunt-porcupines-for-bezoars-used-in-traditional-chinese-medicine/

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The illegal exploitation of the Javan Leopard (*Panthera pardus melas*) and Sunda Clouded Leopard (*Neofelis diardi*) in Indonesia

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Abstract

Indonesia is home to the Javan Leopard (*Panthera pardus melas*) and the Sunda Clouded Leopard (*Neofelis diardi*), both of which are threatened by habitat loss, human-wildlife conflict issues and the illegal wildlife trade. Leopards and clouded leopards are threatened by the illegal wildlife trade across their range, however, very little is known of the illegal trade in these two species in Indonesia, or of the efforts made to tackle this crime. Both the Javan Leopard and Sunda Clouded Leopard are protected species in Indonesia and both species are listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), meaning commercial international trade is generally prohibited. To better understand the trade, and efforts to end this trade, we collected records of seizures and prosecutions relating to Javan Leopards and Sunda Clouded Leopards in Indonesia for the period 2011–2019. Despite both species being protected by law, this study reveals the prevalence of extensive poaching, illegal domestic trade and international trafficking of both species. A total of 41 seizure records were obtained from 2011 to 2019, which was estimated to amount to approximately 83 animals, which likely represents only a fraction of the total number of cases and therefore the risk may be substantially greater. Approximately half of the cases resulted in successful prosecution and of these, the highest sentence given was 2 years in jail and a fine of IDR50mil (~USD3300). The majority of the penalties handed down for these crimes were far below the maximum potential penalties and are unlikely to be effective deterrents.

Keywords

Big cats, conservation, crime, Java, poaching, wildlife trade

Introduction

The Indonesian archipelago is made up of a diverse landscape that supports a large proportion of the Earth's fauna and flora including a high number of endemic species (Meijaard et al. 2005; von Rintelen et al. 2017). The country has extremely high biodiversity and for precisely this reason, it is also one of the most significant illegal wildlife trade hubs globally (Samedi and Iskandar 2000; Shepherd 2010; Lyons and Natusch 2012; Chng and Eaton 2016; Gomez and Shepherd 2019). Indonesia is both a source and end use destination for a wide range of species, many of which are threatened with extinction (Samedi and Iskandar 2000; Shepherd and Magnus 2004; Meijaard et al. 2012; Shepherd et al. 2015; Morgan and Chng 2017; Gomez et al. 2017; Nijman et al. 2018). Further rare, endemic and range-restricted species are frequently in high demand in the international commercial market for exotic pets (Courchamp et al. 2006; Nijman and Stoner 2014; Janssen and Shepherd 2018). Two species of high conservation concern that continuously feature in seized wildlife shipments in Indonesia are the Javan Leopard (*Panthera pardus melas*) and the Sunda Clouded Leopard (*Neofelis diardi*), though there is very little documentation or published literature pertaining to their exploitation. Both species are assessed by the IUCN Red List of Threatened Species (hereafter referred to as the Red List) as being threatened with extinction and have a restricted range, making them extremely vulnerable to exploitation.

The Javan Leopard is considered one of the most threatened subspecies of Leopard (Wibisono et al. 2018) and among the most threatened of all big cats. Endemic to the island of Java in Indonesia, deforestation and habitat conversion have significantly depleted wild populations and greatly reduced the species range which is now limited to fragmented and isolated pockets of forested areas around the island (Wibisono et al. 2018; Stein et al. 2020). According to Wilting et al. (2016), only 5% of the island is actually habitable for the species. The conservation status of this species was last assessed in 2008 as Critically Endangered by the Red List, with fewer than 250 mature breeding adults and reported populations in decline (Stein et al. 2020). The main threats to the species are habitat loss and prey base depletion (Stein et al. 2020) which is resulting in increasing human conflict as Leopards prey on livestock or pets (Partasasmita et al. 2016; Wilting et al. 2016).

The Sunda Clouded Leopard is only found on the island of Borneo (encompassing Brunei, the Malaysian states of Sabah and Sarawak, and Kalimantan, Indonesia) and the island of Sumatra, Indonesia. The species was recognised as a separate species from the Clouded Leopard *N. nebulosa*, in 2008 based on distinct differences in molecular and morphological data (Buckley-Beason et al. 2006; Kitchener et al. 2006). Wilting et al. (2011), further designated populations of Sunda Clouded Leopard on Borneo and those on Sumatra as two distinct subspecies i.e. Bornean Clouded Leopard *N. d. borneensis* and Sumatran Clouded Leopard *N. d. diardi*. On a global scale the species is assessed as Vulnerable by the Red List, with populations reported as declining across their range predominantly due to forest loss and degradation (Hearn et al. 2015), but on a subspecies level, both are classified as Endangered (Hearn et al. 2008; Sunarto

et al. 2008). Poaching is also noted as a threat in some parts of its range (Hearn et al. 2016), and it is suspected that poaching for commercial trade in Indonesia may be a key threat.

The "Act of the Republic of Indonesia No.5 of 1990 concerning conservation of living resources and their ecosystems", widely known as the "Conservation Act (No.5) 1990", is the principal legislation pertaining to the regulation of wildlife trade in Indonesia. Under this Act, species are categorised as either "Protected" or "Unprotected". Protected species are listed under "Government Regulation No.7, 1999, Concerning the preservation of flora and fauna". Protected species are not allowed to be caught, injured, killed, kept, possessed, cared for, transported, or traded whether alive or dead. Exceptions in this regard are permitted by the Government for the purposes of research, science and/or safeguarding a species. Violation of this Act can result in imprisonment for a maximum of five years and a fine of up to IDR100 million (~USD6700). Both the Javan Leopard and Sunda Clouded Leopard are classified as Protected species in Indonesia. Under "Government Regulation No. 8, 1999 concerning the utilization of wild plants and animals", the trade of a Protected species is permitted if the specimens are captive-bred. Captive-bred animals are subject to regulations under the "Decree of the Ministry of Forestry, No.P.19/Ministry of Forestry-II/2005 concerning captive management of wild plant and animal species" and Article 10 in "Government Regulation No. 8, 1999", defines that only second and subsequent generations of captive-bred Protected animals may be traded, and that all breeders must be registered with the Ministry of Environment and Forestry's Department of Forest Protection and Nature Conservation (KKH) (for exporters) and Nature Conservation Agency (BKSDA) (for breeders supplying to exporters, but not exporting themselves). At an international level, both species are also listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which means any commercial international trade in wild animals is effectively prohibited.

In this study, we examined seizure data involving these two species in Indonesia to gain an understanding of the extent of the trade and of the efforts being made to tackle this crime. We provide documented evidence of the trade which can be used to better assess the conservation status of remaining populations and identify appropriate measures to mitigate illegal exploitation of both species.

Methods

We collected records of seizures and prosecutions relating to Javan Leopards and Sunda Clouded Leopards in Indonesia for the period 2011–2019. Data were extracted from various sources including from media reports, published literature and the government website, Sistem Informasi Penelusuran Pekara (SIPP) (an open access information database of the courts for each district). Online searches for related seizures were conducted in both English (search terms: Javan Leopard, Sunda Clouded Leopard, leopard followed by seizures, hunting, killing, trade) and Indonesian (search

terms: macan, macan tutul, macan dahan, neofelis, macan kumbang and panthera). We only included records where Indonesia is reported as the location of the seizure in the analysis or reported as the origin of shipment seized elsewhere. All reported seizures and prosecutions were carefully checked to avoid duplication.

From each record, we extracted information on date of seizure, species seized (assumed to be accurately reported), commodity (live animals, paws, skull, skin, etc), quantities of each commodity, purpose of hunting/trade (i.e. for consumption, pets, trophies, etc), location of seizures and trafficking routes, suspects arrested and prosecution outcomes. Using the seizure data, we mapped important trade hubs and centres where trade exists. We have estimated a minimum number of Javan Leopards and Sunda Clouded Leopards recorded in trade from commodities seized, by either counting whole or near-whole specimens seized (e.g. live animals, skins), or by tallying quantities of body parts seized (e.g. claws, teeth, paws, skull) that form one whole individual per seizure record. In terms of tallying body parts, a leopard is naturally assumed to have four paws, 18 claws and four canines.

Due to inherent biases in the way seizure data are reported (given varying levels of law enforcement, reporting and recording practices, language biases, etc.), this dataset is interpreted with caution. Reported seizures are likely to represent only a fraction of the illegal trade and so underestimate its full extent (Burgess et al. 2014; Nijman 2015). As such, the dataset presented here is not to be assumed as representing absolute trafficking trends or volumes.

Results

A total of 41 seizure records were obtained involving Javan Leopards and Sunda Clouded Leopards in Indonesia from 2011 to 2019, which was estimated to amount to approximately 83 animals (i.e. 51 Javan Leopards; 32 Sunda Clouded Leopards). There were no seizure data found for 2013. At least 3 of these incidents were considered retaliatory killings of Javan Leopards that had entered villages or preyed on livestock and pets. The majority of obtained seizure records involved the Javan Leopard with 24 incidents involving an estimated 51 animals while the Sunda Clouded Leopard was reported in 18 incidents involving an estimated 32 animals. The greatest number of seizures were recorded in 2019 (10 seizures) followed by 2015 (9 seizures) and 2018 (8 seizures) (Fig. 1).

The most frequent commodity seized throughout the study period were skins (seized in 18 incidents which encompassed whole specimens, pieces or items for which skin had been used in accessories e.g. bag, hat and Reog art (used in traditional Indonesian dance) (Table 1, Fig. 1). This was followed by the seizure of live animals (9 incidents) and taxidermy products (8 incidents). The most abundant commodity seized were canines amounting to 30 pieces in 6 incidents that occurred in 2018 and 2019. Overall, body parts consisting of canines, claws, paws, skin and skulls along with taxidermy products made up the greatest percentage of commodities seized (Fig. 1).

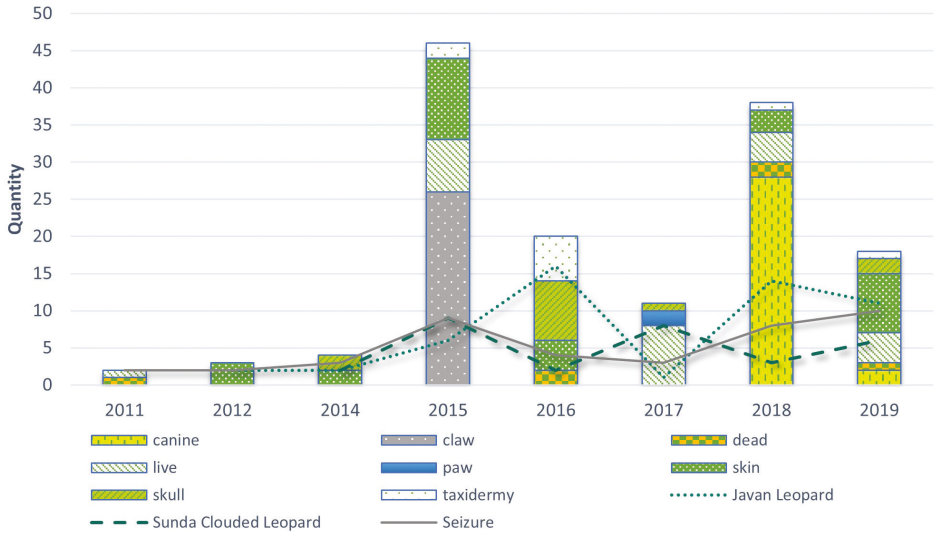

Figure 1. The number of seizures (grey line) obtained for Indonesia that involved either the Javan Leopard or the Sunda Clouded Leopard in Indonesia from 2011 to 2019 (no data for 2013) based on data extracted from media sources, published literature, CITES Trade Database, Indonesian government website (SIPP), etc., including various commodities seized (e.g. live, skin, canines, claws, taxidermy, etc) (bar graph) with an estimated number of both leopard species involved based on commodities seized per record (dotted lines).

Table 1. The various types of commodities from Javan Leopard and Sunda Clouded Leopard seized in Indonesia from 2011 to 2019 including the frequency of each commodity seized and quantities.

Commodity	Seizure (#)		Quantity	
	Javan Leopard	Sunda Clouded Leopard	Javan Leopard	Sunda Clouded Leopard
canine	3	3	20	10
claw	1	1	22	4
dead	3	2	4	2
live	3	6	6	17
paw	1		2	
skins				
– skin (pieces)	5	5	12	6
– skin (head)	1		2	
– skin (whole)	3	1	7	1
– other (bag, hat, Reog art)	2	1	2	1
skull	5		13	
taxidermied	5	3	7	3

All seizure records obtained, with the exception of 2, occurred in Indonesia (39 incidents) i.e. the islands of Java (18 incidents), Sumatra (18 incidents) and Kalimantan (3 incidents) (Fig. 2). The province of West Java and Jakarta, located on the island of Java, appear to be trade hotspots with 7 and 6 incidents obtained for each location respectively. That said, it should also be noted the lack of, or fewer, seizures in other locations could reflect poorer enforcement effort.

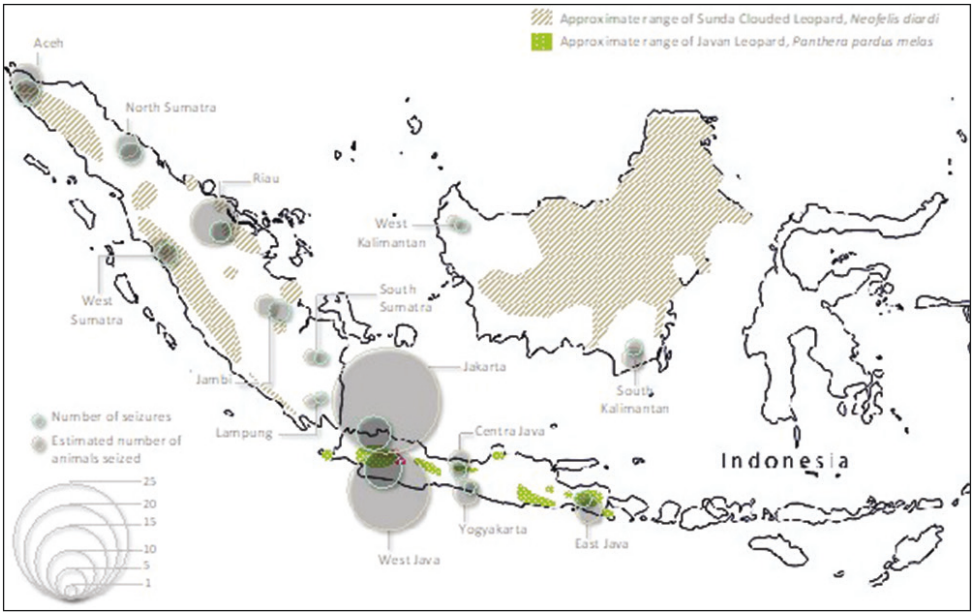

Figure 2. Location of seizure incidents involving Javan Leopard and Sunda Clouded Leopard that occurred in Indonesia from 2011 and 2019. Locations are grouped by provinces in Indonesia. A total of 41 seizure incidents were obtained of which 39 are mapped out above. The remaining two incidents occurred in Russia and UK respectively with origins reported as Indonesia. Approximate range for both species is extracted from the IUCN Red List of Threatened Species (Hearn et al. 2015; Stein et al. 2020).

The international trafficking of both species from Indonesia occurred in 3 incidents. Two incidents involved the Javan Leopard: one occurred in Russia and one in the UK but with origins of seized shipments reported as Indonesia. The seizure in the UK occurred in 2014 and involved 2 leopard skulls among various wildlife items seized while the incident in Russia occurred in 2015 involving various live animals from Indonesia including a Javan Leopard destined for the pet trade. The third incident occurred in Jakarta in 2015 involving a live Sunda Clouded Leopard ordered by a buyer in Kuwait.

At least 31 of the seizure incidents included multiple species seized along with Javan Leopard and Sunda Clouded Leopard, including live animals, body parts or taxidermy/ preserved animal parts. Tigers (*Panthera tigris*) (in 17 seizures) and Sun Bears (*Helarctos malayanus*) (in 13 seizures) were the most frequent species seized together with both species.

Of the 41 seizure records obtained, we could only find successful prosecution records for 20 cases (48.8%; 10 cases involving Sunda Clouded Leopard, 9 cases involving Javan Leopard, and 2 cases involving both species) involving 29 suspects (Table 2). The highest sentence given was 2 years in jail and IDR50mil (~USD3550) fine to a trader caught in 2018 for possession of 4 canines belonging to a Sunda Clouded Leopard and a bag made from the skin of a Sunda Clouded Leopard. Remaining convictions ranged from 1–1.6 years with fines (7 cases, 15 suspects) to <1 year with fines (11 cases, 12 suspects).

Table 2. The number of arrests and convictions (20 cases) involving Javan Leopard and Sunda Clouded Leopard in Indonesia, 2011–2019 based on the Indonesian government website (SIPP).

Date	Seizure location	Species	Commodity	Quantity	Other species seized	No. of suspects arrested	Prosecution
11-Dec 2011	West Sumatra	SCL	dead	1	None	1	9 months in jail + IDR5 million (~USD355) fine or additional 1 month in jail.
19-Dec 2012	Riau	JL	skin (pieces)	2	Tiger skins, Sun Bear head, deer skull, deer skin, goat head, monkey heads and Leopard Cat (*Prionailurus bengalensis*) heads	1	3 months in jail + IDR1 million (~USD70) fine or additional 1 month in jail.
3-Jan 2014	Aceh	SCL	skin (pieces); skull	1	body parts of Tiger, Golden Cat, Leopard Cat, Sumatran Serow (*Capricornis sumatraensis*), hornbill, Sun Bear	2	1 year in jail + IDR10 million (~USD700) fine or additional 4 months in jail
20-May 2014	West Kalimantan	SCL	skin (pieces)	1	body parts – species not specified	1	2 months + 10 days in jail + IDR500 thousand (~USD35) or additional 1 month in jail
6-Nov 2015	Jakarta	SCL	live	1	live gibbon, birds of paradise, Sun Bear	5	1.6 years in jail + IDR10 million (~USD700) fine or additional 3 months in jail – 4 SUSPECTS 1.3 years in jail + IDR10 million (~USD700) fine or additional 3 months in jail – 1 SUSPECT
14-Oct 2015	Lampung	SCL	skin (pieces)	1	Sun Bear, Leopard Cat	3	1.6 years in jail + IDR50 million (~USD3550) fine or additional 1 months in jail – 1 SUSPECT 1 year in jail and IDR50 million (~USD3550) fine or additional 3 months in jail – 2 SUSPECTS
16-Sep 2015	West Sumatra	SCL	claw	4	body parts – species not specified	1	6 months in jail + IDR100 million (~USD7100) fine or additional 1 month in jail.
30-Jul 2015	West Java	JL	claw; skin (pieces); leopard skin hat	22; 5; 1	body parts of marine turtles, deer, Tiger, mouse deer, Sunda Pangolin (*Manis javanica*), Asian Elephant (*Elephas maximus*), Sun Bear, birds of paradise	1	3 months in jail + IDR1 million (~USD70) fine or additional 1 month in jail.
15-Jan 2016	Jakarta	JL SCL	skin (whole); skin (pieces), taxidermy; skulls taxidermy	1; 3; 3; 8 1	taxidermy parts of Sumatran Serow, deer, Sun Bear, python, Tiger, Golden Cat (*Catopuma temminckii*), birds of paradise, parrots, eagle and Bali Starling (*Leucopsar rothschildi*)	1	1 year in jail + IDR50 million (~USD3550) fine or additional 1 month in jail.
2-Aug 2016	Jambi	SCL	taxidermy	1	taxidermy parts of Sunda Pangolin, Leopard Cat, Golden Cat, Chital (*Axis axis*), Sambar Deer (*Rusa unicolor*), Tiger	2	8 months in jail + IDR1 million (~USD70) fine or additional 1 month in jail – 1 SUSPECT No SIPP record for SUSPECT 2
3-Oct 2017	South Kalimantan	JL	head; paw	1; 2	None	1	2 years in jail + IDR50 million(~USD3550) fine or additional 3 months in jail*
22-Feb 2017	Riau	SCL	live	7	Black Eagle (*Ictinaetus malaiensis*), langurs, otters	2	1.2 years in jail + IDR25 million (~USD1700) fine or additional 1 month in jail – 1 SUSPECT 8 months in jail + IDR50 million (~USD3550) fine or additional 2 months in jail – 1 SUSPECT

Date	Seizure location	Species	Commodity	Quantity	Other species seized	No. of suspects arrested	Prosecution
29-Jan 2018	North Sumatra	SCL SCL	canine leopard skin bag	4 1	body parts of Tigers, Sun Bears	1	2 years in jail + IDR50 million (~USD3550) fine or additional 2 months in jail.
11-May 2018	South Kalimantan	SCL	canine; skin (pieces)	5; 2	Sun Bear, deer	1	1 year in jail + IDR5 million (~USD355) fine or additional 2 months in jail.
11-Apr 2018	Jakarta	JL	canine	18	body parts of Sun Bear, Tiger, Lion	1	9 months in jail + IDR50 million (~USD3550) fine or additional 1 month in jail
21-Nov 2018	West Java	JL	canine	1	body parts of Tiger, elephant accessories	1	8 months in jail + IDR10 million (~USD700) fine or additional 1 month in jail.
23-Apr 2018	Jambi	JL	taxidermy	1	taxidermy parts of Tiger, Sun Bear, Common Muntjac (*Muntiacus muntjac*), Binturong (*Arctictis binturong*), deer	1	1 month in jail + IDR5 million (~USD355) fine or additional 1 month in jail.
5-Aug 2019	Yogyakarta	JL SCL	skin (whole); skull canine	2; 1 1	Reog art made from Tiger skins, peafowl feathers, deer antlers	1	1.6 years in jail + IDR2 million (~USD140) fine or additional 2 months in jail.
29-Nov 2019	Central Java	JL	skin (pieces); skull	1; 1	live peafowl	1	9 months in jail + IDR500 thousand (~USD35) or additional 1 month in jail.
30-Oct 2019	Central Java	JL	canine	1	body parts of babirusa (*Babyrousa* sp.), deer, hornbill, Tiger, Sun Bear	1	7 months in jail + IDR10 million (~USD700) fine or additional 1 month in jail.

Note: JL: Javan Leopard, SCL: Sunda Clouded Leopard. *Sentence suggested by the court: the actual sentence given was unknown. Conversion to USD is based on exchange rate of USD1=IDR14,059 (https://www1.oanda.com/currency/converter/; 10 June 2020).

Discussion

Based on the analyzed seizure data from 2011 to 2019, there is a substantial illegal trade in the Javan Leopard and the Sunda Clouded Leopard in Indonesia. The trade in both species predominantly supplies a demand for wildlife trophies and ornaments as illustrated by the fact that mostly body parts, particularly skins, as well taxidermy products were seized. This corresponds to findings of Partasasmita et al. (2016) which revealed targeted hunting of the Javan Leopard by a village community in Sukabumi, West Java, due to an increased demand for animal skins and other valuable body parts, as well as other studies in Asia that reveal the availability of leopard skins of various species in wildlife markets (D'Cruze and Macdonald 2015; Nijman and Shepherd 2015; Ghimirey and Acharya 2020), indicating the demand for and their value as trophies/ornaments. In a study on the global trade in clouded leopards, Indonesia was frequently cited as a source country of concern particularly in reference to the trade in skins, meat and bones (D'Cruze and Macdonald 2015). Trade in body parts of both species could also be feeding a demand for traditional medicine. For example, leopard skin is used in Indonesia to treat skin disease (Partasasmita et al. 2016). In fact, much like the Tiger, almost every part of the leopard is used in traditional medicine – meat and bones are used to enhance male strength and virility, ash from burnt hair for foot and mouth disease, liver and bile as an antibiotic, brain for lung and heart disease, heart for asthma, while teeth, claws and tongue are prized as amulets/charms (Partasasmita et al. 2016). This raises further concerns as leopards are increasingly being used as substitutes for Tigers, which are locally extinct in many parts of their range and fast depleting in others (Raza et al. 2012). The data also revealed live individuals of both species exploited for the exotic pet trade (9 incidents and 23 animals, i.e., 6 Javan Leopards and 17 Sunda Clouded Leopards). Three of these incidents reported cubs seized, two of which occurred as recently as 2019 in Sumatra: one incident took place in Riau where two suspects were arrested for trying to smuggle one Javan Leopard cub, four Lion (*Panthera leo*) cubs and close to 60 Indian Star Tortoises (*Geochelone elegans*) and the other in Aceh, where a villager was caught trying to sell two Sunda Clouded Leopard cubs.

Aside from the clear intention of illegal exploitation of both species for trade, there were at least three cases involving the retaliatory killing of Javan Leopards that reportedly wandered into villages or preyed on livestock. All three incidents occurred in West Java involving at least seven animals. In two of the incidents, the leopards were either shot or poisoned, but the bodies were not found by the authorities (only pictures posted of the dead leopards). In the third incident, a leopard was caught by locals in the Ciamis-Garut area citing human-leopard conflict. When authorities came to retrieve the animal, the locals asked for money before they would hand over the animal. This had reportedly happened a few times in this area, and authorities were suspicious as this was generally coordinated by one individual person. These three incidents raise doubts as to the genuine nature of these conflicts and suggest that to some extent, loopholes in the law are being exploited (i.e. authorities overlook the killing of leopards

if they are deemed to be a threat to human life or livestock) to harvest these protected species for trade. Human-leopard conflict in Indonesia is reportedly becoming more frequent due to increasing fragmentation and loss of suitable habitat as well as depleting prey base (Partasasmita et al. 2016; Gunawan et al. 2017; Wibisono et al. 2018). This presents a significant conservation threat to the Javan Leopard and potentially the Sunda Clouded Leopard if not resolved urgently and further complicates efforts to eradicate illegal trade in these species.

Our study also reveals the international trafficking of both species from Indonesia to Kuwait, Russia and the UK, in violation of national legislation and CITES regulations. This was derived from three seizure incidents, two of which involved live animals for the pet trade, and one involving skulls. Live individuals of both species were despatched to Kuwait and Russia. In the first incident, the seizure took place in Jakarta in 2015 and involved a Sunda Clouded Leopard that was being smuggled to Kuwait. This was part of a larger investigation into the international trafficking of wildlife (including orangutan, Sun Bear, birds of paradise) sourced from Sumatra and Indonesian Papua to Middle Eastern countries. The second incident occurred in Russia in 2015, where a woman was caught at the Domodedovo Airport with plastic boxes containing animals sourced from wildlife markets in Indonesia including a live Javan Leopard. The incident of leopard skulls occurred in the UK in 2014, where an illegal wildlife trader was caught for selling two leopard skulls and 134 primate parts on e-Bay which had reportedly been sourced from a wildlife trader based in East Java. Given the close proximity to the Malaysian States of Sabah and Sarawak, cross border trade in these species between Indonesia and Malaysia should be considered a possibility as well.

The Javan Leopard and Sunda Clouded Leopard are strictly protected under Indonesia's national laws and by international regulations, yet this study reveals the prevalence of poaching, illegal domestic trade and international trafficking of both species. More than half of seizure incidents obtained were a result of intel and further investigation by enforcement authorities. Most of the seizure data (with the exception of 7 incidents) involved numerous wildlife species seized and not just leopards. This included high-profile species such as Tigers (41% of seizure incidents obtained for this study) and orangutans (in 2 incidents) as well as various other wildlife encompassing birds, deers, gibbons, pangolin, serow, snakes, slow loris, bears and turtles. This indicates enforcement efforts are not specifically targeted at Sunda Clouded Leopards or Javan Leopards but rather focused on dismantling Tiger poaching rings or general wildlife smuggling syndicates. This in itself suggests that true trade or poaching levels are vastly underestimated. The ongoing poaching and commercial trade is a conservation concern as both the Javan Leopard and the Sunda Clouded Leopard are highly threatened species and even low levels of removal could have major repercussions on remaining populations. For instance, recent studies on the distribution and population size of the Sunda Clouded Leopard in Borneo failed to detect the species in some areas and suggest that the species occurs in extremely low densities (Hearn et al. 2019). Approximately half of the cases resulted in successful prosecution and of these, the

highest sentence given was 2 years in jail and a fine of IDR50mil (~USD3300) to a wildlife trader caught in 2018 for attempting to sell 4 canines belonging to a Sunda Clouded Leopard, a bag made from the skin of a Javan Leopard and parts from Tigers and Sun Bears. All four species are strictly protected for which the maximum penalty afforded by Indonesia's wildlife laws is 5 years in prison and a fine of IDR100mil (~USD6700). Remaining convictions ranged from <1–1.6 years with fines ranging from IDR500,000 to IDR1mil (~USD35-70). The penalties handed down for these crimes are hardly deterrents and it is not known why maximum penalties as provided for under Indonesian law are not utilised further considering that multiple highly vulnerable and protected species are involved in these incidents and that such low penalties undermine enforcement efforts.

Conclusion

Poaching for commercial trade is pushing many wild cat species to the brink of extinction across their range in Asia (D'Cruze and Macdonald 2015; Nijman and Shepherd 2015; Nijman et al. 2019). The hunting of wildlife, particularly by indigenous communities for ceremonial clothing, food, medicine, protective charms and hunting trophies, has traditionally always been part of Indonesian culture (Meijaard 1999). However, hunting motives have since evolved, e.g., from one of subsistence to being commercially driven due to high commodity value (Meijaard 1999; Bennet and Robinson 2000; Harrison et al. 2016; Voigt et al. 2018). This, combined with modern hunting methods (including indiscriminate snaring), increasing accessibility of forests and increasing human-wildlife conflict, has resulted in significant detrimental impacts on wildlife populations across Asia (Gray et al. 2018; Symes et al. 2018), including Indonesia (Gunawan et al. 2017; Wibisono et al. 2018). Indonesia also has a notorious reputation for illegal and/or unsustainable trade in wild and exotic animals as pets, both as a source and demand country, involving a tremendous diversity and abundance of species (Nijman et al. 2009; Shepherd 2010; Harris et al. 2017; Morgan and Chng 2017; Gomez and Bouhuys 2018), including wild cats (Nijman et al. 2019). Over-harvesting of wildlife for the pet trade has been persistently raised as a key threat to Indonesia's biodiversity, particularly when it involves rare, endemic and restricted range species (Nijman and Stoner 2014; Janssen and Shepherd 2018), such as the Javan Leopard and Sunda Clouded Leopard. Hence, the illegal exploitation of the Javan Leopard and the Sunda Clouded Leopard for trade in Indonesia should be considered a significant threat to both species because of their threatened status in the wild (i.e. both species populations are small, in decline and vulnerable to extinction) and considering the dataset underrepresents true trade volumes.

We recommend further research into the drivers behind the poaching and trade in Javan Leopards and Sunda Clouded Leopards, including a focus on the links between human-wildlife conflict and trade. We encourage the Government of Indonesia to ramp up efforts to prioritise this issue and to investigate and dismantle

criminal networks involved in the commercial trade in both species and their parts and derivatives. We strongly suggest penalising offenders involved in the poaching and commercial trade in these species in Indonesia to the full extent of the law to create a deterrent. Cases resulting in prosecutions should be highlighted in the media to assist in raising awareness of the conservation plight these two species face as well as to educate the public regarding the legislation and penalties in place to prevent poaching and illegal trade. Finally, further monitoring of the poaching and trade in the Javan Leopard and Sunda Clouded Leopard, and of the efforts made to eradicate these crimes should continue to measure progress and to aid in informing future conservation and enforcement efforts.

Acknowledgements

We thank the public for partially funding this work through their generous donations. Biofagri Ascadendria Rachmayuningtyas is thanked for assisting in collecting data and translation. We also thank Sarah Heinrich and Vincent Nijman for very useful comments on an earlier draft of this paper. The authors have no support to report.

References

Bennet EL, Robinson JG (2000) Hunting of wildlife in tropical forests: implication for biodiversity and forest peoples. http://documents.worldbank.org/curated/en/101611468780290485/pdf/multi0page.pdf [accessed on 11 May 2020]

Buckley-Beason VA, Johnson WE, Nash WG, Stanyon R, Menninger JC, Driscoll CA, Howard J, Bush M, Page JE, Roelke ME, Stone G, Martelli PP, Wen C, Ling L, Duraisingam RK, Lam PV, O'Brien SJ (2006) Molecular evidence for species level distinction in clouded leopards. Current Biology 16(23): 2371–2376. https://doi.org/10.1016/j.cub.2006.08.066

Burgess EA, Stoner SS, Foley KE (2014) Bring to bear: An analysis of seizures across Asia (2000–2011). TRAFFIC, Petaling Jaya, Selangor, 40 pp.

Chng SCL, Eaton JA (2016) In the Market for Extinction: Eastern and Central Java. TRAFFIC, Petaling Jaya, Selangor, 98 pp.

Courchamp F, Angulo E, Rivalan P, Hall RJ, Signoret L, Bull L, Meinard Y (2006) Rarity Value and Species Extinction: The Anthropogenic Allee Effect. PLoS Biology 4(12): e415. https://doi.org/10.1371/journal.pbio.0040415

D'Cruze N, Macdonald DW (2015) Clouded in mystery: the global trade in Clouded Leopards. Biodiversity Conservation 24: 3505–3526. https://doi.org/10.1007/s10531-015-1010-9

Ghimirey Y, Acharya R (2020) Clouded Leopard *Neofelis nebulosa* (Grifth, 1821) (Mammalia: Carnivora: Felidae) in illegal wildlife trade in Nepal. Journal of Threatened Taxa 12(16): 17229–17234. https://doi.org/10.11609/jott.6504.12.16.17229-17234

Gomez L, Bouhuys J (2018) Illegal otter trade in Southeast Asia. TRAFFIC, Petaling Jaya, Selangor, 51 pp.

Gomez L, Shepherd CR (2019) Bearly on the radar – an analysis of seizures of bears in Indonesia. European Journal of Wildlife Research 65(6): e89. https://doi.org/10.1007/s10344-019-1323-1

Gomez L, Leupen BTC, Krishnasamy K, Heinrich S (2017) Scaly Nexus: Mapping Indonesian pangolin seizures (2010–2015). TRAFFIC, Southeast Asia Regional Office, Petaling Jaya, Selangor, 38 pp.

Gray TNE, Hughes AC, Laurance WF, Long B, Lynam AJ, O'Kelly H, Ripple WJ, Seng T, Scotson L, Wilkinson NM (2018) The wildlife snaring crisis: An insidious and pervasive threat to biodiversity in Southeast Asia. Biodiversity and Conservation 2018(27): 1031–1037. https://doi.org/10.1007/s10531-017-1450-5

Gunawan H, Iskandar S, Sihombing VS, Wienanto R (2017) Conflict between humans and leopards (*Panthera pardus melas* Cuvier, 1809) in Western Java, Indonesia. Biodiversitas (Surakarta) 18(2): 652–658. https://doi.org/10.13057/biodiv/d180229

Harris JBC, Tingley MW, Hua F, Yong DL, Adeney M, Lee TM, Marthy W, Prawiradilaga DM, Sekercioglu CH, Suyadi, Winarni N, Wilcove DS (2017) Measuring the impact of the pet trade on Indonesian birds. Conservation Biology 31(2): 394–405. https://doi.org/10.1111/cobi.12729

Harrison RD, Sreekar R, Brodie JF, Brook S, Luskin M, O'Kelly H, Rao M, Scheffers B, Velho N (2016) Impacts of hunting on tropical forests in Southeast Asia. Conservation Biology 30(5): 972–981. https://doi.org/10.1111/cobi.12785

Hearn A, Sanderson J, Ross J, Wilting A, Sunarto S (2008) *Neofelis diardi* ssp. *borneensis*. The IUCN Red List of Threatened Species 2008: e.T136945A4351615. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T136945A4351615.en [accessed on 06 May 2020]

Hearn A, Ross J, Brodie J, Cheyne S, Haidir IA, Loken B, Mathai J, Wilting A, McCarthy J (2015) *Neofelis diardi* (errata version published in 2016). The IUCN Red List of Threatened Species 2015: e.T136603A97212874. https://dx.doi.org/10.2305/IUCN.UK.2015-4.RLTS.T136603A50664601.en [accessed on 05 May 2020]

Hearn A, Ross J, Macdonald DW, Bolongon G, Cheyne S, Mohamed A, Samejima H, Brodie JF, Giordano A, Alfred R, Boonratana R, Bernard H, Loken B, Augeri DM, Heydon M, Hon J, Mathai J, Marshall AJ, Pilgrim JD, Hall J, Breitenmoser-Würsten C, Kramer-Schadt S, Wilting A (2016) Predicted distribution of the Sunda clouded leopard *Neofelis diardi* (Mammalia: Carnivora: Felidae) on Borneo. The Raffles Bulletin of Zoology 33: 149–156.

Hearn A, Ross J, Bernard H, Bakar S, Goossens B, Hunter L, Macdonald D (2019) Responses of Sunda clouded leopard *Neofelis diardi* population density to anthropogenic disturbance: Refining estimates of its conservation status in Sabah. Oryx 53(4): 643–653. https://doi.org/10.1017/S0030605317001065

Janssen J, Shepherd CR (2018) Challenges in documenting trade in non-CITES-listed species: A case study on crocodile skinks (*Tribolonotus* spp.). Journal of Asia-Pacific Biodiversity 11(4): 476–481. https://doi.org/10.1016/j.japb.2018.09.003

Kitchener AC, Beaumont MA, Richardson D (2006) Geographical variation in the clouded leopard, *Neofelis nebulosa*, reveals two species. Current Biology 16(23): 2377–2383. https://doi.org/10.1016/j.cub.2006.10.066

Lyons JA, Natusch DJ (2012) Exploited for pets: the harvest and trade of amphibians and reptiles from Indonesian New Guinea. Biodiversity and Conservation 21(11): 2899–2911. https://doi.org/10.1007/s10531-012-0345-8

Meijaard E, Sheil D, Nasi R, Augeri D, Rosenbaum B, Iskandar D, Setyawati T, Lammertink M, Rachmatika I, Wong A, Soehartono T, Stanley S, O'Brien T (2005) Life after logging: Reconciling wildlife conservation and production forestry in Indonesian Borneo. CIFOR, Bogor Indonesia, 345 pp.

Meijaard E, Buchori D, Hadiprakarsa Y, Utami-Atmoko SS, Nurcahyo A, Tjiu A, Prasetyo D, Nardiyono, Christie L, Ancrenaz M, Abadi F, Antoni ING, Armayadi D, Dinato A, Ella, Gumelar P, Indrawan TP, Kussaritano, Munajat C, Priyono CWP, Purwanto Y, Puspitasari D, Putra MSW, Rahmat A, Ramadani H, Sammy J, Siswanto D, Syamsuri M, Andayani N, Wu H, Wells JA, Mengersen K (2012) Quantifying killing of orangutans and human-orangutan conflict in Kalimantan, Indonesia. PLoS ONE 6(11): e27491. https://doi.org/10.1371/journal.pone.0027491

Meijaard E (1999) Human imposed threats to sun bears in Borneo. Ursus 11: 185–192.

Morgan J, Chng SCL (2017) Rising internet-based trade in the critically endangered ploughshare tortoise *Astrochelys yniphora* in Indonesia highlights need for improved enforcement of CITES. Oryx: 2–7. https://doi.org/10.1017/S003060531700031X

Nijman V (2015) An overview of international wildlife trade from Southeast Asia. Biodiversity Conservation (2010) 19: 1101–1114. https://doi.org/10.1007/s10531-009-9758-4

Nijman V, Shepherd CR (2015) Trade in tigers and other wild cats in Mong La and Tachilek, Myanmar – A tale of two border towns. Biological Conservation 182: 1–7. https://doi.org/10.1016/j.biocon.2014.10.031

Nijman V, Stoner S (2014) Keeping an ear to the ground: monitoring the trade in Earless Monitor Lizards. TRAFFIC Southeast Asia, Selangor, 20 pp.

Nijman V, Martinez CY, Shepherd CR (2009) Saved from trade: Donated and confiscated gibbons in zoos and rescue centres in Indonesia. Endangered Species Research 9: 151–157. https://doi.org/10.3354/esr00218

Nijman V, Langgeng A, Birot H, Imron MA, Nekaris KAI (2018) Trade, captive breeding and the imminent extinction of a songbird. Global Ecology and Conservation 15: e00425. https://doi.org/10.1016/j.gecco.2018.e00425

Nijman V, Morcatty T, Smith JH, Atoussi S, Shepherd CR, Siriwat P, Nekaris KAI, Bergin D (2019) Illegal wildlife trade – surveying open animal markets and online platforms to understand the poaching of wild cats. Biodiversity (Nepean) 20(1): 58–61. https://doi.org/10.1080/14888386.2019.1568915

Partasasmita R, Shanida SS, Iskandar J, Noviar E (2016) Human-leopard conflict in Girimukti Village, Sukabumi, Indonesia. Biodversitas 17(2): 783–790. https://doi.org/10.13057/biodiv/d170255

Raza RH, Chauhan DS, Pasha MKS, Sinha S (2012) Illuminating the blind spot: A study on illegal trade in Leopard parts in India (2001–2010). TRAFFIC India/WWF India, New Delhi, 52 pp.

Samedi, Iskandar DT (2000) Freshwater turtle and tortoise conservation and utilization in Indonesia. In: Van Dijk PP, Stuart BL, Rhodin AGJ (Eds) Asian turtle trade: Proceedings of a

workshop on conservation and trade of freshwater turtles and tortoises in Asia. Chelonian Research Monographs No. 2, 106–111.

Shepherd CR (2010) Illegal primate trade in Indonesia exemplified by surveys carried out over a decade in North Sumatra. Endangered Species Research 11(3): 201–205. https://doi.org/10.3354/esr00276

Shepherd CR, Magnus N (2004) Nowhere to hide: the trade in Sumatran Tiger. TRAFFIC Southeast Asia, Petaling Jaya, Selangor, 212 pp.

Shepherd CR, Nijman V, Krishnasamy K, Eaton JA, Chng S (2015) Illegal trade pushing the Critically Endangered Black-winged Myna *Acridotheres melanopterus* towards imminent extinction. BirdLife International 26(2): 147–153. https://doi.org/10.1017/S0959270915000106

Stein AB, Athreya V, Gerngross P, Balme G, Henschel P, Karanth U, Miquelle D, Rostro-Garcia S, Kamler JF, Laguardia A, Khorozyan I, Ghoddousi A (2020) Panthera pardus (amended version of 2019 assessment). The IUCN Red List of Threatened Species 2020: e.T15954A163991139. https://dx.doi.org/10.2305/IUCN.UK.2020-1.RLTS.T15954A163991139.en [accessed on 06 May 2020]

Sunarto S, Sanderson J, Wilting A (2008) *Neofelis diardi* ssp. *diardi*. The IUCN Red List of Threatened Species 2008: e.T136866A4347690. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T136866A4347690.en [accessed on 06 May 2020]

Symes WS, Edwards DP, Miettinen J, Rheindt FE, Roman C (2018) Combined impacts of deforestation and wildlife trade on tropical biodiversity are severely underestimated. Nature Communications 2018(9): e4052. https://doi.org/10.1038/s41467-018-06579-2

Voigt M, Wich SA, Ancrenaz M, Meijaard E, Abram N, Banes GL, Campbell-Smith G, d'Arcy L, Delgado RA, Erman A, Gaveau D, Goosens B, Heinicke S, Houghton M, Husson SJ, Leiman A, Llano S, Makinuddin N, Marshall A, Meididit A, Miettinen J, Mundry R (2018) Global demand for natural resources eliminated more than 100,000 Bornean Orangutans. Current Biology 28(5): 761–769. https://doi.org/10.1016/j.cub.2018.01.053

von Rintelen K, Arida E, Häuser C (2017) A review of biodiversity-related issues and challenges in megadiverse Indonesia and other Southeast Asian countries. Research Ideas and Outcomes 3: e20860. https://doi.org/10.3897/rio.3.e20860

Wibisono HT, Wahyudi HA, Wilianto E, Pinondand IMR, Primajati M, Liswanto D, Linkie M (2018) Identifying priority conservation landscapes and actions for the Critically Endangered Javan Leopard in Indonesia: conserving the last large carnivore in Java Island. PLoS ONE 13(6): e0198369. https://doi.org/10.1371/journal.pone.0198369

Wilting A, Christiansen P, Kitchener AC, Kemp YJM, Ambu L, Fickel J (2011) Geographical variation in and evolutionary history of the Sunda clouded leopard (Neofelis diardi) (Mammalia: Carnivora: Felidae) with the description of a new subspecies from Borneo. Molecular Phylogenetics and Evolution 58: 317–328. https://doi.org/10.1016/j.ympev.2010.11.007

Wilting A, Patel R, Pfestorf H, Kern C, Sultan K, Ario A, Penaloza F, Kramer-Schadt S, Radchuk V, Foerster DW, Fickel J (2016) Evolutionary history and conservation significance of the Javan leopard Panthera pardus melas. Journal of Zoology 299(4): 239–250. https://doi.org/10.1111/jzo.12348

ANNEX B: CURRICULUM VITAE

monitor
CONSERVATION RESEARCH SOCIETY

Lalita Gomez

Programme Officer

My journey in the field of wildlife trade research began in 2015, investigating, researching and identifying measures to combat the illegal exploitation of wildlife. I've largely concentrated on the exploitation of species for meat, medicine and pets in Southeast Asia. This has involved field research, online trade research, data analysis, legislative reviews and reporting in the region.

I've analysed data and published findings to provide documented evidence that can be used raise the profile of species being exploited by illegal trade, to support law enforcement action, to identify weaknesses and loopholes in wildlife regulations and support policy reform, to support development of conservation action plans and to identify measures needed to enhance protection for species. Over the years I've assessed the impacts of illegal trade on a wide variety of species with a particular focus on bears, pangolins, otters and more recently songbirds.

Prior to this, I spent almost a decade in the field of environmental consulting, managing and delivering on environmental related projects covering both the onshore and offshore environments to meet local regulatory requirements as well as international standards.

This encompassed environmental impact assessments, ecological studies, environmental management plans, environmental scoping studies, environmental and social baseline research and monitoring surveys, and environmental regulatory reviews. This has enabled me to analyse and present wildlife trade data from an added technical perspective.

Contact

H/P: +6012-3624021

Email: lalita.gomez@mcrsociety.org

Skype: lalita.gomez7

Affiliations

IUCN SSC Bear Specialist Group

IUCN SSC Pangolin Specialist Group

IUCN SSC Otter Specialist Group

MareCet - NGO focused on conservation of marine mammals in Malaysia

monitor
CONSERVATION RESEARCH SOCIETY

Education

Masters of Science, 2007
Completed a two-year study on nutrient cycling within a peat swamp forest in Malaysia to understand what supports such high biodiversity in a low productivity environment, an area of study that had never been previously examined in Malaysia. This included leaf litter decomposition analysis, stable carbon isotope and dietary analysis of invertebrates and fish fauna.

BSc (Honours) Environmental Management , 2002
Graduated with a second-upper after a one-year research programme on the influence of water hyacinth (an introduced aquatic macrophyte rapidly colonising Malaysian waters) on the ecology of tin mine lakes in Malaysia.

BSc Environmental Management
Monash University, 2001

Professional Experience

Monitor Conservation Research Society (Monitor), October 2018 – present
- Programme Officer
Conducting research, surveys, monitoring and analysis of the illegal wildlife trade with a particular focus on lesser known species in trade.

TRAFFIC Southeast Asia, June 2015 – September 2018
- Programme Officer
Manage and deliver projects and proposals related to the trade of wildlife used as meat and medicine in the Southeast Asian region including undertaking market monitoring, research and analysis.

Environmental Resources Management (ERM), August 2010 – May 2015
- Project Consultant
Manage and deliver environmental related projects and proposals. Conduct environmental impact assessments, environmental management plans, ecological studies, environmental scoping studies, environmental and social baseline and monitoring surveys, regulatory reviews, IFC Performance standards, for the oil and gas sector and industrial and infrastructure projects.

GSR Environmental Consultancy Sdn Bhd, October 2007 – July 2010
- Project Consultant
Conduct environmental impact assessments, environmental management plans, environmental and social baseline and monitoring surveys, environmental planning blueprint.

Wildlife Conservation Society, January 2007– July 2007
- Intern
Led a 6-member team in field work for data collection to determine the population density of elephants in Taman Negara.

Monash University, 2003 – 2005
- Research Assistant
Conducted research related to freshwater ecology including identifying aquatic insects, dietary analysis of aquatic insects, studying nutrient dynamics in freshwater/marine ecosystems, etc

Freelance Writer, 2003 – present
Write articles on various topics including wildlife conservation, lifestyle, personalities, etc.

ANNEX C: ETHICAL STATEMENT DECLARATION

monitor
CONSERVATION RESEARCH SOCIETY

05-07-2022

To whom it may concern,

Re: ethics for PhD by published work

I write this letter as Executive Director of the Monitor Conservation Research Society (Monitor), which was established in 2017, and former Regional Director of TRAFFIC from 2012-2017.

Monitor has strict protocols with regards to data collection and storage which were legally established to allow for our work internationally. Lalita has adhered to these since we employed her.

TRAFFIC as an organisation does not have the equivalent of a university research ethics committee, but over the last 30 years the organisation has developed a working set of guidelines and procedures which are followed when carrying out research.

Very best regards,

Dr Chris R Shepherd
Executive Director
Monitor Conservation Research Society

T: +1 250 302 9701 E: info@mcrsociety.org A: Box 200, Big Lake Ranch, British Columbia, V0L 1G0, Canada

ANNEX D: SIGNED LETTERS BY CO-AUTHOR(S)

monitor
CONSERVATION RESEARCH SOCIETY

TO: PhD Committee
FROM: Boyd Leupen
DATE: 30 September 2020

Lalita Gomez - Statement on contributions to joined / co-authored papers

Dear Members of the PhD Committee

Lalita Gomez and I have been working together since 2015 researching and investigating the illegal trade of wildlife in Southeast Asia and during this time we have co-authored multiple papers together. She intends to include a number of these in her PhD by Published Works. For the below listed papers, I can confirm she made the following contributions:

Gomez, L. Leupen, B.T.C., Krishnasamy, K. and Heinrich, S. 2017. Scaly nexus: mapping Indonesian pangolin seizures (2010-2015). TRAFFIC, Petaling Jaya, Malaysia.
Data collection - LG, BTCL. Analysis - LG, BTCL, SH. Writing of the paper - LG, BTCL, KK.

Leupen, B.T.C, Gomez, L. and Shepherd, C.R. 2017. Recent observations of the illegal trade in serows in Lao PDR. TRAFFIC Bulletin 29: 37–40.
Data collection - BTCL, LG, CRS. Analysis - BTCL, LG, CRS. Writing of the paper - BTCL, LG, CRS.

Gomez, L., Leupen, B.T.C., Heinrich, S. 2016. Observations of the illegal pangolin trade in Lao PDR, 2016. TRAFFIC Southeast Asia Regional Office, Petaling Jaya, Selangor, Malaysia.
Data collection - LG, BTCL. Analysis - LG, BTCL, SH. Writing of the paper - LG, BTCL.

Gomez, L., Leupen, B.T.C. and Tian, K.H. 2016. The trade of African pangolins to Asia: a brief case study of pangolin shipments from Nigeria. TRAFFIC Bulletin 28(1):3–5.
Data collection – TKH. Analysis - LG, BTCL. Writing of the paper - LG, BTCL.

Sincerely yours,

Boyd Leupen | Programme Officer
Monitor Conservation Research Society

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monitor
CONSERVATION RESEARCH SOCIETY

TO: PhD Committee
FROM: Dr Chris R. Shepherd
DATE: 30 September 2020

Lalita Gomez - Statement on contributions to joined / co-authored papers

Dear Members of the PhD Committee

Lalita Gomez and I have been working together since 2015 researching and investigating the illegal trade of wildlife and during this time we have co-authored multiple papers together. She wishes to use a number of these in her PhD by Published Works, particularly her work on bears that she has undertaken in Southeast Asia. For the below listed papers, I can confirm she made the following contributions:

Gomez, L., Wright, B., Joseph, T. and Shepherd, C.R. (2021) An analysis of the illegal bear trade in India. Global Ecology and Conservation e01552
Data collection: LG, TJ. Analysis: LG. Writing of the paper: LG. Recommendations/review: CRS, BW

Gomez, L and Shepherd, C.R. (2021) The illegal exploitation of the Javan leopard (Panthera pardus melas) and Sunda clouded leopard (Neofelis diardi) in Indonesia. Nature Conservation 43: 25–39 (2021). DOI: 10.3897/natureconservation.43.59399
Data collection: LG, CRS. Analysis: LG. Writing of the paper: LG. Recommendations/review: CRS.

Shepherd, C.R., Kufnerová, J., Cajthaml, T., Frouzová, J. and Gomez, L. 2020. Bear trade in the Czech Republic: An analysis of legal and illegal international trade from 2005 to 2020. European Journal of Wildlife Research (2020) 66:92. DOI: https://doi.org/10.1007/s10344-020-01425-7
Data collection – JK, TC, FJ, LG, CRS. Analysis – LG, CRS. Writing of the paper – CRS, LG.

Gomez, L., Shepherd, C.R. and Khoo, M.S. 2020. The illegal bear bile trade in Sabah and Sarawak. Endangered Species Research 41: 279–287. DOI: 10.3354/esr01028
Data collection – KMS. Analysis – LG. Writing of the paper - LG, CRS.

Gomez, L. and Shepherd, C.R. 2019. Bearly on the radar: an analysis of bear seizure data in Indonesia. European Journal of Wildlife Research (2019) 65:89. DOI: 10.1007/s10344-019-1323-1
Data collection - LG, CRS. Analysis – LG. Writing of the paper - LG, CRS.

Gomez, L., Shepherd, C.R. and Morgan, J. 2019. The online trade of Sun Bears in Indonesia. TRAFFIC Bulletin 31(2): 67-71
Data collection – JM. Analysis – LG. Writing of the paper - LG, JM, CRS

Gomez, L. and Shepherd, C.R. 2018. Trade in bears in Lao PDR with observations from market surveys and seizure data. Global Ecology and Conservation 15 (2018) e00415. DOI: 10.1016/j.gecco.2018.e00415
Data collection – LG. Analysis - LG, CRS. Writing of the paper - LG, CRS.

T: +1 250 302 9701 E: info@mcrsociety.org A: Box 200, Big Lake Ranch, British Columbia, VOL 1GO, Canada

Sincerely yours,

Dr Chris R Shepherd | Executive Director
Monitor Conservation Research Society

T: +1 250 302 9701 | E: chris.shepherd@mcrsociety.org
A: Box 200, Big Lake Ranch, British Columbia, VOL 1G0, Canada

TO: PhD Committee
FROM: Emerson Sy
DATE: 21 September 2020

Lalita Gomez - Statement on contributions to joined / co-authored papers

Dear Members of the PhD Committee

Lalita Gomez and I were colleagues during her time in TRAFFIC (2015-2018) and one of the projects we worked together on was an analysis of pangolin seizure data and market observations to reveal the extent of the trade in the Philippine Pangolin. She wishes to use this paper in her PhD by Published Works and I confirm she made the following contributions to the paper:

Gomez, L. and Sy, E. 2018. Illegal pangolin trade in the Philippines. TRAFFIC Bulletin 20(1): 37-39
Data collection - LG, ES. Analysis – LG. Writing of the paper - LG, ES

Best regards,

Emerson Sy
Executive Director
Philippine Center for Terrestrial and Aquatic Research

Consultant
TRAFFIC
USAID Protect Wildlife Project

TO: PhD Committee
FROM: Jamie Bouhuys
DATE: 30 September 2020

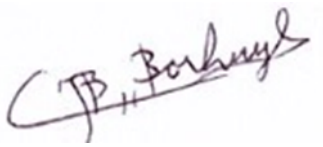
Lalita Gomez - Statement on contributions to joined / co-authored papers

Dear Members of the PhD Committee

Lalita Gomez and I worked closely together when we were in TRAFFIC undertaking market surveys of wildlife trade across Southeast Asia, revealing the significant trade of otters taking place on online platforms in the region, working on the first Sun Bear Conservation Action Plan, etc and co-authored several publications in the process. In particular, we spent two weeks in Lao PDR on an investigation to determine the presence of illegal bear farms across the country and together with E. Livingstone, published a paper on our findings. Lalita wishes to include this paper in her PhD by Published Works and I confirm she made the following contributions:

Livingstone, E., Gomez, L. and Bouhuys, J. 2018. A review of bear farming and bear trade in Lao PDR. Global Ecology and Conservation 13(2018) e00380. DOI: 10.1016/j.gecco.2018.e00380
Data collection - LG, JB. Analysis – EL. Writing of paper - EL, LG.

Sincerely yours



Jamie Bouhuys
Inspector Expertise CITES/ Species Protection Enforcement
Netherlands Food and Consumer Product Safety Authority (NVWA)

TO: PhD Committee
FROM: Kanitha Krishnasamy
DATE: 29 September 2020

Lalita Gomez - Statement on contributions to joint / co-authored papers

Dear Members of the PhD Committee,

When Lalita Gomez was a member of staff at TRAFFIC from 2015 - 2018, we worked closely on numerous projects over the years, researching and investigating the illegal trade of wildlife in Southeast Asia. Through the course of this work, we co-authored several publications. Among these is an analysis on the use of Saiga Antelope horn for traditional Chinese medicine in Malaysia, which she wishes to use in her PhD by Published Works. I confirm she made the following contributions to the paper:

Gomez, L. and Krishnasamy, K. 2019. A rapid assessment of the trade in Saiga Antelope horn in Peninsular Malaysia. TRAFFIC Bulletin 31(1): 35-38

Data management – LG. Analysis - LG, KK. Writing of the paper - LG, KK.

Sincerely yours,

Kanitha Krishnasamy
Regional Director
TRAFFIC Southeast Asia

TO: PhD Committee
FROM: Or Oi Ching
DATE: 30 September 2020

Lalita Gomez - Statement on contributions to joined / co-authored papers

Dear Members of the PhD Committee

Lalita Gomez and I were colleagues during our time in TRAFFIC undertaking market surveys and research on wildlife trade issues in Southeast Asia. Her focus of work was on monitoring the illegal trade of bears while I was working on wildlife trade monitoring outreach programmes with local communities living near a protected forest complex in the north of Malaysia. Based on the data we had collected we wrote a paper exposing the indiscriminate snaring and poaching of bears in Malaysia which she wishes to use in her PhD by Published Works. I confirm she made the following contributions to the paper:

Or, O.C., Gomez, L. and Lau, C.F. 2017. Recent reports of seizures and poaching of sun bears in Malaysia. International Bear News 26 (2): 17-18
Data collection - OOC, LG, CFL. Analysis - OOC, LG. Writing of the paper - LG, OOC.

Sincerely yours,

Or Oi Ching
PhD. Candidate
University of Nottingham Malaysia Campus

TO: PhD Committee
FROM: Dr Sarah Heinrich
DATE: 30 September 2020

Lalita Gomez - Statement on contributions to joined / co-authored papers

Dear Members of the PhD Committee

Lalita Gomez and I have collaborated on various different projects over the years researching the exploitation of lesser known species being traded for various purposes in Southeast Asia such as pangolins and more recently porcupines. We have co-authored several publications together in the process, some of which she wishes to use in her PhD by Published Works. For the below listed publications, I confirm she made the following contributions:

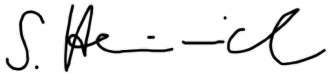
Heinrich S, Toomes A, and Gomez, L. 2020. Valuable stones: The trade in porcupine bezoars. Global Ecology and Conservation, 24 (2020) e01204

Data collection – AT. Analysis – SH. Writing of the paper – SH, AT with input from LG (personal observations from surveys of traditional medicine outlets in Malaysia). Legislative interpretation/review – LG.

Gomez, L., Leupen, B.T.C., Heinrich, S. 2016. Observations of the illegal pangolin trade in Lao PDR, 2016. TRAFFIC Southeast Asia Regional Office, Petaling Jaya, Selangor, Malaysia.

Data collection - LG, BTCL. Analysis - LG, BTCL, SH. Writing of the paper - LG, BTCL.

Sincerely yours



Dr Sarah Heinrich

Visiting Research Fellow
The University of Adelaide
Faculty of Sciences
School of Biological Sciences
Adelaide, 5005, AUSTRALIA

MEMO

OXFORD BROOKES UNIVERSITY

TO: PhD Committee
FROM: Professor Vincent Nijman
DATE: 17 October 2020

Lalita Gomez - Statement on contributions to joined / co-authored papers

Dear Members of the PhD Committee

Lalita Gomez and I have worked on a number of projects investigating the illegal wildlife trade in Southeast Asia such as the unsustainable trade of songbirds in Asia, the trade of serow and other Caprinae species for meat and medicine in Myanmar, etc. We recently co-authored an analysis on the illegal exploitation of pig-nosed turtles in Indonesia which she wishes to include in her PhD by Published Work and for which I can confirm that she made the following contributions:

A. Shepherd, C.R., Gomez, L. and Nijman, V. (2020). Illegal wildlife trade, seizures and prosecutions: a 7.5-year analysis of trade in pig-nosed turtles *Carettochelys insculpta* in and from Indonesia. Global Ecology and Conservation 24 (2020) e01249.

Data collection – LG, CRS, VN. Analysis – LG, VN. Writing of paper – LG, CRS, VN.

Sincerely yours,

Vincent Nijman
Professor in Anthropology
Oxford Brookes University