Abstract

International trade in wildlife is a major threat to biodiversity conservation. CITES, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, is the primary mechanism for maintaining sustainability in international wildlife trade. However, CITES has been criticised because it relies on regulatory measures but disregards the economic reality of wildlife trade. Through means of a case study on the trade in pangolins (*Manis* spp.) in Asia, we critically evaluate the CITES approach to controlling trade and demonstrate significant inadequacies to it. This is because it fails to accurately monitor supply, particularly where trade is illegal, it fails to consider the impact of trade controls in realistic terms, and it does little to consider the complex nature of demand for wildlife products or contend with changing market dynamics. To more effectively manage trade we argue that reforms are needed within CITES. Specifically, improved monitoring of supply (e.g., by accounting for illegal and legal trade) and monitoring of demand and prices for wildlife (e.g., through national wildlife consumption surveys) would enable the Convention to function from a more comprehensive understanding of wildlife trade. These data, integrated with the Convention's existing trade database, would allow more realistic evaluation of trade controls, and could inform decision-making and the implementation of interventions which go beyond regulation and address demand directly. In a world of rapid economic and social change understanding markets and addressing demand as well as supply is essential to conserving the world's trade threatened species.

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1. Introduction

International trade in wildlife is a major threat to biodiversity conservation (Broad et al. 2003; Sutherland et al. 2009) and can diminish species' populations, cause extirpations, and ultimately threaten ecosystem function (Challender et al. 2015; Duckworth et al. 2012; Smith et al. 2010). It is of serious concern to policymakers at present as a result of rising demand for traditional Asian medicine, luxury foods and curios, among other trades (e.g., pets), and current laws and regulations are increasingly being by-passed (Challender & MacMillan 2014; Natusch & Lyons 2012; Rosen & Smith 2010).

CITES, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, which entered into force in 1975, is the primary mechanism for controlling international wildlife trade (CITES 2014a). It seeks to ensure that international trade does not threaten the survival in the wild of c.35, 000 species (CITES 2014a). It relies on regulatory measures including trade bans (3% or 931 species are listed in Appendix I) and controls (96% or 34, 419 species are listed in Appendix II and <1% or 147 species are listed in Appendix III), which are established following an assessment of species' extinction risk, and the subsequent monitoring of trade levels (CITES 2014a; Wijnstekers 2011). It is implemented by member states (known as Parties, currently numbering 180) through a system of permits, national legislation and enforcement mechanisms, and nominated national agencies (CITES 2014a).

However, CITES has been criticised because it disregards the economic reality of wildlife trade and its broader socio-economic and cultural drivers (e.g., Challender et al. 2015; Challender & MacMillan 2014; Cooney & Abensperg-Traun 2013; Roe et al. 2002). Controlling trade requires understanding markets, including supply (e.g., species abundance, production and trade volumes) and demand (e.g., consumer preferences, demand elasticity and social norms surrounding consumption) and how these forces interact (e.g., price and market structure), and crucially, how they can be influenced

and respond to different interventions (e.g., Phillip et al. 2009; Damania & Bulte 2007; Dickson 2003). Yet, while CITES has recognised the economic nature of trade and its broader complexity (e.g., Res. Conf. 13.2, Rev. CoP14; Res. Conf. 16.6; see Challender et al. 2015), these factors are typically excluded from decision-making (e.g., listing species in the Appendices), monitoring, and implementation, which remain focused on trade controls (Mathur 2009; Abensperg-Traun 2009).

Although supply is monitored, the process is impeded. This is partly because population data are lacking and go uncollected for many listed species (Parsons et al. 2010; Phelps et al. 2011; Abensperg-Traun et al. 2011) but it is also because CITES efforts exclude illegal trade (with few exceptions, e.g., elephant ivory – see Res. Conf. 10.10, Rev. CoP16), but which is estimated to be worth USD20 billion a year globally and involve large volumes of many taxa (Challender et al. 2015; South & Wyatt 2011; Rosen & Smith 2010). Moreover, despite trade controls being used to regulate supply, the impact of these measures is only tangentially considered in decision-making (see Res. Conf. 9.24, Rev. CoP16). Yet, in some cases they have stimulated trade (e.g., Rivalan et al. 2007; Courchamp et al. 2006), sent it underground (e.g., Rosen & Smith 2010; Underwood et al. 2013), and increased prices for wildlife products (e.g., 't Sas-Rolfes 2000; MacMillan & Han 2011), and which have resulted in adverse impacts on the conservation of listed species (e.g., Rivalan et al. 2007; Leader-Williams 2003).

Crucially, CITES also fails to adequately understand or address demand (see Res. Conf. 9.24, Rev. CoP16), but which may be characterised by complex socio-cultural factors, and which can undermine trade controls (e.g., Biggs et al. 2013; Underwood et al. 2013; Rosen & Smith 2010). Similarly, the Convention does not contend with changing market dynamics, which may be signalled by rapid price movements (e.g., sharp increases in retail prices for rare species; Hall et al. 2008), and which may herald an extinction crisis for certain highly protected species (e.g., Brook et al. 2012; Ferreira et al. 2012; Courchamp et al. 2006).

Here, we critically evaluate the CITES approach to controlling trade through means of a case study

on the trade in pangolins (*Manis* spp.) in Asia, and suggest reforms that would enable the

Convention to more effectively govern international wildlife trade. Specifically, we analyse CITES

trade data and seizure data on pangolins in Asia and review actions taken within the Convention to

control trade in Asian pangolins in order to evaluate the effectiveness of these actions. We then

present analyses of price data and contemporary demand for pangolin products to demonstrate the

utility of understanding markets to informing trade interventions which go beyond regulation of

supply. We then suggest reforms we argue would enable CITES to more effectively govern

international wildlife trade.

2. Case study background: pangolins in Asia

Pangolins are insectivorous mammals covered in epidermal scales. Four species occur in Asia, the

Chinese (*Manis pentadactyla*), Sunda (*M. javanica*), Indian (*M. crassicaudata*), and Philippine

pangolin (*M. culionensis*), and which are collectively distributed from Pakistan east through southern

China, and south throughout the Indian sub-continent and much of Southeast Asia (Kingdon et al.

2013; Challender et al. 2014). Historically, they have been exploited locally for a range of

consumptive uses (e.g., as a protein source, a 'tonic' food, and an ingredient in traditional Asian

medicine), most conspicuously in China (Wu et al. 2004; Wu & Ma 2007), but also for international

trade (Figure 1; Herklots 1937; Harrisson & Loh 1965). Understudied, they are also difficult to

census, and with few exceptions (e.g., Wu et al. 2004) there is a lack of quantitative data on

populations (e.g., Challender et al. 2014a, 2014b). However, it is understood that populations in

China were commercially extinct by the mid-1990s, and which has since been dependent on imports,

mainly from Southeast Asia (Figure 1; Wu et al. 2004; SATCM 1996). This has driven regional trade

dynamics with international trade being substituted for local use in many areas (e.g., MacMillan &

Nguyen 2013; Newton et al. 2008; Pantel & Anak 2010), and evidence suggests populations are

declining rapidly, and the species' are becoming increasingly rare as a result (Challender et al. 2014a; 2014b).

Asian pangolins provide a useful case study with which to evaluate the CITES approach to controlling trade because of their long history of involvement with the Convention's regulatory processes. They have been included in Appendix II since 1975, they were included in the Review of Significant Trade (RST) process in 1988 (preliminary phase), 1992 (phase I) and 1999 (phase IV), and the Chinese and Sunda pangolins were also candidate species for the RST in 2004 (post-CoP13 phase). The RST process is a desk-based species-specific non-compliance response mechanism through which remedial measures such as export quotas and field projects are formulated where CITES trade data suggests trade levels have been unsustainable (Reeve 2002). All Asian pangolins, with the exception of the Philippine species which was recently described as distinct from the Sunda pangolin (see Gaubert & Antunes 2005) and listed in Appendix II in 2007, were also subject to a proposed transfer from Appendix II to Appendix I at the 11th meeting of the Conference of the Parties (CoP; 2000). However, the Parties instead opted to establish zero export quotas for all wild-caught animals traded commercially – in effect a proxy trade ban (CITES 2000a). Despite these measures, and the species being listed as protected in all but two range states today (Bhutan and Brunei Darussalam), some of which have implemented strong regulatory measures, most notably China (see Figure 1), Asian pangolins are currently subject to on-going illicit international trade (Wu & Ma 2007; Challender et al. 2014a, 2014b). It is understood this trade is typically destined to China and Vietnam, where pangolin meat is consumed as a luxury food and scales are prescribed in traditional medicines, and is now sourced from Southeast and South Asia, and increasingly from Africa (Figure 1; Challender 2011; Challender & Hywood 2012; Mahmood et al. 2012).

3. Methodology and data sources

To critically evaluate the CITES approach to controlling trade we used CITES trade data and seizure data on pangolins in Asia and charted actions taken for Asian pangolins in the Convention by reviewing CITES documentation. To gain an understanding of prices and demand for pangolin products we conducted semi-structured interviews with traditional medicine retailers and wholesalers in China and Vietnam, and staff in restaurants known to serve pangolins in Vietnam. We augmented our price data with that available in the literature, and describe our methods in more detail below.

3.1. Trade data

3.1.1. CITES trade data

To determine trade levels, species and derivatives in trade, we downloaded data from the CITES trade database (UNEP World Conservation Monitoring Centre, Cambridge, UK) which is the primary source of data on international wildlife trade and contains data on imports, exports, and re-exports of CITES listed species as reported by Parties in their annual reports (UNEP-WCMC 2013). Data for all *Manis* spp. were downloaded in a comparative tabulation report in October 2013, and records of Asian pangolins and *Manis* spp. in trade between 1975 and 2012, as reported by importers, were extracted for analyses (e.g., Carpenter et al. 2005). Trade in skins (including length and skin pieces), scales (by weight), bodies, specimens and live animals only were analysed as they could unambiguously be equated to a number of individual animals (e.g., Nijman 2010). Records where origins/exporters were of African origin were excluded to avoid analysing reported trade in African pangolins. Although it is likely these data contain biases (e.g., under-reporting and lack of reporting), reflecting variation in reporting competency and compliance among CITES Parties historically, and while CITES trade data have been demonstrated to be unreliable (e.g., Blundell & Mascia 2005), there is no substitute source of data on international wildlife trade at the species level. We therefore used these data to estimate trade levels but acknowledge the likely biases they contain.

3.1.2. Seizure data

While pangolins in Asia are evidently traded illegally at the international level (Challender 2011; Wu & Ma 2007), CITES does not record this trade centrally. Data from seizures involving pangolins in Asia (including derivative, species, and number of animals in trade) between July 2000 (when zero export quotas came into effect) and 2013 were therefore compiled in a MS Excel database and also used to estimate trade levels. Although these data also contain biases (see below) they provide the most comprehensive means of analysing illicit trade (e.g., Underwood et al. 2013; Rosen & Smith 2010) and were collected in four main ways. First, requests for seizure data were made to all ASEAN-WEN (Association of Southeast Asian Nations-Wildlife Enforcement Network) member countries' Customs, Police and CITES focal points and China's CITES Management Authority, and were extracted from Peninsular Malaysia's Department of Wildlife and National Parks (Perhilitan) annual reports (2003-2009), in Spring 2011. Second, data were provided by organisations working in Asia with an interest in wildlife trade, including but not limited to TRAFFIC (including seizures from TRAFFIC's Bulletin journal), Wildlife Alliance Cambodia, and ASEAN-WEN. Third, data from local, national and international media were obtained by means of a Google alert for the word 'pangolin' in English, established in 2009, and alerts in Chinese, Vietnamese, and Bahasa established in 2010. A Google alert regularly searches for news articles and web pages on the internet using keywords and emails links to articles to a designated email address. Finally, data were acquired from published and grey literature on wildlife trade in Asia, and where reputable records of trade were found during data collection (e.g., from court cases), they were included in our analyses.

To estimate trade volumes species-specific parameters were used (Table 1). For CITES data this applied to records of scales and skins (length) only as other derivatives were assumed to represent actual numbers of animals in trade (following UNEP-WCMC 2013). For seizure data and records of trade, trade was categorised as involving 'individual animals' (e.g., live or dead pangolins), 'scales',

'meat' (e.g., de-scaled animals), and/or 'other', and number of animals was taken from the original

data source where present or was estimated based on reported weights (Table 1). To avoid double

counting seizures, each confiscation was identified as a unique seizure based on the number/weight

of animals/derivatives seized, and date (day, month, year) and location. In compiling the database

careful attention was paid in order not to duplicate seizures which were often reported in multiple

sources, and on completion duplicate seizures were removed from the database where found.

Where seizures involved more than one derivative they were treated as mutually exclusive and

though this does not account for the bias of missing shipments in estimating illegal trade levels, it

does provide an estimated upper limit of pangolins in illegal trade in Asia based on the seizures

recorded in our database. Species in trade was recorded from the original data source where

present, or was inferred from reported countries of origin, species distribution, and seizure location,

though this necessitated recording trade as involving one of multiple species for some seizures (see

Table 1).

Although our seizure data provide a means of analyses, inherent biases mean they should not be

interpreted as temporal trade trends or absolute trade volumes (e.g., Milliken et al. 2012). This is

because they do not account for law enforcement effort or reporting effort, which are difficult to

acquire on a regional scale (e.g., Burn et al. 2011; Underwood et al. 2013).

3.2. History of CITES action on Asian pangolins

To chart actions taken within CITES to control trade in Asian pangolins we reviewed relevant CITES

documents, which were either downloaded from the CITES website (www.cites.org) or obtained

from the CITES Secretariat directly. They included proposals to amend the CITES Appendices (e.g.,

2000b), decisions made at CoP meetings (e.g., 2000a), and Animals Committee meeting documents

(e.g., species selected for the RST and detailed species reviews; e.g., Anon. 1992). We also made

note of illegal trade recorded within the RST process but not reported to CITES.

3.3. Demand and prices for pangolins

To gain an understanding of demand and prices for pangolins and their derivatives, semi-structured

interviews were conducted with staff from restaurants (18) known to serve pangolins in Vinh and Ho

Chi Minh City (HCMC) in Vietnam, and from traditional medicine retailers in Guangzhou, China (67)

and Hanoi and HCMC in Vietnam (48) in 2012 and/or 2013. Interview topics included price, price

trends, availability, utilisation, and consumer characteristics, and additionally in restaurants, the

attributes of pangolins important to consumers. Price data were also collected from a systematic

search of academic and grey literature on wildlife trade and from non-governmental organisations in

Asia (see above), and were sourced from market surveys or interviews originally. Due to the

sensitive nature of the research, responses varied among interviewees in terms of depth and detail,

and our analyses therefore comprised examination of price trends and assessment of the availability

of pangolin products, and in restaurants, the characterisation of consumers and the consumption

setting and pangolin attributes considered important to consumers. All prices were converted to

2013 real prices to account for inflation using historical exchange rates from OANDA

(www.oanda.com).

4. Results

4.1. Trade in pangolins in Asia

CITES trade data indicate that between 1977 and 2012 an estimated 576,303 Asian pangolins were in

international trade. This mainly involved skins (90%; 521,490/576,303), most of which were traded

for commercial purposes (93%; 486,987/521,490), and virtually all of which (99%; 514,284/521,490)

occurred prior to, or in, the year 2000 (Figure 2). This mainly involved the Sunda pangolin (87%;

451,994/521,490) and Chinese pangolin (11%; 56,148/521,490) and the bulk of skins (66%;

347,474/521,490) were imported to the US and Mexico from Lao PDR (26%; 133,379), Malaysia

(23%; 117,559), Thailand (16% 84,077), and Indonesia (7%; 36,084). Scales comprised a further 9%

of trade (or an estimated 53, 114 animals) which primarily took place between Malaysia, and China

and Hong Kong in the mid-1990s, but included an estimated 2,220 Sunda pangolins in trade in 2012.

Trade in other derivatives was negligible by comparison (<1%). Overall, trade reported to CITES up

to 2000 involved an estimated 23,418 $\pm$ 18,736 animals (mean $\pm$ SD) annually, and peaked twice,

most notably in 2000 (Figure 2).

However, evidence from the RST process indicates that much trade occurred in this period that was

not reported to CITES, and that these figures do not reflect supply of pangolins products to

international markets. For instance, at a minimum, tens of thousands of pangolins were illegally

imported to China in the early 1990's, largely from Southeast Asia (also see Wu & Ma 2007; Li and Li

1998). Similarly, up to 10t of scales were imported to Taiwan (P.R. China) annually between 1980

and 1985 and up to 13t of scales were imported to South Korea annually throughout the 1980s, in

addition to 55t in 1993, while China also imported a minimum of 95t of scales between 1990 and

1995 from Southeast Asia (Broad et al. 1988; Anon. 1992; Anon. 1999a, b), and trade in skins also

went unrecorded (also see Nooren & Claridge 2001). On this evidence alone, unreported trade

involved a minimum estimate of an additional 88-163% (or 505,423 - 935,369 animals based on

parameters in Table 1) of trade reported to CITES.

Since 2000, little trade has been reported to CITES which perhaps suggests that the introduction of

zero quotas has led to its near cessation (Figure 2). However, seizure data and records of trade

indicate that a substantial illegal trade has taken place since. Between July 2000 and 2013 there

were at least 886 seizures involving pangolins in Asia, which including records of trade represents an

estimated 227,278 animals in trade illegally, or 16,269 + 11,191 animals (mean + SD) annually (Figure

2). These data also indicate that trade comprised scales mainly (41% of trade; or an estimated

94,279 animals) as well as live and dead animals (31%; 71,302/227,278), and pangolin meat (26%;

59,525/227,278). In contrast, there were few skins (2%; 5,170/227,278) and other derivatives

(<0.1%; 2/227,278) in trade. These data further show that this trade occurred across Asia and involved all four species of Asian pangolin as well as derivatives of African pangolins (Figure 3). However, they arguably represent the metaphorical 'tip of the iceberg' in terms of trade volumes as this trade is clandestine, and characteristically, it is suspected much of it goes undetected and/or unrecorded (e.g., Underwood et al. 2013; Stiles et al. 2013).

4.2. History of CITES action on Asian pangolins

In response to high volumes of international trade in Asian pangolins, the species have been involved in a number of CITES processes. On the basis that trade levels were potentially unsustainable in the 1980s (see Figure 2) each species (excluding the Philippine pangolin) was included in the preliminary phase of the RST process in 1988 (Figure 1). This comprised a detailed review of information on the biology, threats and international trade in each species. It concluded that populations were thought to have declined in many areas in Asia as a result of hunting, but the absence of population data meant it was not possible to determine the impact of trade on populations (see Broad et al. 1988).

Similarly, and on the same basis, the species were selected for review in phase I of the RST in 1992, and which saw the advent of time-bound remedial measures where trade levels were deemed detrimental to species survival in the wild (see Reeve 2002). These reviews documented high volumes of illegal trade in Asian pangolins (see Section 4.1) and reported hunting-driven population declines in many areas of the species' range. In response, a series of primary recommendations (to be implemented within 30 days) and secondary recommendations (to be implemented with 12 months) were made, and which were predominantly regulatory in nature (see Table 2).

Notwithstanding implementation of these recommendations (see CITES 1999), high volumes of international trade, mainly in skins, continued to occur throughout the 1990s (Figure 2) and Asian

pangolins were subsequently included in phase IV of the RST process in 1999 (Figure 1; see Anon 1999a, 1999b). These reviews again concluded that the species were subject to extremely heavy hunting pressure, in particular the Chinese and Sunda pangolins, which had caused major populations declines, and that illegal trade, much of which was destined for China, dwarfed trade reported to CITES (see Section 4.1; Anon. 1999a, Anon. 1999b). Further, they concluded that the high value of pangolins was incentivising supply and that there were very high levels of international demand for pangolin meat and scales, particularly in China. Again, primarily regulatory-based recommendations were formulated, and which included further restricting supply until the population status of each species had been assessed and trade control measures had been developed and implemented (see Table 2).

While still subject to phase IV of the RST, Asian pangolins were subject to a proposed transfer from Appendix II to Appendix I at CoP11 (2000; see CITES 2000b). Like the above reviews, the proposal documented high levels of legal and illegal trade, in particular involving the Chinese and Sunda pangolins but also the Indian species, and associated population declines. Equally, it acknowledged the extremely high incentives to collect pangolins in Asia and the very high international demand for pangolins products, both meat and scales, particularly in China, much of which was being met with illegal supply (see CITES 2000b). Although the CITES Secretariat acknowledged that the Sunda pangolin at least met the criteria for an Appendix I listing (see CITES 2000c), it considered the transfer of the species to Appendix I to be premature because phase IV of the RST process had not been completed, and the proposal was ultimately rejected by Parties. Instead, and despite the proposal outlining the reality of trade, both in terms of supply and demand, the Parties established zero export quotas for all wild-caught Asian pangolins traded for primarily commercial purposes – or a proxy trade ban (CITES 2000b).

Despite the purpose of these measures being to control trade, evidence from CITES trade data suggest the Appendix I proposal catalysed trade, which would account for the peak in trade in 2000 based on the potential for a trade ban to have been established (e.g., Rivalan et al. 2007), and despite zero export quotas, illegal trade has continued since (Figure 2). However, as this trade is not recorded by CITES it has not been acted upon with the Convention. For instance, although the Chinese and Sunda pangolins were candidate species for the post-CoP13 phase of the RST process (2004), they were not selected for detailed review on the basis that reported trade levels were negligible. However, in reality they were subject to high levels of seemingly unsustainable trade, albeit illegal, and arguably in need of further trade intervention (Figure 2; Figure 3; CITES 2004). Following the establishment of zero quotas, it wasn't until 2010 that further action was taken to address this trade in the form of a 'CITES alert' sent by the Secretariat to Parties, and which drew attention to it. The issue was subsequently raised at CoP16 (2013; Figure 1), which resulted in a reporting mandate for range states in Asia for the 65th meeting of the CITES Standing Committee (July 2014), and which ultimately led to the current mandate for all Parties to submit information on pangolin trade to the 66th Standing Committee meeting (January 2016; see Figure 1).

4.3. Demand and prices for pangolins

Semi-structured interviews in China and Vietnam revealed that pangolin products, both meat and scales, were readily available in these markets and provided insights into contemporary demand. In China, they revealed that scales were available from 69% (22/32) and 80% (28/35) of retailers in 2012 and 2013 respectively, and in Vietnam from 91% (21/23) in 2012 and 77% (37/48) in 2013, and either in raw or fried form or both. As reported nearly exclusively by retailers and wholesalers, scales are used in traditional medicines to improve blood circulation, cure skin diseases, and stimulate milk secretion in lactating women, as prescribed in official Chinese and Vietnamese pharmacopeia. Other medicinal uses were also reported, which included to help cure cancer, as well as non-medical applications such as use of the scales as guitar plectrums. Although obtaining

accurate information on the volume of scales sold was problematic, based on the sensitivity of the

research topic and pangolin scales being one of hundreds of ingredients stocked by retailers and

wholesalers, their availability indicates that they remain in demand for medicinal purposes as

corroborated by interviewees. This is despite scales being associated with illegality both Vietnam

and China, but particularly the latter, where scales certified by government agencies (indicated by

the presence of a sticker on the packaging) may be sold legally but only through designated hospitals

(see Figure 1). However, uncertified scales were widely available from medicinal outlets, as our

interviewees attest.

Semi-structured interviews revealed that pangolins also continue to be in demand for their meat. In

Vietnam, this was available in all 18 restaurants frequented, and which were high-end luxury

restaurants characterised by private dining rooms with flat-screen televisions and the promotion of

luxury brands of whisky and entertainment venues (e.g., nightclubs). Interviewees reported that

pangolins are in demand for their meat because the animals are considered to be rare and are wild-

caught, because they retail at high prices (pangolin was the most expensive meat in 16/18

restaurants frequented) and illegality associated with procurement means they perform an

important social function of imparting status among consumers. Consumers are characteristically

business elites (e.g., bankers) and/or state officials keen to 'look after clients' when signing business

contracts or very wealthy consumers keen to 'try something new'. The lead author observed the

typical consumption of a Sunda pangolin in a restaurant in HCMC, whereby the animal was brought

into the restaurant alive and killed for consumption in front of the consumers. These were three

middle-aged Vietnamese men (40-55 years old), who paid USD700 (USD340 kg^{-1}) for the 2 kg animal,

and who were trying it for the first time based on a friend's recommendation.

Available data indicate the retail price of pangolins products is also increasing. In China, the price of

scales has increased from USD 76.15 kg^{-1} in 2000 to USD 759.15 kg^{-1} in 2013 (Figure 4a; see Wu &

Ma 2007), and though fewer data are available over time, in Vietnam from USD 200.64 kg^{-1} in 2008 (n=48) to USD 484.91 kg^{-1} in 2013 (n=62). The price of meat has also been increasing, from USD 46.92 to USD 297.12 kg^{-1} between 2000 and 2012 in China (Figure 4b), and from USD 163.39 (n=11) to 304.64 kg^{-1} (n=10) between 2007 and 2012 in Vietnam. These price rises can be attributed to growing demand in these markets following fast-paced growth in recent decades and the development of luxury, urban markets, especially for wild meat (e.g., Drury 2011; Wu & Ma 2007; Zhang & Yin 2014). However, they can also be attributed to the impact of regulation, meaning there is a higher risk to retailers/wholesalers from selling scales specifically, as stated by interviewees, and declining supply, i.e., fewer pangolins, which was also asserted by interviewees and whom reported pangolins and their scales are now rare and hard to source, as reported in China and Vietnam.

5. Discussion

5.1. Lessons learnt from the case study

Data on trade in pangolins in Asia indicates that CITES monitoring does not reflect supply to international markets and that illegal trade has undermined reporting to CITES both pre- and post-2000. This is despite the implementation of remedial measures formulated to control trade in the RST, and the establishment of zero quotas, which appear to have catalysed trade in the year 2000 and otherwise sent it underground. This has implications for trade governance because it means that CITES now understands less about the dynamics of this trade than before zero export quotas were established. For instance, it possesses little data on trade levels, species or derivatives in trade, or countries of origin, export and destination, and therefore precludes any assessment of the sustainability of trade.

The impact of zero quotas, to send trade underground, occurred despite the requirement for Parties to consider the impact of trade controls on trade dynamics and species conservation (see Res. Conf. 9.24, Rev. CoP16). However, Parties are not required to assess the impacts in realistic terms.

Proponents of amendments to the Appendices are only required to provide information on how the proposed changes will '*affect the nature of trade*' (which the listing criteria interpret as the purpose and source of trade, and derivatives in trade, etc – see Res. Conf. 9.24, Rev. CoP16), but they are not required to consider explicitly, for example, will a listing in CITES simply send trade underground? Will it catalyse trade? Will it increase prices? Yet, this is impractical because it is known that proposed amendments and adopted changes to species' listings can adversely affect trade leading to negative conservation outcomes. For example, it is known that these decisions have served to increase prices and stimulate trade (e.g., Rivalan et al. 2007; Courchamp et al. 2006), adversely affecting listed species (Leader-Williams 2003; 't Sas-Rolfes 2000).

Although unrecorded and illegal trade arguably reflect compliance problems in terms of governance and enforcement capacity among CITES Parties (e.g., Reeve 2002; Duckworth et al. 2012), they are also indicative of substantial international demand for pangolin products. However, as above, there is no explicit requirement to consider consumer demand for wildlife products in CITES decision-making (see Res. Conf. 9.24, Rev. CoP16). Again this is unrealistic because it disregards the complex socio-cultural, consumer, and economic factors of demand (e.g., the social norms driving consumption, the social function of wildlife products, and price elasticity), but which can undermine trade controls, as evidenced by ongoing illegal trade in many species (e.g., Rosen & Smith 2010; Biggs et al. 2013; Drury 2011; Zhang & Yin 2014). As demonstrated in our case study, zero export quotas were established despite the proposal to transfer Asian pangolins to Appendix I explicitly recognising very high levels of international demand for pangolin meat and scales, particularly in China (see CITES 2000b). Within China, pangolin scales have been used in traditional medicines since at least the 16th century, and is a form of medicine used by hundreds of millions of people today (Cheung 2011). Moreover, the proposal also recognised that since the mid-1990's China has reportedly been dependent on pangolin imports from elsewhere in Asia (Figure 1; CITES 2000b; Wu & Ma 2007).

Understanding demand though can inform the appropriateness of, and likely impact of interventions. Our semi-structured interviews in China and Vietnam reveal that pangolins continue to be in demand today for their scales, despite being associated with illegality, and their meat, the attributes of which in procurement and consumption terms suggest that relying on trade controls will be inadequate to halt trade and additional interventions will be needed. Rarity, the fact that pangolin meat is wild, illegality, high price, and the significance of conspicuous consumption in East and Southeast Asian consumer markets, suggest that trade controls will be unlikely to influence demand and counter-intuitively, may even act to stimulate it (Wong & Ahuvia 1998; Shairp 2013). More appropriate interventions could therefore be social marketing and behaviour change programmes targeted at consumers and their social and professional networks directly, in order to change their preferences and purchasing behaviour (e.g., Challender & MacMillan 2014). Or, for consumers of meat, a form of business-to-business led social responsibility initiative to reduce demand for pangolins in restaurants, the specifics of which could be honed through further research.

Although quantifying demand is difficult, understanding markets (e.g., market conditions and price trends) could be used to inform interventions, for example where demand appears to be increasing, as our case study demonstrates. While pangolins have been consumed locally through history in Asia for their scales and meat, demand in China and Vietnam appears to be increasing driven by rising levels of wealth, and which has catalysed, luxury urban demand today, especially for meat, and led to rising prices (Figure 4; Wu & Ma 2007; Drury 2011; also see Hall et al. 2008; Courchamp et al. 2006). These data also suggest that supply is declining, which is supported indirectly by traditional medicine retailers and wholesalers whom reported that pangolins are hard to source, and by the understanding that pangolin populations in Asia have been declining rapidly in recent decades, driven by international trade (e.g., Challender et al. 2014). As populations in China have been

depleted (Figure 1; Wu et al. 2004) the source of pangolins has shifted to Southeast Asia (Newton et al. 2008; Anon 1999a) and South Asia (e.g., Mahmood et al. 2012), and facilitated by increasing economic ties with African nations, to Africa as well (Challender & Hywood 2012). However, CITES lacks a responsive mechanism through which to consider and act on these market dynamics. For instance, price data are not recorded in CITES, and although rising prices for pangolins and population declines were recorded in the RST process, few listed species proportionately have been subject to the process (see Challender et al. 2015), while the remedial measures formulated for pangolins did nothing to address demand. However, these price trends are extremely worrying because where similar price increases have been observed for other rare species; they have been inversely correlated to population size (e.g., Courchamp et al. 2006; also see Hall et al. 2008), and they suggest that while pangolins in Asia face an increasing threat of extinction, since the establishment of zero export quotas in 2000, this has largely gone unnoticed in CITES.

5.2. Reforms to CITES

CITES is the mechanism through which international trade in wildlife is regulated. Our case study demonstrates significant inadequacies to its current approach because it fails to accurately monitor supply, to consider the impact of trade controls in realistic terms or the complex nature of demand for wildlife, and it doesn't contend with changing market dynamics. Here we outline reforms which we assert would enable CITES to more effectively manage trade.

Notwithstanding the urgent need for concerted research and monitoring effort on the status and sustainable harvest of many CITES listed species (Smith et al. 2010; Phelps et al. 2011; Challender et al. 2015), supply, and the trade threat posed to many listed species could be better understood by formally monitoring illegal trade. Within CITES this could comprise the verification and submission of data (e.g., from seizures and prosecutions) by Parties centrally. CITES already has provisions to record illegal trade in its trade database under the source code 'I', to which the US currently reports

seizures, and to which illegal trade data could be reported by all Parties. Alternatively, CITES already

records illegal trade, at least for elephants, in the form of ETIS (the Elephant Trade Information

System), to which Parties also submit data (see Milliken et al. 2012), and which could be expanded

to incorporate illegal trade generally.

While an illegal trade database within CITES has previously been discussed, the idea has been

dismissed due to concerns about the Secretariat's management capacity and duplication of effort

with other organisations (e.g., Interpol; see CITES 2012). However, lack of a mechanism or mandate

to record this trade centrally in CITES and ensure it informs decision-making, remains the elephant in

the room in CITES terms. This is because many species are traded illegally (e.g., Rosen & Smith 2010;

Phelps et al. 2011) but such trade typically goes unrecorded. Although seizure data typically

represent only a fraction of illegal trade, these volumes can be substantial as our case study

demonstrates (also see Underwood et al. 2013), and reporting would allow robust analyses and

ensure that these data, which would realistically comprise the best available evidence on trade,

could contribute to decision-making (e.g., Milliken et al. 2012). Formal reporting would also likely

mean that data would be of higher quality than that currently used to understand illegal trade (e.g.,

seizures reported in the press), and would arguably bring about a better understanding of illicit trade

dynamics to inform interventions. Currently, this only happens for elephants, and though Parties are

requested to report periodically on selected species traded illegally through Special Reporting

Requirements (see CITES 2014c), these comprise only a fraction of those CITES listed species in illegal

trade, while the reporting processes are fragmented, often difficult for Parties to keep abreast of,

and poor reporting rates undermine any contribution these date could make to decision-making

(e.g., CITES 2014c). A step change to reporting all illegal trade would alleviate these problems, while

improving the evidence base for decision-making.

Monitoring of demand and retail prices for listed species would also allow CITES to gain an understanding of demand, and market dynamics, with which to inform interventions. Although quantifying demand is difficult, monitoring could take the form of national, annual wildlife consumption surveys to capture trends in the consumption of internationally-sourced CITES listed species. This could include a quantitative element to collect data on sales volumes, the number of retail outlets selling given species and their derivatives, as well as consumer characteristics and price data. It could also include a qualitative, inductive element to capture current and emerging demand factors (e.g., social norms surrounding consumption) and emerging markets and products, such as markets pushed for rhino horn in recent years (see Biggs et al. 2013). Where trade is illegal, other appropriate methodologies could also be used to collect sensitive data (such as indirect questioning; e.g., St. John et al. 2010). This monitoring could be conducted by Parties' within a standard format to be reported to CITES centrally through their national agencies, and in conjunction with other industry bodies where appropriate (e.g., trade, commerce or traditional medicine agencies) to ensure robust reporting.

All these data (illegal trade, demand and prices) could be maintained in a central database managed by a new 'CITES Economic Bureau', and be integrated with CITES existing trade database. This would allow the impact of trade controls to be evaluated, both before and after implementation, and the application of interventions which go beyond regulation. For instance, mandating Parties to consider the impact proposed amendments to the Appendices would likely have on consumer demand and prices, as well as supply (e.g., through Revisions to Res. Conf. 9.24, Rev. CoP16), would enable a more realistic assessment of the proposed amendment to bringing trade under control. Where proposed changes are adjudged to be inadequate (e.g., where trade is illegal or would likely go underground, where demand is characterised by being inelastic, is culturally embedded, or data suggest demand is growing; e.g., Biggs et al. 2013), parallel interventions which address demand directly could be implemented simultaneously. These could include targeted social marketing and

behaviour change programmes to change consumer preferences and reduce demand (e.g.,

Challender & MacMillan 2014), approaches which have arguably proven more effective historically

at influencing demand and bringing about control of wildlife trade than purely regulatory measures

(e.g., Stiles 2004; Philip et al. 2009; Roe et al. 2002). The CITES Economic Bureau could also provide

objective expertise on decision-making in economic terms, either like the CITES Secretariat currently

provides for proposed amendments to the Appendices, or like the Food and Agriculture Organisation

(FAO) expert panel does for commercially exploited aquatic organisms. However, these data should

not be limited to informing proposals to amend the Appendices. Annual analyses of all trade (legal

and illegal, prices, and consumption trends) by the CITES Economic Bureau would provide an on-

going and up to date mechanism with which to evaluate the efficacy of all CITES interventions. For

instance, where legal/illegal trade data, consumption trends and/or price data suggest that demand

for a given species or product is rapidly increasing and could be unsustainable, it could inform the

implementation of initial or revised, parallel demand management interventions.

To implement these changes, a number of issues would need to be addressed. These include a

reluctance among Parties' to cede further sovereignty by committing to reporting illegal trade;

potentially low reporting rates of illegal trade for similar reasons; funding to implement demand and

price monitoring and the associated reporting by Parties (which would be substantial), and capacity

of developing world Parties. How these changes would be brought about (e.g., by Resolution or

amendments to the Convention text) would also need to be considered, as would the agencies

responsible for management and implementation of the likely diverse and multi-faceted demand

management measures. However, funding for the proposed CITES Economic Bureau and the

required monitoring activities to be carried out by the Parties', at least in the developing world,

could potentially come from new financing sources currently being explored by CITES (e.g., Global

Environmental Facility (GEF) funding), and the Economic Bureau could work with Parties

collaboratively, as well as designated national agencies, including but not limited to Management

and Scientific Authorities (e.g., local marketing experts) to implement these demand focused measures.

Without a mechanism to record illegal trade, to understand markets and address demand, and evaluate the impact of trade controls, as our case study demonstrates, listed species will continue to be subject to illicit and potentially detrimental trade, despite receiving protection within CITES. In a world characterised by rapid economic and social change, understanding and maintaining information concerning highly dynamic markets, evaluating the impact of interventions, and implementing measures which influence demand as well as supply is now essential to conserving the world's trade-threatened species.

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267 expertise. *Zoological Research* **33**(3), 271-275.

268   **Figure 1 Selected Asian pangolin trade and CITES timeline**

1960s-80s
An estimated 160,000 pangolins harvested annually in China

1980s
Market for pangolin leather products in Taiwan (PR China) declines

1996
Populations in China reportedly commercially extinct, and China effectively dependent on pangolin imports from Southeast Asia.

Price of scales kg^{-1} in China doubles Between 1995 and 1996

2007
China introduces notification on species used in traditional medicines including pangolins, and penalties for pangolin offences introduced.

Notification also stipulates: hunting licenses are not be issued for pangolins, stockpiles of derivatives should be verified, and trade is to be subject to certification, and restricted to Chinese medicine manufacturers and designated hospitals

2014
China deems consumption of pangolins Illegal under criminal law

SC65: Few Parties provide information under Decisions 16.41 and 16.42.

SC65 established an inter-sessional working group with a mandate to work with the CITES Secretariat to gather further information on trade in African and Asian pangolins.

1992
All Asian pangolins included in Phase I of RST.

Recommendations included: prohibition of imports from Thailand and Indonesia, Parties requested to be vigilant about trade in scales.

2000
Proposal to transfer Asian pangolins to Appendix I submitted to CoP11; Zero export quotas established for all wild-caught Asian pangolins traded for primarily commercial purposes

1925-1960s
Tens of tonnes of scales traded between Indonesia, and China and Hong Kong

1989
China introduces Regulations on Implementation of Protection of Terrestrial Wild Animals

1975
Inception of CITES

All Asian pangolins listed in Appendix II

1900

2000

2014

1950-70s
Trade in tens of thousands of skins annually between Southeast Asia and Taiwan (P.R. China) for the leather industry.

1988
All Asian pangolins included in preliminary phase of RST.

China lists the Chinese pangolin as a State Category II protected species

1995
State Administration of Traditional Chinese Medicine (SATCM) in China suggests species commercially extinct in China

All pangolins listed in Appendix II (CoP9).

2004
Chinese and Sunda pangolins excluded from the post-CoP13 phase of the RST due to negligible reported trade levels.

2009
First recorded seizure involving African pangolins in Asia.

2013
The CITES Secretariat raises concern about illegal trade in pangolins in an agenda item on enforcement matters at CoP16, and Decisions (16.41 and 16.42) are taken requesting range states to submit information on illegal trade to SC65 (July 2014)

2010
The CITES Secretariat issues a 'CITES Alert' to law enforcement agencies on fraudulent and illegal trade in pangolins.

1981
China accedes to CITES

1999
All Asian pangolins included in Phase IV of RST.

Recommendations included: no export or re-export certificates to be issued until national population statuses assessed, adequate trade controls measures implemented, and adequate population monitoring systems developed.

2006
China introduces Regulations on Management of Import and Export of Endangered Species of Wild Fauna and Flora to implement CITES.

1994
Vietnam accedes To CITES

Table 1 Parameters used to estimate number of pangolins in trade in Asia

Species	Commodity			
	Individual (kg)	Scales (g)	Meat (kg)	Skins (m)
Chinese pangolin	4.33[a]	573.47[b]	3.75[c]	0.2[d]
Indian pangolin	6.5[e]	1000[f]	5.5[g]	0.2[d]
Sunda pangolin	4.96[h]	360.51[i]	4.59[j]	0.2[d]
Philippine pangolin	4.96[k]	360.51[l]	4.59[m]	0.2[d]
Chinese/Indian pangolin	5.41[n]	786.74[o]	4.62[p]	-
Chinese/Sunda pangolin	4.64[q]	466.99[r]	4.17[s]	-
Sunda/Philippine pangolin	4.96[t]	360.51[u]	4.59[v]	-
Chinese/Indian/Sunda	5.26[w]	644.66[x]	4.33[y]	-
Manis spp.	4.96[z]	360.51[aa]	3.74[bb]	0.2[d]

[a]Mean weight taken from available seizure data (n=848), [b]Taken from Zhou et al. (2012), [c]Calculated by subtracting b from a, [d]Following Broad et al. (1988), [e]adapted from Prater (1980), [f]Taken From Misra & Hanfee (2000), the scales of the Indian pangolin are larger than those of Asian conspecifics suggesting they comprise a higher proportion of body mass (Heath 1995), [g]Calculated by subtracting f from e, [h]Trimmed mean (n=20,857; see Pantel & Anak 2010), [i]Taken from Zhou et al. (2012), [j]calculated by subtracting i from h, [k]As h, [l]As i, [m]As j, [n]mean of a and e, [o]Mean of b and f, [p]mean of c and g, [q]mean of a and h, [r]Median weight taken from Zhou et al. (2012), [s]Calculated by substracting r from q, [t]As h, [u]As i, [v]As j, [w]Mean of a, e and h, [x]Mean of b, f and i, [y]Calculated by substracting x from w, [z]As h, [aa]As i, [bb]As j.

305 **Figure 2 Estimated numbers of Asian pangolins in international trade between 1977 and 2012 as reported to CITES, and estimated number of pangolins**

306 **in illegal trade in Asia between July 2000 and 2013**
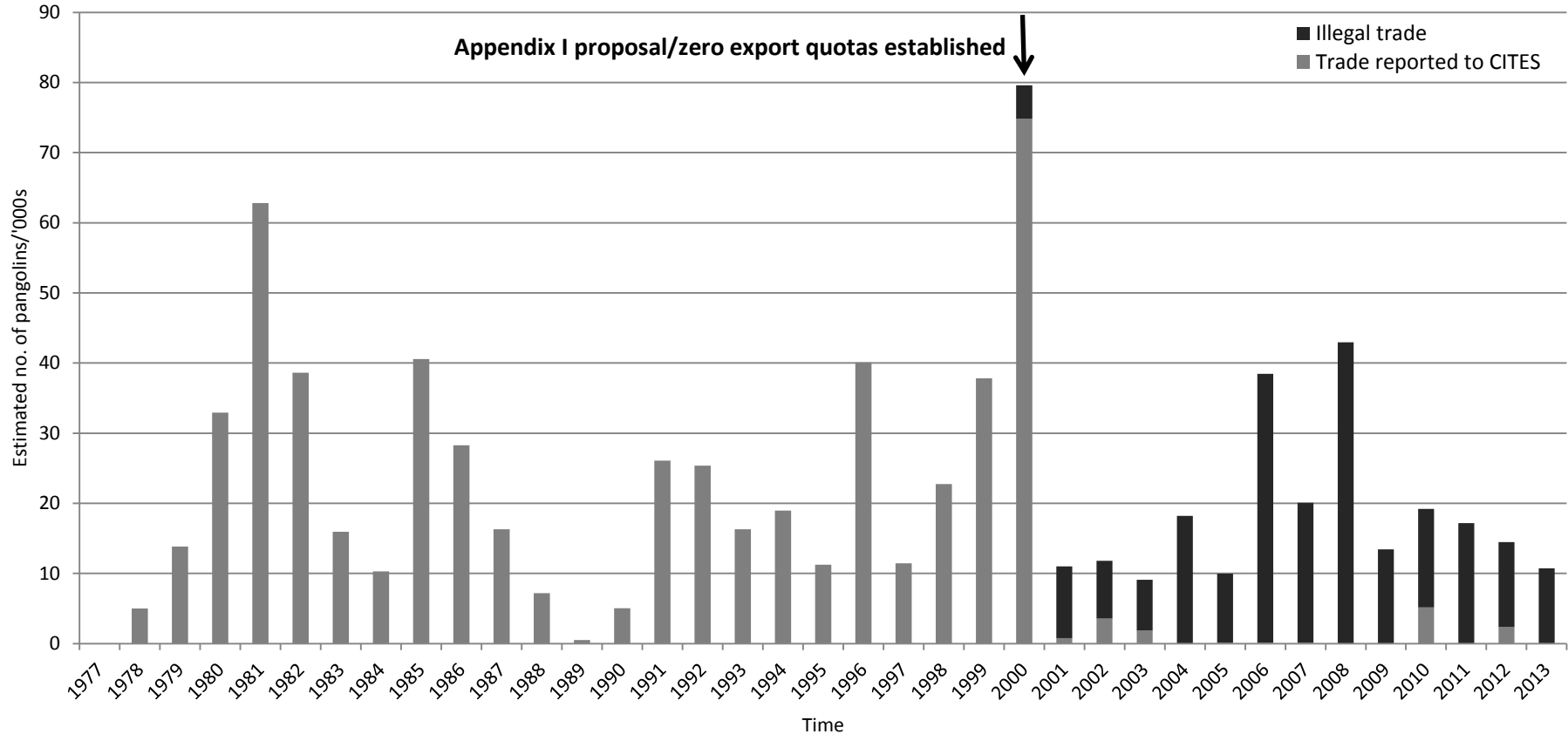
307

308 Caption: Illegal trade is based on seizures made in, or trade recorded in Cambodia, China, Hong Kong SAR, India, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Pakistan,

309 Philippines, Singapore, Sri Lanka, Taiwan (PR China), Thailand and Vietnam. Source: CITES trade database (UNEP World Conservation Monitoring Centre, Cambridge, UK),

310 and for illegal trade, various sources (see main text).

Figure 3 Number of pangolins in illegal trade in Asia by species as reported, inferred, and possibly

312 **in trade between July 2000 and 2013**
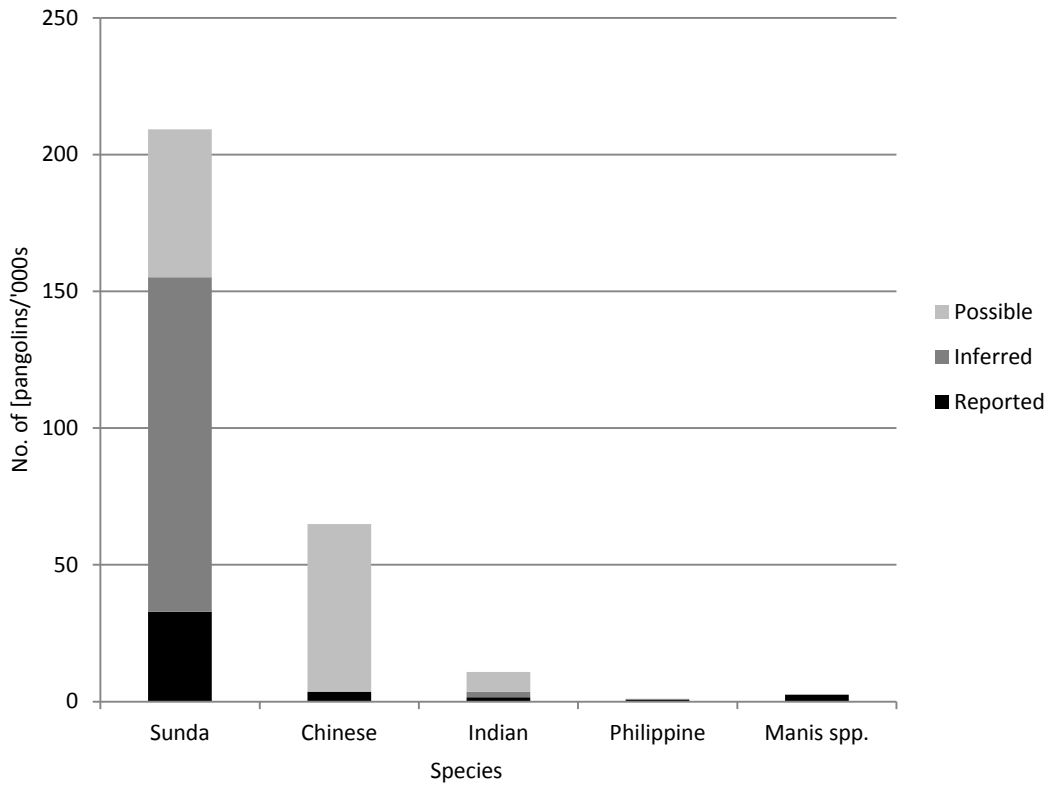
313

314 Caption: Lack of formal reporting of illegal trade in CITES means relying on sources such as the press to

315 determine trade volumes and species of pangolin in trade, but which is problematic. Here, species in trade is

316 presented as reported in trade, as inferred in trade based on reported countries of origin, species' distribution

317 and seizure location, and as possibly in trade where it was not possible determine illegal trade to species level.

318 Trade in the Philippine pangolin comprised 996 animals (reported, 662 animals; inferred 334). Trade in Manis

319 spp. estimated at 2,480 animals, including trade reportedly exported from Nigeria and Angola.

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327   **Table 2 Recommendations for *Manis* spp. in the CITES RST process**

Phase	Species	Recommendation (P = Primary, S = Secondary)	Country
I (1992)	*M. javanica, M. pentadactyla, M. crassicaudata*	P: Prohibit imports of items originating in Indonesia and Thailand because of legislation protecting the species in both countries.	All Parties
I (1992)	*M. javanica, M. pentadactyla, M. crassicaudata*	S: Parties involved in trade in oriental medicines, particularly Singapore, China (including Taiwan) and Hong Kong requested to be vigilant regarding trade in pangolin scales.	All Parties trading in oriental medicine
I (1992)	*M. javanica, M. pentadactyla, M. crassicaudata*	S: The Secretariat should advise non-party importing countries, in particular the Republic of Korea, that trade controls exist for these species and request that they co-operate in ensuring all specimens imported have been legally exported.	Non-Party importing countries, particularly Korea
I (1992)	*M. javanica, M. pentadactyla, M. crassicaudata*	S: The Management Authority of Malaysia should advise the Secretariat of the protection status of pangolins, especially in Sabah and Sarawak.	Malaysia
I (1992)	*M. javanica, M. pentadactyla, M. crassicaudata*	S: The Management Authority of Singapore should investigate the origin of pangolin scales imported, to verify the legality of exports and advise the Secretariat on outcomes of its inquiry.	Singapore
I (1992)	*M. pentadactyla*	The Management Authority of China should advise the Secretariat of the status of its research on *Manis pentadactyla*.	China
IV (1999)	*M. javanica, M. pentadactyla, M. crassicaudata*	P: No export or re-export certificate should be issued, or accepted, for specimens of these three species until the following actions have taken place and reported on to the satisfaction of the Secretariat: ▪ An assessment of the distribution and population status (including abundance) of the three species in all range States that authorize exports of specimens of these species; ▪ The competent authority of Lao PDR and the Management Authorities of Singapore, Thailand, Cambodia, People's Republic of China, Malaysia, Vietnam, Myanmar and Indonesia have developed and implemented adequate control measures and inspection procedures to detect and intercept illegal shipments of specimens of all *Manis* spp; ▪ The authorities of all range States wishing to trade in pangolins, their parts and derivatives have developed adequate, scientifically-based population monitoring systems and measures to identify and regulate exports of legally obtained specimens.	All Parties

328

Figure 4a Mean retail price of pangolin scales kg^{-1} in China between 1992 and 2013
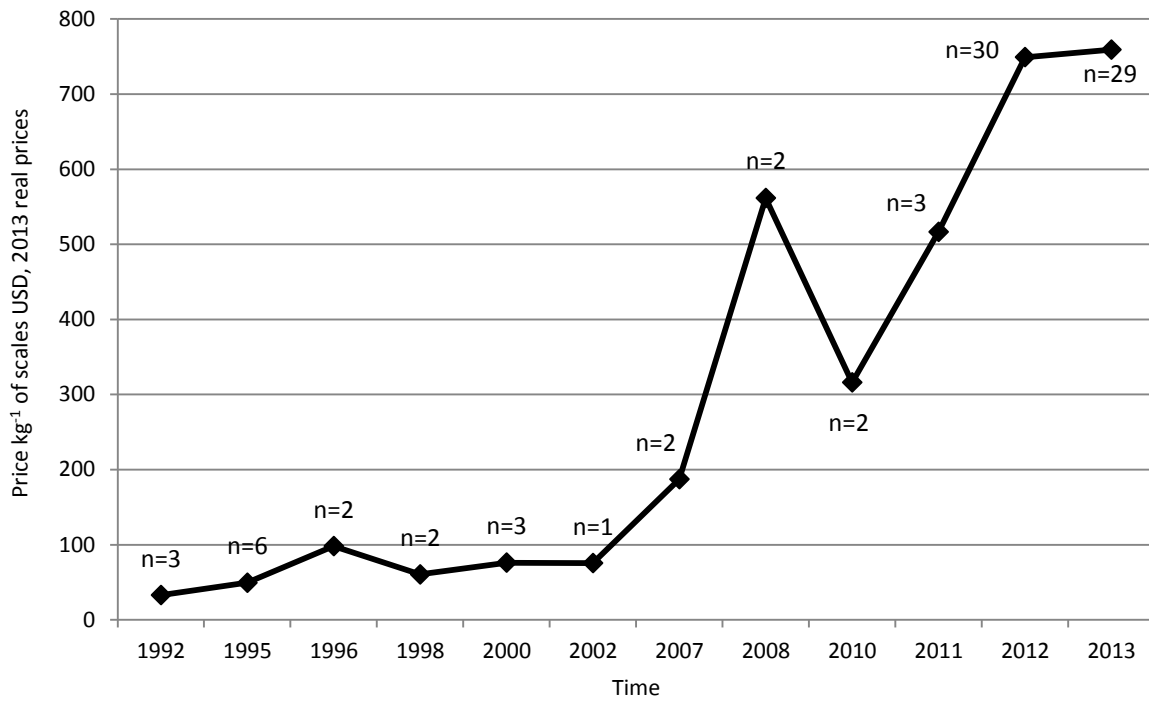
Figure 4b Mean retail price of pangolin meat/animal kg^{-1} in China between 1991 and 2012
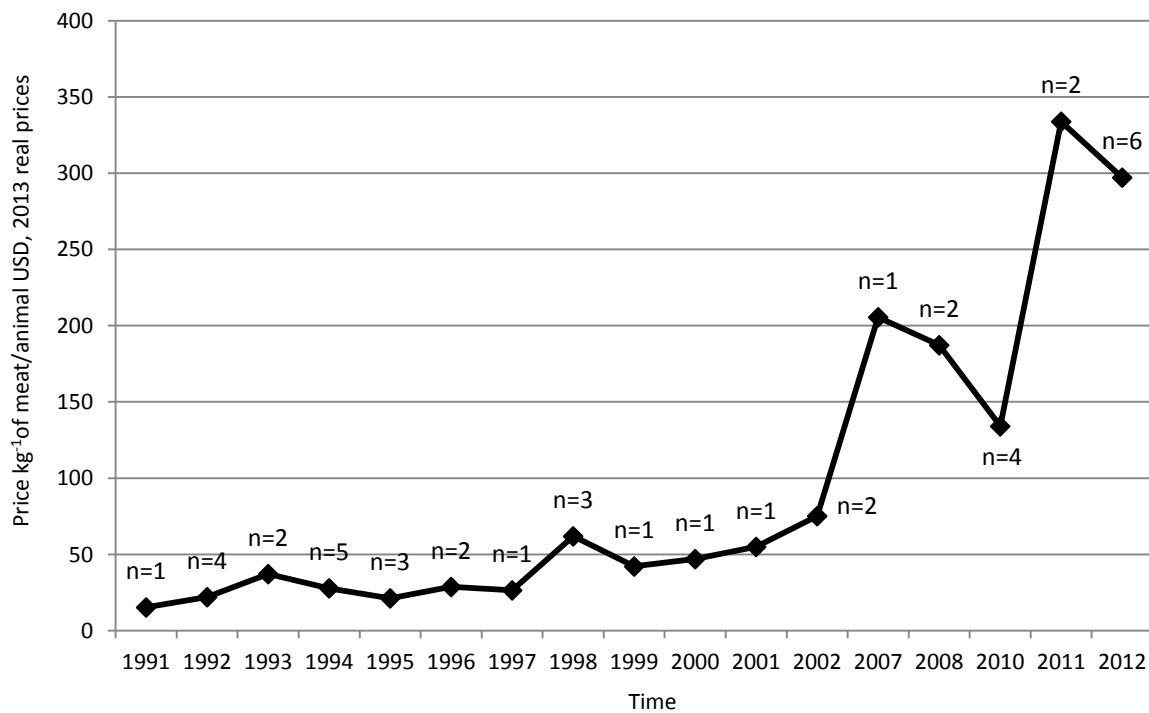
Revision notes

In response to the following 11 specific points raised by reviewer one, we have responded as follows:

Page 5, para 1 – We have removed our punchlines, and placed these points in the discussion which has been reviewed in full. We have replaced the final paragraph of the introduction with one that articulates what we present in the paper, and toned down the language so the paper reads much less like a CITES-bash.

P.7, para 1 – We have cited literature which discusses inadequacies in CITES trade data, and which is now reflected in this paragraph. We have also reviewed our methods on trade data, to ensure we clearly state how we validated data sets and accounted for likely biases in trade data.

Page 8 – We have amended our methods section to clearly explain how we avoided double-counting of seizures.

P8, line 36-8 – We agree introducing one bias is a poor way to account for another bias. However, we wanted to present an upper limit of pangolins in illicit trade in Asia, based on our database. As such, we have revised text on these lines and on this point to make it clear for the reader to easily understand what we have done.

Page 10, l.43-60/Page 11 lines 24-Page 12 lines 33 - We have reviewed both the results section and discussion section of our paper in full, removing all opinion and leaving only evidence in the results section.

Unspecified comment – We have introduced a methods and results section on the history of CITES action on Asian pangolins as suggested by the reviewer, and drawn on this evidence in the discussion. We see how this adds value to the paper, and thank the reviewer for this suggestion.

Page 12, line 38-54 – As above, we have reviewed the results and discussions sections of our paper.

Page 12 to page 14 – We have revised our results section on interviews and social science surveys conducted. We also note difficulties associated with conducting these surveys in the methods section, and then present the results more clearly in the results section.

*Unspecified comment*s - We have revised our discussion section in full, as noted above.

*Unspecified comment*s – We hope after these amendments to our paper, those we seek to influence will read the paper.

Highlights (for review)

- We critically evaluate the CITES approach to controlling international trade
- We do so through means of a case study on the trade in pangolins in Asia
- Reforms are needed to CITES in order better govern international trade
- CITES should seek to understand markets and the impact of trade controls
- It should also record illegal trade and monitor demand and prices for wildlife