frontiers in Conservation Science

ORIGINAL RESEARCH
published: 05 November 2021
doi: 10.3389/fcosc.2021.746366

Digging Deeper: Understanding the Illegal Trade and Local Use of Pangolins in Palawan Province, Philippines

Lucy J. Archer[1,2,3], Samuel T. Turvey[1], Charity M. Apale[2], Darlyn B. Corona[2], Ronald L. Amada[2] and Sarah K. Papworth[3]*

[1] Institute of Zoology, Zoological Society of London, London, United Kingdom, [2] ZSL Philippines Palawan Office, Puerto Princesa City, Philippines, [3] Department of Biological Sciences, Royal Holloway University of London, Egham, United Kingdom

The illegal wildlife trade represents an urgent conservation challenge, but measuring, understanding, and designing interventions to address it is a complex task. As some of the world's most illegally trafficked wild mammals, pangolins are regularly observed in the illegal wildlife trade, but little is known of the intricacies of the trade at local levels, particularly for lesser-known species such as the Philippine pangolin (*Manis culionensis*). This research represents the first range-wide study to concurrently document local use and trade of the Philippine pangolin across Palawan Province, Philippines, and provides new information on trade actors, dynamics, and the conditions that help to facilitate this industry. The study was carried out across 18 Palawan municipalities, covering all mainland municipalities, Araceli Island, and the Calamianes Island group. A mixed methods approach was used, combining 1,277 bean count surveys to investigate consumption and hunting levels, alongside 59 in-depth key informant interviews to better understand trade logistics and dynamics. Our results suggest that local use of the species is geographically widespread, but trade hubs were most frequently reported from northern municipalities. Several enabling conditions help facilitate trade across the province, and our data suggest the species may be contributing to the international pangolin trade at levels considerably higher than seizure records indicate.

Keywords: illegal wildlife trade, pangolins, Philippines, key informant interviews, bean count method, local use

OPEN ACCESS

Edited by:
Mayukh Chatterjee,
Wildlife Trust of India, India

Reviewed by:
Raymond Jansen,
Tshwane University of Technology, South Africa
Dan Challender,
University of Oxford, United Kingdom
Hari Prasad Sharma,
Tribhuvan University, Nepal

****Correspondence:***
Lucy J. Archer
lucy.archer@ioz.ac.uk

Specialty section:
This article was submitted to Human-Wildlife Dynamics, a section of the journal Frontiers in Conservation Science

Received: *23 July 2021*
Accepted: *12 October 2021*
Published: *05 November 2021*

Citation:
Archer LJ, Turvey ST, Apale CM, Corona DB, Amada RL and Papworth SK (2021) Digging Deeper: Understanding the Illegal Trade and Local Use of Pangolins in Palawan Province, Philippines. Front. Conserv. Sci. 2:746366. doi: 10.3389/fcosc.2021.746366

INTRODUCTION

The illegal wildlife trade is a major threat to wildlife across many parts of the world. With thousands of species now traded (Wyler and Sheikh, 2008; Sas-Rolfes et al., 2019; Esmail et al., 2020), it represents an urgent conservation challenge that has received global attention (Duffy and Humphreys, 2014). However, measuring the full extent of this trade is difficult, with estimates often based on seizure records that are subject to detection and reporting bias (e.g., levels of law enforcement and reporting may differ between regions, and non-English reports may be omitted; Underwood et al., 2013; Utermohlen and Baine, 2017). The illegal and sensitive nature of the trade complicates monitoring efforts, and generating data on the routes and actors involved is a complex task, resulting in often simplified accounts and debates on how to tackle the issue due to a limited understanding of complexities across different systems (Phelps et al., 2016; Sas-Rolfes et al., 2019).

Pangolins have been legally used and traded for centuries, with archaeological records indicating potential human use since the terminal Pleistocene (Piper et al., 2011), and trade records available from the early 20th century (Challender et al., 2020). Concerns over the level of trade, and whether it was sustainable, led to the inclusion of Asian pangolins in the Convention on International Trade in Endangered Species (CITES) at its inception in 1975, and zero export quotas for wild-caught Asian pangolins in commercial trade were established in 2000. However, only since 2017 have all eight species been listed in Appendix I and therefore all commercial trade in wild caught pangolins officially banned (Challender and O'Criodain, 2020). Today, overexploitation of both African and Asian species is recognised as one of the most significant threats to their conservation (Chong et al., 2020; Mahmood et al., 2020; Wu et al., 2020) and pangolins are now thought to be some of the world's most illegally trafficked wild mammals, with demand for pangolin parts and products driven for use in traditional Asian medicine and as a culinary delicacy (Challender et al., 2012; Xing et al., 2020; Olmedo et al., 2021), alongside the sale in wild meat markets across much of Sub-Saharan Africa (Ingram et al., 2016, 2017). An average of 33 countries were involved in the illegal international trade of pangolins each year during the period 2000–2015, with an average of 27 new trade routes identified annually (Heinrich et al., 2017). The trade in pangolins is therefore a global issue. However, most knowledge is based on national-level seizure records, with finer-scale trade dynamics much less known, and low levels of research attention make monitoring the impact of trade difficult (Willcox et al., 2019). With all eight species now threatened with extinction and thought to be experiencing large declines, understanding how the pangolin trade works and operates at local levels will be crucial to design effective conservation strategies and reduce unsustainable exploitation.

The Philippine pangolin (*Manis culionensis*) is Critically Endangered and has the smallest range of all eight pangolin species, occurring only within Palawan Province in the Philippines (Schoppe et al., 2019). In addition to its inclusion in Appendix I of CITES, the species is protected by Philippine national laws (Lagrada, 2008) and domestic trade is banned (**Table 1**). To date, the Philippine pangolin has been relatively underrepresented in trade reports and is infrequently encountered in international seizure records (Heinrich et al., 2017; Challender et al., 2020). However, whether this reflects low trade levels or low monitoring efforts is unclear. Further, morphological similarities with the Sunda pangolin (*Manis javanica*) and the recent taxonomic differentiation of the two species (Gaubert and Antunes, 2005) complicates species identification and could result in misidentification of pangolin seizures. Sunda pangolins are regularly reported in international trade records (Challender et al., 2020), but distinguishing between species requires the use of genetic analysis or specific expertise to identify morphological indicators, methods and skills that are often practically and/or financially unfeasible for law enforcement bodies.

Existing knowledge of Philippine pangolin trade is limited to analysis of seizure records (Gomez and Sy, 2018; Sy and Krishnasamy, 2020) and unpublished reports consisting of wider studies on wildlife trade (Cruz et al., 2007), research on pangolin trade in southern Palawan (Schoppe and Cruz, 2008), and two Masters studies exploring trade dynamics across seven mainland Palawan locations (Lagrada, 2012; Bayron, 2014). Records from 2000–2006 show the Philippine pangolin to be the 11th most frequently traded animal in Palawan Province (Cruz et al., 2007). Since then, trade in the species is thought to have grown, with an increase in pangolin seizures in the Philippines post 2010 (Gomez and Sy, 2018), and a nine-fold increase in seizures between 2018 and 2019 compared to the previous two years (Sy and Krishnasamy, 2020). These records could reflect a growth in law enforcement efforts rather than a rise in pangolin trade, as biases that can influence seizure records (e.g., Underwood et al., 2013) were not accounted for. However, the volume of pangolins seized on average has also increased from 2010 onwards (Gomez and Sy, 2018), suggesting (but not confirming) an actual rather than perceived increase in pangolin trade levels. Within Palawan Province, pangolin seizures have been reported from Puerto Princesa City, Roxas, Taytay, El Nido and Coron municipalities (Gomez and Sy, 2018; Sy and Krishnasamy, 2020) and there is evidence of pangolins being exported internationally to Malaysia from southern Palawan (Schoppe and Cruz, 2008), alongside the domestic trade of pangolins from Palawan to Manila (Sy and Krishnasamy, 2020). However, details on who is sourcing the pangolins, alongside where they are being sourced, remain unknown. In addition to wildlife trade, wildmeat consumption can represent a threat to some species and is common across southeast Asia (Bennett and Rao, 2002), but local consumption of pangolins is little researched and understood, despite multiple factors that can link local use and trade of wildlife (Blair et al., 2017). Recent research suggests that pangolin consumption exists across the species' range (Archer et al., 2020), but data on potential levels of consumption are lacking.

TABLE 1 | National regulations in the Philippines relating to the transport, collection or killing of Critically Endangered species.

Protection	Protection level	Details
The Republic Act No. 9147	The Republic Act No. 9147/Wildlife Resources Conservation and Protection Act of 2001 considers species listed in CITES Appendix I as Critically Endangered and prohibits the collection of threatened species, including for traditional use by indigenous peoples. This law supersedes the Peoples' Rights Act of 1997 (republic Act No. 8371) that provides priority rights for indigenous peoples in the harvesting of any natural resources within ancestral domains.	Transporting: 6 months−1 year imprisonment and a fine of PhP 50,000–1,00,000 (USD $985–1,970). Collection, possession, or trading: 2 and 4 years imprisonment and a fine of PhP 5,000–300,000 (USD $98–5,909). Killing: 6–12 years imprisonment and/or fine of PhP 1,00,000–1,000,000 (USD $1,970–19,698)

Sources: GOVPH (1997), Schoppe et al. (2020) and Sy and Krishnasamy (2020).

There is therefore an urgent need for an improved understanding of trade dynamics and networks, key trade hubs, actors, and potential levels of offtake and local use across the species' range. Without this information, deciding where law-enforcement action should be targeted or scaled up, and what types of conservation interventions could have most impact, is difficult. Large-scale, range-wide data on the human dimensions of the trade are therefore needed. This study provides new insights into levels of pangolin consumption and hunting, trade actors, key trade hubs and trade logistics across Palawan Province, Philippines. We demonstrate that local use of the species is occurring across Palawan Province, and trade in Philippine pangolins is occurring at levels considerably higher than previously thought. With Southeast Asia subject to high levels of trade and among the world's "wildlife trade hotspots" (Nijman, 2010; Rosen and Smith, 2010; Duckworth et al., 2012; UNODC, 2016), understanding how Philippine pangolin trade contributes to this bigger picture is important to inform national and international laws and legislation, alongside international-level efforts to control the trade (e.g., ASEAN Wildlife Enforcement Network).

METHODS

Due to its inherently sensitive nature, collecting data on illegal resource use and exploitation can be difficult, with no one method providing a methodological panacea (Gavin et al., 2010). Therefore, we adopted a mixed methods approach employing a standardised bean count survey alongside targeted key informant interviews (KIIs) to generate a quantifiable and in-depth understanding of the study system. Both methods were used alongside a large-scale household survey that was carried out in 72 villages across 18 municipalities in Palawan Province (**Supplementary Figure 1**) from January to June 2019. This survey collected data on respondent observations and perceptions of pangolins and other native species, the results of which have been published elsewhere (Archer et al., 2020).

All research was authorised by the Palawan Council for Sustainable Development (Gratuitous permit 2018–23), and permission was sought from each municipal or city mayor and village captain prior to conducting research. As we were unable to gain permits to survey indigenous communities within ancestral domains, all surveys were conducted in lowland villages outside of areas with a certificate of ancestral domain title. The purpose of our research was explained to respondents prior to every interview, and verbal free prior informed consent was sought before each interview commenced. All responses were anonymous. Participants could stop the interview at any time and only adults aged 18 or above were interviewed. Project design was approved by the Zoological Society of London Human Ethics Committee (Reference: I-FM12).

Bean Count Method

The bean count method is an anonymous questioning technique that estimates the percentage of people engaging in a sensitive activity (Lau et al., 2011; Jones et al., 2020). It is simple in design, protects respondent anonymity, and has been shown to increase prevalence estimates up to 10% greater than direct reports (Lau et al., 2011). However, to date, the method has received little application in conservation science (but see Jones et al., 2020). Bean count surveys were carried out at the end of each household questionnaire and were conducted in Filipino, Cuyonon or Bisayan languages by three interviewers local to Palawan Province (including authors DBC and RLA). 1,296 households from across Palawan Province were targeted, with the number of villages per municipality weighted depending upon the geographical area of each municipality to provide a wide geographical spread and representative sample from across the province (see Archer et al., 2020). Within each village, specific neighbourhoods were chosen through discussion with village officials who recommended areas with high human-wildlife interactions. Eighteen households per village were interviewed and were selected at random by targeting every 5th household. Interviews were limited to one person per household to increase independence of responses.

The bean method was adapted by using coloured buttons (**Figure 1**) and respondents were given two jars of buttons: one small, one large. Each jar was filled with buttons of four different colours (50 in the small jar, 80 in the large jar) so that removal or addition of one button would not be obvious. Interviewers explained which colour buttons represented "no" (blue buttons) and "yes" answers and checked for respondent understanding through the demonstration of a dummy question on a non-sensitive topic. Interviewers then asked three sensitive questions: did any member of the respondent's household (i) use local wildlife (green buttons), (ii) consume pangolin meat (white buttons), or (iii) hunt pangolins (red buttons). Interviewers turned away so that they could not see the respondent's button choice for these questions. Buttons were double counted at the end of each day by members of the survey team.

Bean Count Method Analysis

Data were analysed using R software version 4.0.3 (R Core Team, 2020). The effect of municipality on the proportion of households consuming or hunting pangolins per village was investigated using logistic regression models for binomial count data using a binomial error structure. Municipalities with zero consumption or hunting reports were excluded from models, and municipalities with the lowest consumption or hunting rates were used as the model reference levels. Odds ratios were calculated using the package SJplot (Lüdecke, 2021). To ensure respondent anonymity and protection, results are reported here at the municipal rather than village level (cf. St. John et al., 2016).

Key Informant Interviews

Key Informant Interviews (KIIs) are a qualitative method used in the social sciences to gain in-depth information from identified stakeholders, or from people who are knowledgeable about a particular subject area (Elmendorf and Luloff, 2006). They differ from questionnaires and structured surveys in that they provide a two-way discussion on the topic with scope for follow-up questions that can help generate ideas and provide additional insights on a subject area (Newing, 2011). A semi-structured interview guide was developed by the interviewers

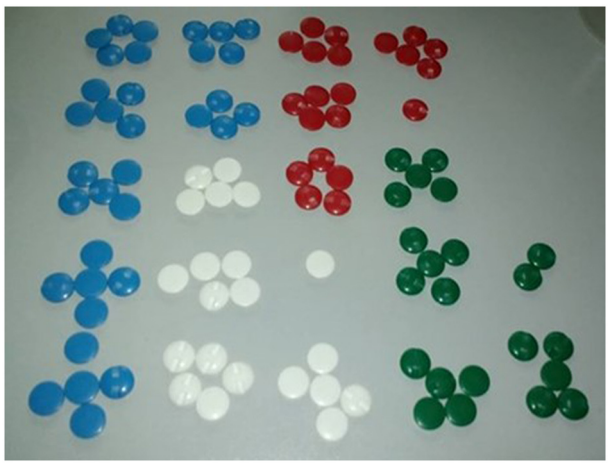

FIGURE 1 | Example of buttons being counted following interviews. Green buttons represented use of local wildlife; white buttons indicated pangolin consumption; red buttons indicated pangolin hunting. Blue buttons represented "no" answers.

(LJA and CMA) following two rounds of pilot surveys to trial and explore key themes. This provided a list of key topics to discuss (e.g., levels of pangolin hunting; hunting methods; trade actors; trade routes and hubs; trade logistics; demand for pangolins; **Table 2**), but allowed for detailed discussions through the use of open-ended questions (Newing, 2011). Topics were not strictly followed in order; each interview could take its own direction based on the respondent's responses, with respondents encouraged to elaborate on other connected areas if they wished. Respondents for KIIs were selected using snowball sampling whereby informants recommended other informants who were deemed to hold important knowledge or information on pangolins (Elmendorf and Luloff, 2006; Newing, 2011). A total of 72 interviews were conducted across 18 municipalities by two interviewers (authors CMA and LJA). Interviews were conducted primarily in Filipino or Bisayan languages (occasionally in English when possible) and were translated verbatim to English by CMA, with LJA transcribing. Each interview was then discussed by both interviewers at the end of each day. Respondents were classified as key informants if they could provide first-hand information on either pangolin hunting or trade. All other interviews were excluded from this analysis ($n = 13$).

KII Analysis

KIIs were analysed using an applied thematic analysis framework (Guest et al., 2014). A hybrid approach was used (Swain, 2018), incorporating a top-down deductive process with a bottom-up inductive process. This approach was used due to a combination of a priori research questions that the research aimed to answer, and open-ended questions allowing for the development of post-empirical themes that were generated through analysis of the data (**Table 2**). This represents differing epistemological approaches, with codes generated through deductive and inductive methodologies, both of which we deemed important to consider in this research context. Data were organised and processed using NVivo Pro (version 12). A five-step process was followed, combining the approaches of Swain (2018) and Braun et al. (2016): (1) data familiarisation; (2) code generation and code searches; (3) searching for themes; (4) reviewing themes; and (5) defining and naming themes.

RESULTS

A total of 1,277 households participated in the bean count survey. Specific respondent demographics are not available for this survey due to its anonymous nature, which prevents results being linked to individual respondents; in our wider survey of 1,294 households across the same 72 villages (which included all households in the bean count survey), most respondents (82%, $n = 1{,}067$) had lived in their current village since birth, and had regular visits to natural places (67% visiting daily and 20% visiting at least once a month), and had a mean age of 44 (range 18–87; see Archer et al., 2020 for further details).

A total of 59 KIIs were also completed. Key informants identified as former or current pangolin hunters ($n = 28$); village officials ($n = 15$); family members of a pangolin hunter ($n = 4$); buyers of pangolins ($n = 4$); and wildlife rangers ($n = 2$). Six individuals chose not to disclose their involvement type. These categories are not mutually exclusive, with some village officials also reporting previous hunting experience. The majority ($n = 56$) of key informants were male. KIIs were completed in 14 of 18 municipalities surveyed, with key informants unavailable from the municipalities of Linapacan, Bataraza, Rizal and Dumaran.

Four main research themes were identified through our applied thematic analysis of KII data and bean count results (**Table 2**).

Theme 1: Exploitation Is Geographically Widespread

Overall, 37% ($n = 471$) of households reported hunting wildlife, 10% ($n = 126$) of households reported hunting pangolins, and 21% ($n = 265$) of households reported consuming pangolins (**Figure 2A**). Pangolin hunting was reported in all municipalities surveyed other than Linapacan Island and in 83% ($n = 59$) of villages. Pangolin consumption was reported by respondents in all municipalities surveyed and in 99% ($n = 71$) of villages.

Hunting and consumption rates of pangolins differed across municipalities (**Figure 2**). Municipality had no significant influence on hunting levels (GLM, $X2 = 25.44$, $df = 16$, $p = 0.06$), but did influence consumption levels (GLM, $X2 = 35.31$, $df = 17$, $p = 0.006$), with respondents in El Nido significantly more likely to consume pangolins than those in Linapacan (GLM, odds ratio 8.53 ± CI 1.59–158.64, $df = 1$, $p = 0.043$; see **Supplementary Tables A,B**). Further questioning during KIIs suggests that although consumption appears to be geographically widespread, personal use is, and has historically been, opportunistic rather than targeted. One respondent noted: *"Eating pangolins is common—if people see one, they will catch*

TABLE 2 | A-priori and post empirical research themes.

A-priori research themes	Research method	Post empirical themes identified	Key post empirical findings
Levels of pangolin exploitation	Bean count and KIIs	Exploitation is geographically widespread.	Pangolin consumption and hunting reported across Palawan Province.
Trade actors	KIIs	Similar trade chains seen across the province.	Trade chains are similar across the province and involve multiple actors.
Key trade hubs	KIIs	North as a trade hub.	Pangolin trade widely reported but trade hubs more common in northern Palawan.
Trade logistics and dynamics	KIIs	Facilitating environments.	Several enabling conditions help facilitate illegal trade: corruption, bribery, cash advances.
			Hunting as buyer driven.

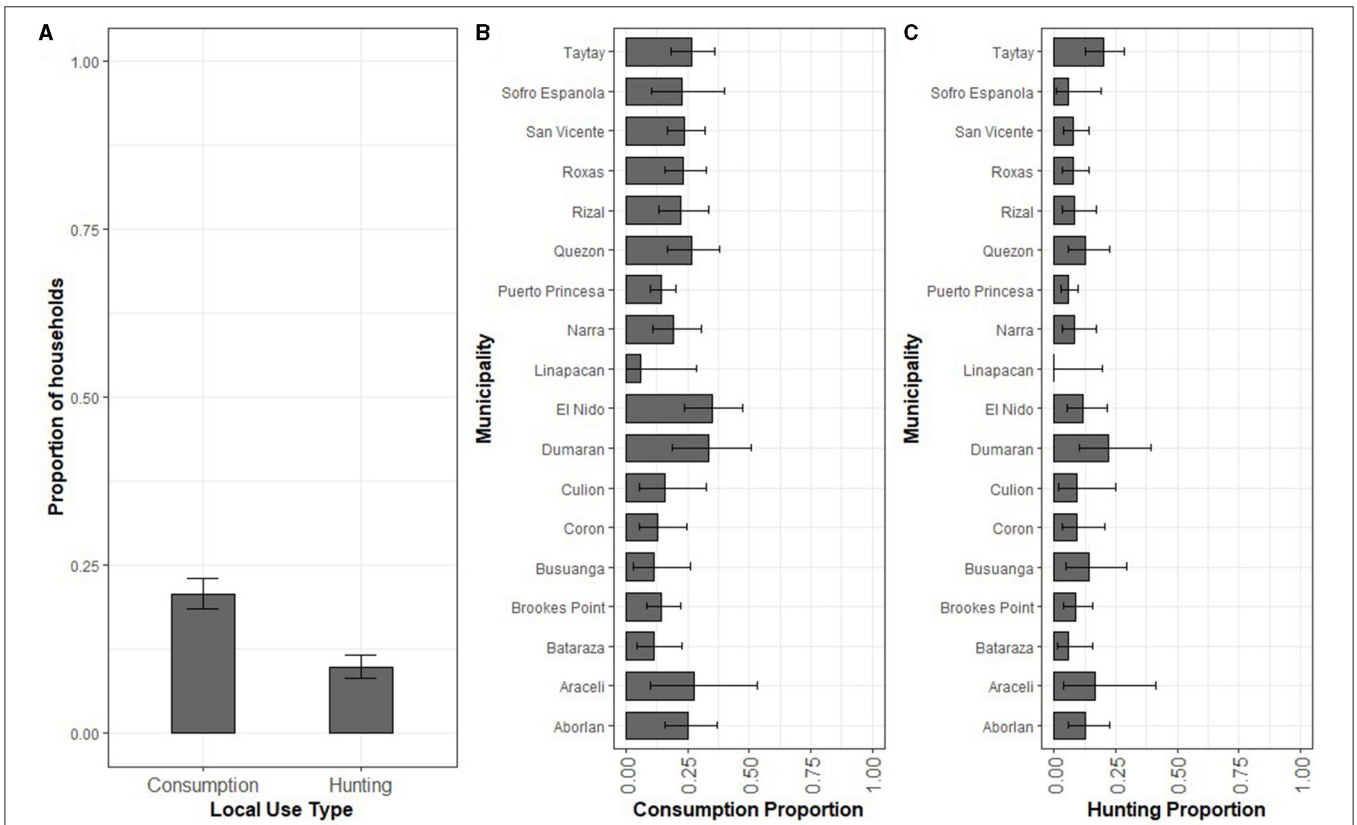

FIGURE 2 | (A) Total proportion of households reporting local use of pangolins; **(B)** proportion of households per municipality who reported consuming pangolins; **(C)** proportion of households per municipality who reported hunting pangolins. Error bars show 95% confidence intervals.

it and eat it—it is delicious. But this isn't targeted killing, just opportunistic."

Pangolin meat was described as extremely tasty, and multiple reports ($n = 21$) described the medicinal value of pangolin parts that are used to treat asthma, tuberculosis, skin diseases and kidney stones. In general, it was described as a clean meat (due to the species' myrmecophagous diet) that promotes strength and boosts the immune system. In the past, pangolin meat would be shared with neighbours and consumed alongside an alcoholic drink, a practise that promoted bonding with friends. This practise still occurs but takes place less frequently, and meat is now shared mostly with family members to avoid publicising the capture.

Theme 2: Trade Actors

Reports of trade chains and actors were similar across the province. The following descriptions follow terminology used by Phelps et al. (2016) to standardise trade reports for wider comparison. As a simplified overview, the trade starts with pangolin harvesters who sell to logisticians (local and non-local). Logisticians sell to specialist smugglers, who export the illegal goods via third-party intermediaries to intermediary vendors

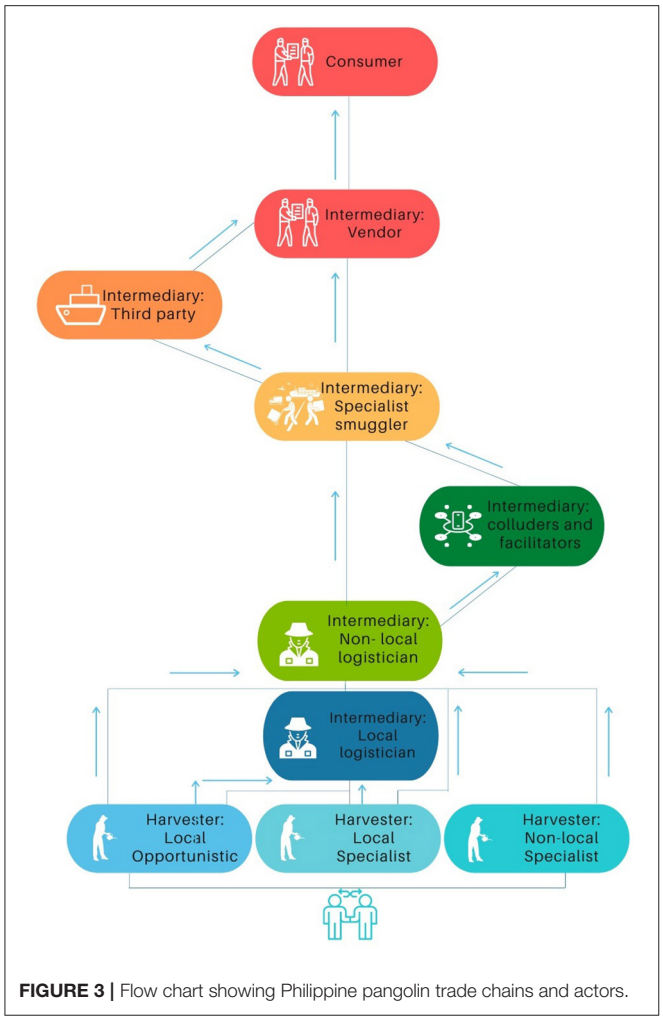

FIGURE 3 | Flow chart showing Philippine pangolin trade chains and actors.

(**Figure 3**). **Supplementary Table C** provides descriptions of each trade actor.

Harvesters can be grouped into three main categories (**Figure 3**; **Supplementary Table C**). Of the available reports, 80% ($n = 41$) described harvesters as local to the respondent's village, and 20% ($n = 10$) described harvesters as non-local specialists. Of the informants who provided further details on local hunting, 92% ($n = 23$) described it as an additional income source, with just 8% ($n = 2$) describing it as a main livelihood. Local harvesters had various livelihoods, including farming, charcoal making, almaciga (*Agathis philippinensis*) gathering and fishing. In contrast, of the informants who provided information on non-local harvesters ($n = 4$), 75% ($n = 3$) reported that pangolin hunting was their primary income, with just one report of a non-local hunter engaging in hunting as an additional income activity. Non-local harvesters travel to nearby villages and municipalities in search of pangolins and will often request the help of specialist local hunters. This has a dual purpose, acting as a courtesy to the local village alongside utilising local knowledge of pangolin occurrence.

Descriptions of hunting patterns by local harvesters described pangolin hunting as seasonal (47%, $n = 7$), year-round (40%, $n = 6$), and year-round but mainly in dry months (13%, $n = 3$). Non-local hunters mostly reported year-round hunting (75%, $n = 3$). Follow-up questioning suggests hunting is perceived as a difficult job, requiring high levels of physical fitness, and which is harder and more dangerous during the rainy season: *"…It is dangerous and tiring work. During the rainy season they prefer not to hunt as it is cold, slippery and wet. Also there are many snakes—big ones!"*

The use of dogs as a hunting aid was reported by 81% ($n = 47$) of informants, and perceived as vital due to the need to hunt at night because pangolins are nocturnal. Hunting groups comprise an average of three people (range: 2–5, $n = 16$) who are accompanied by between two to four dogs.

Following successful pangolin captures, pangolins are sold to intermediary logisticians, who were reportedly non-local (from outside of the village) in 91% of descriptions ($n = 30$). Non-local logisticians were reported as active and direct in their approach, and are seemingly conspicuous at the local level, for example knocking on houses to gauge interest from local people and asking for the names of people who might be able to provide pangolins. When describing how logisticians operate, informants reported a combination of frequent visits, alongside the distribution of mobile telephone numbers to ensure they would be the first person to be offered pangolins. We did not hear of or speak to any harvesters who reported that they would actively seek out logisticians to trade pangolins: *"Buyers of pangolin come here to see if anyone has any pangolins. They come once a month roughly. But sometimes they just provide a contact number."* Multiple logisticians will visit the same village. This creates competition and can cause price fluctuations due to logisticians paying extra to ensure hunters are selling exclusively to them: *"The price varies as you can add commission to make sure you are the only one selling to that buyer."*

Transactions were reported with as few as one pangolin, with some local harvesters noting how they would try to deliver a pangolin to a logistician as soon as they had one to prevent the need for storage and reduce the risk of being caught. One respondent noted: *"There are no minimum quotas, even one will be delivered direct to the buyer [logistician]. They are delivered straight away as people are scared to be caught with pangolins on their possession and you can't preserve the meat."*

Logisticians sell pangolins to specialist smugglers within Palawan Province. Logisticians transport goods within the province and store smaller amounts of pangolins (<100), whereas specialist smugglers will store larger amounts of stock (~1,000), ship goods off the province, and liaise with vendors. Their main source of income is from the illegal wildlife trade, with Palawan porcupine (*Hystrix pumila*), shark fins and sea turtles also reportedly traded alongside pangolins. One specialist smuggler noted how his logisticians would contact him once they have around 500 kilos of whole pangolins, which according to him is "*more or less 80 pangolins.*" He would then use his boat to collect the pangolins which would be taken to warehouses: "*They would be kept at the warehouses until they were flown or shipped outside of Palawan… but this was before [2015/2016].*" It was noted that the pangolins would not be kept for long in the warehouses, and that 1,000 pangolins could be collected from across Palawan Province in one week. Specialist smugglers

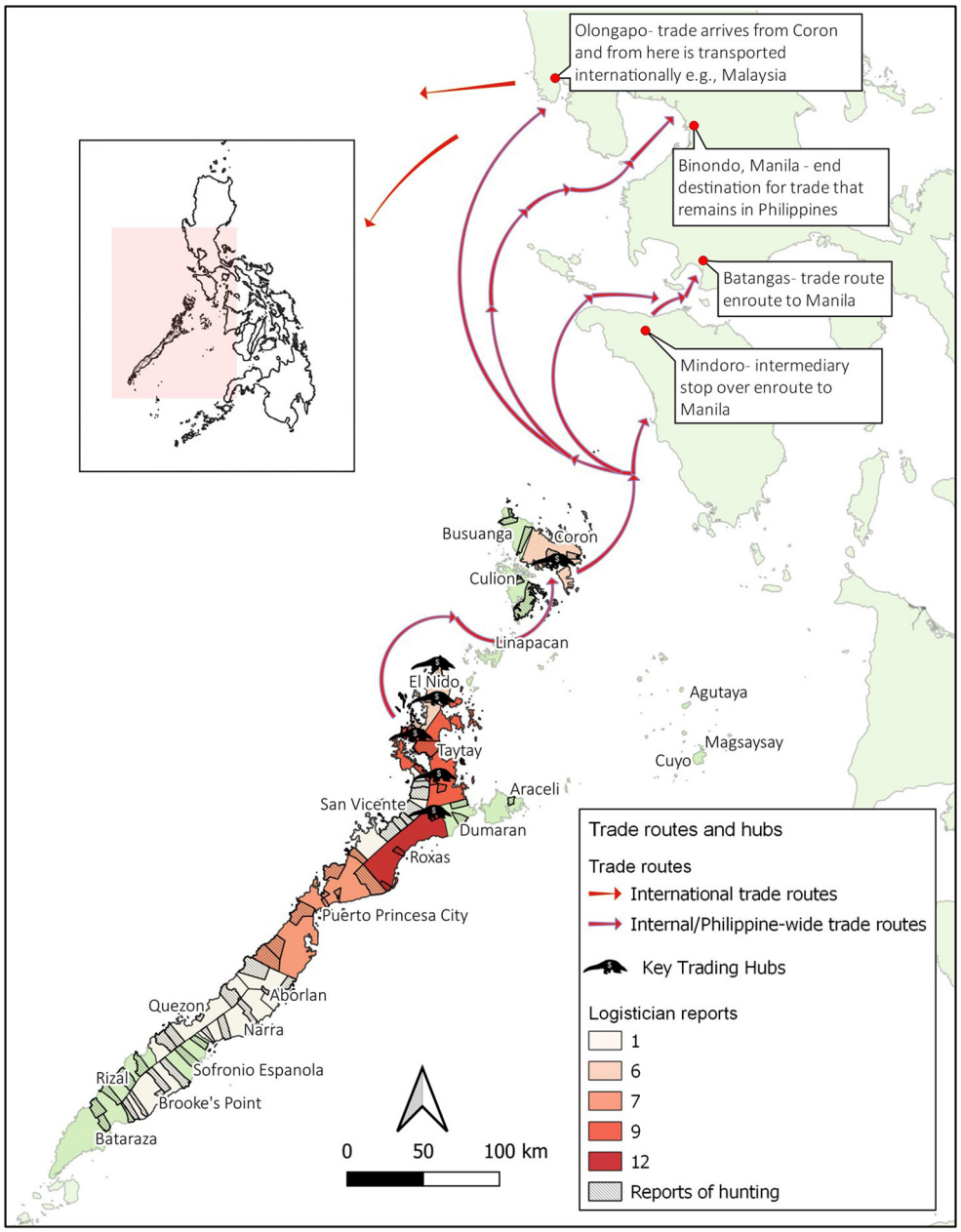

FIGURE 4 | Map of pangolin trade routes and actors. Grey shaded areas outlined in black indicate areas where hunting was reported; red shaded areas indicate the number of logistician reports per municipality; pangolin icons indicate key trade hubs; and arrows represent internal and international trade routes.

reported selling to vendors who are foreign nationals residing in Coron, Roxas, Puerto Princesa City and Manila. Some goods remain in these areas to supply a domestic local market, and some are shipped by vendors to international destinations (Malaysia). However, some reports also described how specialist smugglers would organise the transport of goods to Malaysia on behalf of the vendors. In these cases, the vendors' primary role is to finance the movement of goods, rather than overseeing logistics. The involvement of drugs in the trade chain was also noted during our interviews, with reports that drugs were offered as an alternative payment for pangolins. The drugs could then be sold to make a higher profit.

Theme 3: The North as a Trade Hub

Northern municipalities were most frequently cited as trade hubs, with logisticians reported from Coron, El Nido, Puerto Princesa City, Roxas and Taytay. Within these municipalities, informants mentioned specific areas where trade in pangolins is known to take place, for example where buyers meet or where pangolins are delivered. These areas included Liminangcong (Taytay) and

TABLE 3 | Mean price (and range) for pangolin parts and products across trade actors from 2011–2019.

Pangolin product	Harvester to logistician (USD $)	Logistician to stockholder (USD $)	Stockholder to end market (USD $)	Total price increase
Whole animal (alive)	$151 ($4.50–557, $n = 15$)	$267 ($67–557, $n = 7$)	$728 ($401–1,114, $n = 3$)	382%
Meat (per kilo)	$7 ($4–11, $n = 5$)	$13 ($4–25, $n = 3$)	$111 ($n = 1$)	1486%
Scales (per kilo)	$178 ($16–334, $n = 27$)	$156 ($111–201, $n = 4$)	$765 ($401–1,448, $n = 3$)	330%

N= number of reports.

New Ibajay (El Nido). Exit points and key shipment areas mentioned were Teneguiban (El Nido) and Poblacion (Coron), with key destinations reported to be Binondo and Olongapo City (**Figure 4**). Limited reports were available for international export destinations, but it was noted that some trade travels to Malaysia. Several informants ($n = 6$) noted how the pangolin trade was primarily governed by one major specialist smuggler until 2014/2015. This specialist smuggler had stock houses across northern Palawan and would buy pangolins from logisticians based in municipalities north of, and including, Puerto Princesa City. One respondent noted: *"Buyer X was for years the only buyer for the whole of Coron, Culion and Busuanga. This changed about 5 years ago though [2014] when more buyers started appearing."*

Prices and Estimates of Extraction Rates

Between 1970 and 2000, the mean price reported for a whole pangolin, sold by harvesters to logisticians, was US$8 (range $0.20–31, $n = 8$). There were no reports of scales and meat being sold separately during this period, with all reports relating to the sale of whole animals, mostly for the taxidermy trade.

"In the 1970s and 1980s you could see pangolins just here [by the houses], just walking around... But then more people started arriving in the 1990s—someone from Manila moved here and started asking people to find them and they'd be sold for ₱10 [US$0.25). By 2000, the price had increased to ₱1000 [US$25] per piece... Now, you are lucky if you see one once a year."

Between 2000 and 2010, the mean harvester-logistician price reported for a whole pangolin was US$95 (range $7–267, $n = 3$) and the mean harvester-logistician price for pangolin scales was US$98/kg (range $11–155, $n = 5$). **Table 3** shows the mean prices for pangolin scales, meat and live animals reported during the period 2011–2019 (prices given in USD, using 2015 average exchange rate of $1 = ₱44; www.oanda.com).

When asked about peak trading dates, the majority (73%, n=19) of reports fell between 2013 and 2017, with 2014–2016 the most common trading period cited. During this period, an average of three pangolins (range: 1–5, $n = 6$) were caught per hunting trip. Prior to this, the average number caught per trip was four (range: 2–10, covering the period 1970–2010, $n = 9$). One informant described having 25 pangolins at their property, collected over just one week [in 2010]. They also noted: *"During the peak of trading, over 1000 pangolins were caught from here [this village]… with at least 15 people involved in hunting."*

The average number of people engaged in pangolin hunting per village was 11 (range: 2–30, $n = 15$) with hunting groups comprising an average of three people (range: 1–5, $n = 14$). We therefore estimate that three to four hunting groups operate per village, some hunting only during the dry months, and some hunting year-round. One respondent noted that during the height of the trade, around 40 pangolins could be caught per month: *"You could catch about 20 kilos worth of scales per month [and 1 kilo of scales is about two pangolins]—so that's about PhP160,000 (US$3,565) per month but it has to be split with the group. One hunter built a house within three months of hunting. This was during the height of the trade [2014–2015]. After this, pangolins became harder to catch."*

Theme 4: Facilitating Environments

To transport pangolins, motorcycles ($n = 13$), shuttle vans ($n = 4$), boats ($n = 2$) and planes ($n = 1$) were reported. Concealment methods aid this transport, ranging from the simple use of backpacks, to legally traded marine species that are used to conceal pangolins in shipments. Bribes also help facilitate the movement of goods. For example, the transport of goods by privately chartered planes was reported to cost US$1,850, with US$600 of that amount used as a direct payment to the pilot to not inform the authorities. Transport via boat involved similar bribes, with law enforcement personnel paid to not examine shipments. Bonuses would then be provided if shipments were successful (e.g., arriving on time and not being apprehended). Movement of pangolins across the province also involved bribes. One informant noted: *"Say they have three separate loads of pangolins to trade. They will liaise with the enforcement agencies so that one shipment is caught but a further two loads are allowed through [to pass through check points]—people are paid to turn a blind eye to two of the three loads but one is apprehended so it looks like law enforcement is being effective."*

Although these bribery payments represent large sums of money in local terms, one respondent reported that it was possible to make US$8,000 per shipment of pangolins from Coron to Manila, with four shipments possible per month during the peak trade period [2014–2016], giving a potential gross income of US$32,000 per month. If going from Olongapo to Malaysia, it was possible to make this amount in just one shipment. The funds paid in bribes therefore represent small amounts compared to the potential revenue that can be generated.

Vendors provide upfront funds to specialist smugglers, who distribute a proportion of these funds to logisticians who in turn pay local harvesters or provide items in kind. Harvesters described how this finance mechanism provides upfront funds for desirable items (e.g., motorbikes), but they are then indebted to provide pangolins to pay back the cost. This finance

mechanism appears to provide the framework to ensure the end-user will receive pangolins, with each level of the trade chain in debt to the actor after them. Money to the value of US$41,000 was paid to one specialist smuggler to finance the trade.

Four informants spoke of logisticians who had been caught but were able to continue trading due to the lack of prosecution that followed. One was imprisoned but paid the bail fee and was later acquitted, another was caught twice but never charged, and a third received a warning but was never convicted. A further specialist smuggler spoke of how he was caught but the vendor paid his bail and charges were dropped. However, despite these low conviction rates, some harvesters ($n = 12$) noted how local law enforcement efforts are influencing behaviour at the start of the chain. For example, logisticians were reported to be more cautious following pangolin apprehensions and will temporarily cease operations, which in turn reduces demand. One harvester noted: *"Operations have stopped now as there was an apprehension so there is no one buying right now."*

DISCUSSION

This study represents the first large-scale survey into pangolin trade and use across Palawan Province, and to our knowledge, is the first published study to concurrently document consumption, hunting and trade for any pangolin species. With existing knowledge otherwise limited to seizure records (Gomez and Sy, 2018; Sy and Krishnasamy, 2020) and few empirical studies (Schoppe and Cruz, 2008; Bayron, 2014), we provide the first estimates of levels of consumption and hunting for the Philippine pangolin across its geographic range, alongside up-to-date insights into key trade hubs, actors and logistics, and the facilitating conditions that enable the trade to continue.

Use and hunting of pangolins was reported across Palawan, with consumption reported in all municipalities, and hunting reported in all municipalities except Linapacan (pangolins are likely absent from this municipality; Archer et al., 2020). Though these results do not provide an exact timeframe for past use and hunting, and there may be individual variation in question interpretation, the results suggest a substantial proportion of our respondents use or hunt pangolins, with widespread use reported across the province. However, hunting levels were highest in northern municipalities, and northern Palawan emerged as a key trade hub, suggesting northern areas could be playing an important role in facilitating pangolin trade. As we were unable to conduct interviews in southernmost Palawan, we cannot rule out the existence of trade hubs in these areas, and our results could partly reflect geographical sampling bias. Nonetheless, these results are consistent with seizure records and previous research from northern Palawan (Bayron, 2014; Gomez and Sy, 2018; Sy and Krishnasamy, 2020) and we suggest these areas should be an important focus for illegal wildlife trade mitigation and management moving forward.

Furthermore, though our findings suggest that seizure records can provide an accurate reflection of key trading locations, they fail to offer detailed insights and provide poor estimates of absolute trade levels, with data from this study suggesting that trade levels are considerably higher than seizure records reflect. One specialist smuggler noted how 1,000 pangolins could be collected from agents across Palawan over a one week period; in comparison, seizure records from the same year estimated around 125 pangolins were traded (Gomez and Sy, 2018). If we assume that our findings regarding actor categories, patterns of pangolin hunting and levels of offtake are representative of village-level hunting patterns across Palawan Province (including only the municipalities where pangolins are known to exist), we can extrapolate to provide annual estimates of offtake scenarios per trade actor category during the peak-trading period (2013–2017). Based on seasonal hunting by local hunters, an estimated 6,696 pangolins may have been hunted per year. Based on reports of year-round hunting by local hunters, an estimated 26,784 pangolins could have been harvested per year. Based on hunting levels reported by organised, non-local hunters who hunt year-round as a main income, 53,568 pangolins could have been harvested annually. Although these are hypothetical scenarios and should not be considered as authoritative numbers, our results suggest it is likely that a combination of these scenarios have taken place across Palawan over the past decade, with the number of hunting trips and levels of offtake largely driven by demand and involvement type. Respondents who reported that hunting was their main income (non-local hunters who represent 20% of reports) would typically fall into the highest-impact scenario, whereas respondents for whom hunting was an additional income (local hunters who represent 80% of reports) reported both year-round (53%) and seasonal hunting (47%) and therefore may fall into both the low and medium impact scenarios.

In comparison to these annual offtake estimations, just 740 Philippine pangolins are represented in seizure records covering the period between 2000 and 2017 (Sy and Krishnasamy, 2020). Whilst we acknowledge that trade levels reported here will not be representative of all trade actors, our extrapolations suggest that hundreds of thousands of pangolins may have been traded during the peak trading period alone. This implies the Philippine pangolin has contributed to international pangolin trade in numbers much higher than previously thought. Further, with reports of pangolins being transported from Manila to Malaysia, it is possible that the Philippine pangolin trade may follow a similar trade route to that of the Sunda pangolin (Pantel and Chin, 2009; Pantel and Anak, 2010), increasing the chance for the two species to be confused in seizure records. In addition to international trade, we also found evidence for a small domestic trade in pangolins, with end consumers reported from Coron, Manila, Puerto Princesa City and Roxas. These end consumers were reported to be foreign nationals. Evidence of a domestic trade in Manila is supported by recent evidence of pangolins wandering the streets and golf courses of Manila (presumably the animals had escaped from the trade), and pangolin meat being sold in restaurants in and around Manila (Alberts, 2020; Sy and Krishnasamy, 2020).

Recent reported prices for pangolin products are similar to figures provided elsewhere (Gomez and Sy, 2018), with large increases seen over the past three decades, likely driven by increasing international demand for pangolin parts and

products (Challender et al., 2014). Our results also highlight the inequitable nature of the trade. Large price disparities are seen between the different levels of the trade chain, with stockholders selling pangolin products to the end market at rates between three and 14 times the value that harvesters sell the goods. However, average reported values for whole pangolins and pangolin scales were similar for both harvesters and logisticians. We hypothesise this is due to overlapping actor roles, with some actors (e.g., non-local harvesters) acting as both harvesters and logisticians. This, alongside the overlapping specialist smuggler and vendor roles, highlights the nuances that exist within trade networks and the importance of avoiding simplified accounts and terminology when reporting on the illegal wildlife trade (Phelps et al., 2016).

A range of facilitating conditions are allowing the trade to continue, namely corruption, cash advancements and low prosecution rates. Trade chains were found to be similar across the province and consistently buyer driven. Though reports of bribery and corruption in this research date to 2015–2016, such reports are not uncommon when investigating illegal activities and are widely acknowledged to play a key role in organised crime (Haenlein and Keatinge, 2017; Busilacchi et al., 2018; Harrop, 2020). New and diverse approaches that aim to tackle corruption exist (Plowman, 2020; Tacconi and Williams, 2020), but in general, conventional anticorruption strategies seek to improve rule compliance, alongside altering the cost-benefit calculations of rule-breaking decisions through incentives or disincentives (Heywood, 2018). With the cost of bail and fines reportedly paid for by those higher up the trade chain, our results suggest that existing penalties are failing to provide sufficient disincentives. However, with large sums of money involved, it is unlikely that altering disincentives through financial means will provide a sufficient deterrent to those at higher levels. In contrast, logisticians and harvesters noted how operations would be temporarily ceased following successful apprehensions by wildlife authorities due to fear of arrest. This suggests that increasing the likelihood of detection, rather than the value of financial penalties, may act as a greater deterrent for some trade actors (Leader-Williams and Milner-Gulland, 1993; Ehrlich, 1996; Keane et al., 2008). In this study, dogs were widely reported as essential to a successful pangolin hunt. Using dogs to increase the detection probability of law enforcement checks could therefore have high potential. This approach has been used elsewhere to successfully apprehend ivory, rhino horn and other illegal wildlife products (WWF, 2014; African Wildlife Foundation, 2018). Detection dogs are already used within the Philippines to detect drugs and explosives; the expertise required to train detection dogs therefore already exists and could be incorporated into existing training (PDEA, 2021). However, such an approach would require collaboration between public and private agencies, alongside large financial investment.

More broadly, with drugs connected to the pangolin trade and large monetary transactions reported, our results suggest that the Philippine pangolin trade could be operating within wider organised crime groups. Elsewhere, the illegal wildlife trade has been found to be embedded within sophisticated organised crime (Harrop, 2020) that can impact both national and international security and stability (UNODC, 2010, 2013). Evidence of such links to the Philippine pangolin trade has not been previously documented. This finding, coupled with high numbers of pangolins implicated in the trade, highlights the importance of targeting those at the highest levels of the trade chain using cross-border collaboration through intergovernmental networks such as Interpol and the ASEAN Wildlife Enforcement Network. Further, with large cash advancements seeming to provide a framework that ensures each trade actor is indebted to the actor above them, "follow the money" approaches that aim to disrupt these financing mechanisms at the very top of the chain could help restrict all levels of the trade chain (Haenlein and Keatinge, 2017).

At the lower levels of the trade chain, most harvesters were reported to be local to their village and to engage in pangolin hunting to complement their livelihood activities. Careful consideration of how to engage these trade actors is needed as, in this context, economic incentive-based approaches may have limited value if organised crime groups can offer larger financial enticements, and/or if trade actors do not solely rely on the trade for income. In contrast, heavy-handed approaches that aim to provide disincentives are increasingly deployed in response to wildlife crime (Duffy et al., 2019). However, these risk fostering negative relationships, are inequitable, and are unlikely to reduce involvement in wildlife crime (Harrison et al., 2015; Cooney et al., 2017; Duffy et al., 2019). Working with local people to identify locally-relevant incentives (financial or non-financial) and change the social norms around consumption and hunting practises could instead have value (Chen et al., 2009; Veríssimo, 2013), particularly as previous research has shown that rural communities in Palawan consider wildlife protection to be important (Archer et al., 2020). Further, although pangolin consumption was widely reported, it does not appear to comprise an important part of rural subsistence, presenting an opportunity to address social norms and develop behavioural change or social marketing pride campaigns (e.g., Jenks et al., 2010; Saypanya et al., 2013; Wright et al., 2015) without removing a valuable food source. Such campaigns would also challenge the view of wildlife protection as the responsibility of wildlife departments or NGOs, helping facilitate collaborative approaches. Though different strategies may be required for non-local hunters and logisticians, for whom hunting pangolins represents a more important part of their income, involving these actors to co-develop solutions will be vital to foster trust and build locally relevant interventions that are more likely to be sustainable in the long-term, and could help to build relationships that facilitate intelligence-sharing to disrupt the higher levels of the chain (Biggs et al., 2016; Cooney et al., 2017).

In addition to bottom-up community-led conservation approaches, targeted training for key groups could also have value to influence behaviour at the higher levels of the trade chain (e.g., judiciaries, prosecutors, police, customs officials, air and seaport staff, and wildlife traffic management units). Such training could help ensure all groups are aware of the illegality of pangolin trafficking and how the trade can operate within a wider network of organised crime (Harrop, 2020). In the long-term, changing the social norms around pangolin trafficking is needed to shift the perception of wildlife trafficking from a low-level

to a high-level crime, and will be an essential prerequisite to encourage enforcement bodies and judiciaries to prosecute higher-level trade actors to the full extent of the law.

This research suggests that the Philippine pangolin trade is widespread and occurring at levels considerably higher than previously documented, requiring both the expertise of local people and the large finances of organised crime groups to operate. The complexity and extent of this trade across Palawan Province therefore requires a complex response at multiple levels. With local communities playing a pivotal role in providing the expert knowledge needed to find pangolins, these stakeholders need to play a central role in developing strategies to encourage involvement in conservation and reduce involvement in wildlife crime. Alongside this, increasing the detectability of illegal trade operations will be important to deter those at the intermediary levels of the chain, alongside providing the opportunity to collect evidence against those at the higher trade echelons. However, with highly organised and highly financed crime groups driving the trade, sophisticated and specialist approaches will be needed to disrupt this trade at the highest levels, requiring local, national, and international support.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because of the sensitive nature of the questions asked. We will therefore not share any data that could risk respondent anonymity. Requests to access the datasets should be directed to Lucy J. Archer, lucy.archer@ioz.ac.uk.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Zoological Society of London Human Ethics Committee. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

LJA and SKP were responsible for conceptualisation and project design. CMA, DBC, RLA, and LJA collected the data. LJA led on analysis and writing the original draft. SKP and STT were responsible for validation and review, editing, and supervision. All authors contributed to the article and approved the submitted version.

FUNDING

LJA is funded by the Natural Environment Research Council (grant number NE/L002485/1), with financial support from the Zoological Society of London, to whom she is grateful. Further financial support was provided by an anonymous donor to the ZSL Philippines pangolin project that paid for the salaries of CMA, DBC, and RLA and funded data collection.

ACKNOWLEDGMENTS

This study was approved by the Palawan Council for Sustainable Development (Gratuitous permit 2018–23). Prior consent was provided by every Municipal Mayor, Village Captain, and Protected Area Management Board. We thank these authorities and are grateful for their time. Special thanks go to Mary Nesa Medina, Josefa Gacilos and Jose Majid Ibrahim, who supported data collection and field logistics, and Glenn Labrado, Godofredo Villapando, Carly Waterman and Helen O'Neill for project support. Our final acknowledgements and thanks go to our study participants, who generously gave their time, knowledge and shared their experiences. Without them, this research would not have been possible.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcosc.2021.746366/full#supplementary-material

REFERENCES

African Wildlife Foundation (2018). Conservation sniffer dogs: How a unique human-canine bond leads to wildlife detection. Nairobi: African Wildlife Foundation. Available online at: https://www.awf.org/blog/conservation-sniffer-dogs-how-unique-human-canine-bond-leads-wildlife-detection (accessed April 16, 2021).

Alberts, E. C. (2020). Illegal trade of Philippine pangolins is surging, report shows. Available online at: https://news.mongabay.com/2020/08/weak-enforcement-sees-surging-trade-in-philippine-pangolin-study-shows/ (accessed April 26, 2021).

Archer, L. J., Papworth, S. K., Apale, C. M., Corona, D. B., Gacilos, J. T., Amada, R. L., et al. (2020). Scaling up local ecological knowledge to prioritise areas for protection: Determining Philippine pangolin distribution, status and threats. *Global Ecol. Conserv*. 24:e01395. doi: 10.1016/j.gecco.2020.e01395

Bayron, A. C. (2014). *Trade Dynamics of Palawan Pangolin, Manis culionensis. In partial fulfillment of the requirements for the degree of Bachelor of Science in Environmental Management*. Puerto Princesa City: Western Philippines University, Puerto Princesa Campus.

Bennett, E. L., and Rao, M. (2002). "Wild meat consumption in Asian tropical forest countries: is this a glimpse of the future for Africa?," in *Links Between Biodiversity Conservation, Livelihoods and Food Security: The Sustainable Use of Wild Species for Meat*, eds S. A. Mainka and M. Trivedi (Gland: IUCN; Cambridge: Switzerland), 38–69.

Biggs, D., Cooney, R., Roe, D., Dublin, H. T., Allan, J. R., Challender, D. W. S. W., et al. (2016). Developing a theory of change for a community-based response to illegal wildlife trade. *Conserv. Biol*. 31, 5–12. doi: 10.1111/cobi.12796

Blair, M. E., Le, M. D., Sethi, G., Thach, H. M., Nguyen, V. T. H. H., Amato, G., et al. (2017). The importance of an interdisciplinary research approach to inform wildlife trade management in Southeast Asia. *BioScience* 67, 995–1003. doi: 10.1093/biosci/bix113

Braun, V., Clarke, V., and Weate, P. (2016). "Using thematic analysis in sport and exercise research," in *Routledge Handbook of Qualitative Research in Sport and Exercise*, eds B. Smith and A. C. Sparkes (London: Taylor & Francis [Routledge]), 191–205.

Busilacchi, S., Butler, J. R. A., Rochester, W. A., and Posu, J. (2018). Drivers of illegal livelihoods in remote transboundary regions: the case of the Trans-Fly region of Papua New Guinea. *Ecol. Soc*. 23:46. doi: 10.5751/ES-09817-230146

Challender, D., Waterman, C., and Baillie, J. E. M. (2012). Catalysing conservation action and raising the profile of pangolins - the IUCN-SSC Pangolin Specialist Group (PangolinSG). *Asian J. Conserv. Biol.* 1, 140–141. Available online at: https://www.ajcb.in/archive_dec_12.php

Challender, D. W. S., Heinrich, S., Shepherd, C. R., and Katsis, L. K. D. (2020). "Chapter 16. International trade and trafficking in pangolins, 1900–2019," in *Pangolins. Science, Society and Conservation*, eds D. W. S. Challender, H. C. Nash, and C. Waterman (Cambridge, MA: Academic Press), 259–276. doi: 10.1016/B978-0-12-815507-3.00016-2

Challender, D. W. S., and O'Criodain, C. (2020). "Chapter 19. Addressing trade threats to pangolins in the Convention on International Trade in Endangered Species of Wild Fauna (CITES)," in *Pangolins. Science, Society and Conservation*, eds D. W. S. Challender, H. C. Nash, and C. Waterman Cambridge, MA: Academic Press), 305–320. doi: 10.1016/B978-0-12-815507-3.00019-8

Challender, D. W. S., Waterman, C., and Baillie, J. E. M. (2014). *Scaling up pangolin conservation. IUCN SSC Pangolin Specialist Group Conservation Action Plan:24*. London: Zoological Society of London.

Chen, X., Lupi, F., He, G., and Liu, J. (2009). Linking social norms to efficient conservation investment in payments for ecosystem services. *Proc. Natl. Acad. Sci.* 106, 11812–11817. doi: 10.1073/pnas.0809980106

Chong, J. L., Panjang, E., Willcox, D., Nash, H. C., Semiadi, G., Sodsai, W., et al. (2020). "Chapter 6. Sunda pangolin Manis javanica (Desmarest, 1822)," in *Pangolins. Science, Society and Conservation*, eds D. W. S. Challender, H. C. Nash, and C. Waterman (Cambridge, MA: Academic Press), 89–108. doi: 10.1016/B978-0-12-815507-3.00006-X

Cooney, R., Roe, D., Dublin, D., Phelps, J., Wilkie, D., Keane, A., et al. (2017). From poachers to protectors: engaging local communities in solutions to illegal wildlife trade. *Conserv. Lett.* 10, 367–374. Wiley-Blackwell. doi: 10.1111/conl.12294

Cruz, R. M., Van Den Beukel, D. V., Lacerna-Widmann, I., Schoppe, S., and Widmann, P. (2007). Wildlife trade in Southern Palawan, Philippines. *Banwa* 4, 12–26.

Duckworth, J. W., Batters, G., Belant, J. L., Bennett, E. L., Brunner, J., Burton, J., et al. (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. *Sapiens* 5, 76–95. Available online at: https://journals.openedition.org/sapiens/1327

Duffy, R., and Humphreys, J. (2014). *Mapping Donors : Key areas for tackling illegal wildlife trade (Asia and Africa)*. Evidence on Demand, UK. doi: 10.12774/eod_hd.june2014.duffy_et_al

Duffy, R., Mass,é F., Smidt, E., Marijnen, E., Büscher, B., Verweijen, J., et al. (2019). Why we must question the militarisation of conservation. *Biol. Conserv.* 232, 66–73. doi: 10.1016/j.biocon.2019.01.013

Ehrlich, I. (1996). Crime, punishment, and the market for offenses. *J. Econ. Perspect.* 10, 43–67. doi: 10.1257/jep.10.1.43

Elmendorf, W. F., and Luloff, A. (2006). Using key informant interviews to better understand open space conservation in a developing watershed. *Sci. J. Int. Soc. Arboricult.* 32, 54–61. Available online at: https://www.proquest.com/openview/e65f6d5cf6abf194938df9b70e60f50c/1?pq-origsite=gscholar&cbl=27839

Esmail, N., Wintle, B. C., t'Sas-Rolfes, M., Athanas, A., Beale, C. M., Bending, Z., et al. (2020). Emerging illegal wildlife trade issues: a global horizon scan. *Conserv. Lett.* 13, 1–10. doi: 10.1111/conl.12715

Gaubert, P., and Antunes, A. A. (2005). Assessing the taxonomic status of the Palawan pangolin Manis culionensis (Pholidota) using discrete morphological characters. *J. Mammal.* 86, 1068–1074. doi: 10.1644/1545-1542(2005)86[1068:ATTSOT]2.0.CO;2

Gavin, M. C., Solomon, J. N., and Blank, S. G. (2010). Measuring and monitoring illegal use of natural resources. *Conserv. Biol.* 24, 89–100. doi: 10.1111/j.1523-1739.2009.01387.x

Gomez, L., and Sy, E. Y. (2018). Illegal pangolin trade in the Philippines. *TRAFFIC Bull.* 30, 37–40.

GOVPH (1997). *Republic Act No. 8371. Official Gazette of the Republic of the Philippines*. Manila. Available online at: https://www.officialgazette.gov.ph/1997/10/29/republic-act-no-8371/ (accessed September 17, 2021).

Guest, G., MacQueen, K., and Namey, E. (2014). "Introduction to applied thematic analysis," in *Applied Thematic Analysis*, eds G. Guest, K. MacQueen, and E. Namey (Thousand Oaks, CA: SAGE Publications Inc.), 3–20.

Haenlein, C., and Keatinge, T. (2017). *Follow the Money. Using Financial Investigation to Combat Wildlife Crime*. London: Royal United Services Institute for Defence and Security Studies Occasional:1–44.

Harrison, M., Roe, D., Baker, J., Mwedde, G., and Travers, H. (2015). *Wildlife crime: a review of the evidence on drivers and impacts in Uganda. IIED Research Report*. London. Available from http://pubs.iied.org/pdfs/17576IIED.pdf (accessed February 25, 2018).

Harrop, S. R. (2020). "Conserving pangolins through international and national regulation and effective law enforcement," in *Pangolins. Science, Society and Conservation*, eds D. W. S. Challender, H. C. Nash, and C. Waterman (Cambridge, MA: Academic Press), 281–292. doi: 10.1016/B978-0-12-815507-3.00017-4

Heinrich, S., Wittman, 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*. Petaling Jaya: TRAFFIC Southeast Asia Regional Office.

Heywood, P. M. (2018). Combating corruption in the twenty-first century: new approaches. *Daedalus* 147, 83–97. doi: 10.1162/daed_a_00504

Ingram, D. J., Coad, L., Abernethy, K. A., Maisels, F., Stokes, E. J., Bobo, K. S., et al. (2017). Assessing Africa-Wide Pangolin Exploitation by Scaling Local Data. *Conserv. Lett.* 11:1–9. doi: 10.1111/conl.12389

Ingram, D. J., Coad, L., and Scharlemann, J. P. W. (2016). *Hunting and Sale of Pangolins Across Sub-Saharan Africa : A Preliminary Analysis. OFFTAKE Working Paper No. 1*. 1–3.Available online at: www.offtake.org

Jenks, B., Vaughan, P. W., and Butler, P. J. (2010). The evolution of rare pride: using evaluation to drive adaptive management in a biodiversity conservation organization. *Eval. Prog. Plan.* 33, 186–190. doi: 10.1016/j.evalprogplan.2009.07.010

Jones, S., Papworth, S., Keane, A. M., Vickery, J., and St John, F. A. V. (2020). The bean method as a tool to measure sensitive behaviour. *Conserv. Biol.* 35, 1–27. doi: 10.1111/cobi.13607

Keane, A., Jones, J. P. G., Edwards-Jones, G., and Milner-Gulland, E. J. (2008). The sleeping policeman: understanding issues of enforcement and compliance in conservation Introduction: rules in conservation. *Anim. Conserv.* 11, 75–82. doi: 10.1111/j.1469-1795.2008.00170.x

Lagrada, L. A. (2008). "Conservation and management of the Malayan Pangolin in Palawan Province, Philippines," in *Proceeding of the Workshop on Trade and Conservation of Pangolins Native to South and Southeast Asia* (Petaling Jaya), 29–39.

Lagrada, L. S. (2012). *Population Density, Distribution and Habitat Preferences of the Palawan Pangolin (Manis culionensis, de Elera 1915). In partial fulfillment of the requirements for the degree of Master of Science in Zoology*. University of the Philippines Los Banos.

Lau, J. T. F., Yeung, N. C. Y., Mui, L. W. H., Tsui, H. Y., and Gu, J. (2011). A simple new method to triangulate self-reported risk behavior data-the bean method. *Sex. Trans. Dis.* 38, 788–792. doi: 10.1097/OLQ.0b013e318218cc66

Leader-Williams, N., and Milner-Gulland, E. J. (1993). Policies for the enforcement of wildlife laws: the balance between detection and penalties in Luangwa Valley, Zambia. *Conserv. Biol.* 7, 611–617. doi: 10.1046/j.1523-1739.1993.07030611.x

Lüdecke, D. (2021). *sjPlot: Data Visualization for Statistics in Social Science*. Available online at: https://cran.r-project.org/package=sjPlot (accessed May 10, 2021).

Mahmood, T., Mohapatra, R. K., Perera, P., Irshad, N., Akrim, F., Andleeb, S., et al. (2020). "Chapter 5. Indian pangolin Manis crassicaudata (Geoffroy, 1803)," in *Pangolins. Science, Society and Conservation*, eds D. W. S. Challender, H. C. Nash, and C. Waterman (Cambridge, MA: Academic Press), 71–88.

Newing, H. (2011). *Conducting Research in Conservation: Social Science Methods and Practice*. Routledge. doi: 10.4324/9780203846452

Nijman, V. (2010). An overview of international wildlife trade from Southeast Asia. *Biodivers. Conserv.* 19, 1101–1114. doi: 10.1007/s10531-009-9758-4

Olmedo, A., Veríssimo, D., Milner-Gulland, E. J., Hinsley, A., Dao, H. T. T., and Challender, D. W. S. (2021). Uncovering prevalence of pangolin consumption using a technique for investigating sensitive behaviour. *Oryx* 1–9. doi: 10.1017/S0030605320001040

Pantel, S., and Anak, N. A. (2010). *A preliminary Assessment of Sunda Pangolin Trade in Sabah*. Petaling Jaya: TRAFFIC Southeast Asia.

Pantel, S., and Chin, S. Y. (2009). *Proceedings of the Workshop on Trade and Conservation of Pangolins Native to South and Southeast Asia. 30 June - 2 July 2008, Singapore Zoo, Singapore*. Petaling Jaya: TRAFFIC Southeast Asia.

PDEA (2021). PDEA Welcomes 100 New K9 Handlers and Partner Dogs. Available online at: https://pdea.gov.ph/2-uncategorised/1412-pdea-welcomes-100-new-k9-handlers-and-partner-dogs (accessed April 16, 2021).

Phelps, J., Biggs, D., and Webb, E. L. (2016). Tools and terms for understanding illegal wildlife trade. *Front. Ecol. Environ.* 14, 479–489. doi: 10.1002/fee.1325

Piper, P. J., Ochoa, J., Robles, E. C., Lewis, H., and Paz, V. (2011). Palaeozoology of Palawan Island, Philippines. *Quat. Int*. 233, 142–158. doi: 10.1016/j.quaint.2010.07.009

Plowman, C. (2020). "Law enforcement practitioner's perspective," in *Pangolins. Science, Society and Conservation*, eds D. W. S. Challender, H. C. Nash, and C. Waterman (Cambridge, MA: Academic Press), 293–304. doi: 10.1016/B.978-0-12-815507-3.00018-6

R Core Team (2020). *R: A Language and Environment for Statistical Computing*. Vienna: R Foundation for Statistical Computing. Available from https://www.r-project.org/.

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

Sas-Rolfes, M., Challender, D. W. S., Hinsley, A., Veríssimo, D., and Milner-Gulland, E. J. (2019). Illegal wildlife trade: scale, processes, and governance. *Annu. Rev. Environ. Resour*. 44, 201–228. doi: 10.1146/annurev-environ-101718-033253

Saypanya, S., Hansel, T., Johnson, A., Bianchessi, A., and Sadowsky, B. (2013). Effectiveness of a social marketing strategy, coupled with law enforcement, to conserve tigers and their prey in Nam Et Phou Louey National Protected Area, Lao People's Democratic Republic. *Conserv. Evid.* 10, 29–38. Available online at: http://t.www.conservationevidence.com/reference/pdf/5196

Schoppe, S., and Cruz, R. M. (2008). "The Palawan pangolin," in *Proceeding of the Workshop on Trade and Conservation of Pangolins Native to South and Southeast Asia*. Singapore.

Schoppe, S., Katsis, L., and Lagrada, L. (2019). *Manis culionensis. The IUCN Red List of Threatened Species 8235*. Available online at: https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T136497A123586862.en

Schoppe, S., Katsis, L. K., Alvarado, D. and Acosta-Lagrada, L. (2020). "Philippine pangolin Manis culionensis (de Elera, 1915)," in *Pangolins. Science, Society and Conservation*, eds D. W. S. Challender, H. C. Nash, and C. Waterman (Cambridge, MA: Academic Press). 109–122. doi: 10.1016/B978-0-12-815507-3.00007-1

St. John, F. A. V., Brockington, F., and Bunnefeld, D. (2016). Research ethics: assuring anonymity at the individual level may not be sufficient to protect research participants from harm. *Biol. Conserv*. 196, 208–209. doi: 10.1016/j.biocon.2016.01.025

Swain, J. (2018). *A Hybrid Approach to Thematic Analysis in Qualitative Research: Using a Practical Example*. Thousand Oaks: SAGE Publications Inc. doi: 10.4135/9781526435477

Sy, E. Y., and Krishnasamy, K. (2020). *Endangered by Trade: The Ongoing Illegal Pangolin Trade in the Philippines*. Petaling Jaya: TRAFFIC, Southeast Asia Regional Office.

Tacconi, L., and Williams, D. A. (2020). Corruption and anti-corruption in environmental and resource management. *Annu. Rev. Environ. Resour*. 45, 305–329. doi: 10.1146/annurev-environ-012320-083949

Underwood, F. M., Burn, R. W., and Milliken, T. (2013). Dissecting the illegal ivory trade: an analysis of ivory seizures data. *PLoS ONE* 8:e76539. doi: 10.1371/journal.pone.0076539

UNODC (2010). *The Globalisation of Crime: A Transnational Organized Crime Threat Assessment*. Vienna: United Nations Office on Drugs and Crime.

UNODC (2013). *Transnational Organized Crime in East Asia and the Pacific: A Threat Assessment*. Bangkok: United Nations Office on Drugs and Crime Regional Office for Southeast Asia and the Pacific (ROSEAP), Division for Operations (DO).

UNODC (2016). *United Nations Office on Drugs and Crime World Wildlife Crime Report: Trafficking in Protected Species*. The United Nations Office on Drugs and Crime (UNODC).

Utermohlen, M., and Baine, P. (2017). "Flying under the radar: Wildlife trafficking in the air transport sector," in *USAID Reducing Opportunities for Unlawful Transport of Endangered Species (ROUTES) Partnership and C4ADS*. Available online at: https://www.worldwildlife.org/publications/flying-under-the-radar-wildlife-trafficking-in-the-air-transport-sector (accessed May 01, 2021).

Veríssimo, D. (2013). Influencing human behaviour: an underutilised tool for biodiversity management. *Conserv. Evid.* 10, 29–31. Available online at: https://www.conservationevidence.com/reference/pdf/5190

Willcox, D., Nash, H. C., Trageser, S., Kim, H. J., Hywood, L., Connelly, E., et al. (2019). Evaluating methods for detecting and monitoring pangolin (Pholidata: Manidae) populations. *Global Ecol. Conserv*. 17:e00539. doi: 10.1016/j.gecco.2019.e00539

Wright, A. J., Veríssimo, D., Pilfold, K., Parsons, E. C. M., Ventre, K., Cousins, J., et al. (2015). Competitive outreach in the 21st century: why we need conservation marketing. *Ocean Coast. Manag.* 115, 41–48. doi: 10.1016/j.ocecoaman.2015.06.029

Wu, S., Sun, N. C., Zhang, F., Ades, G., Suwal, T. L., and Jiang, Z. (2020). "Chapter 4. Chinese pangolin Manis pentadactyla (Linnaeus, 1758)," in *Pangolins. Science, Society and Conservation*, eds D. W. S. Challender, H. C. Nash, and C. Waterman (Cambridge, MA: Academic Press), 49–70.

WWF (2014). *Canines and Contraband | Stories | WWF*. Available online at: https://www.worldwildlife.org/stories/canines-and-contraband (accessed April 16, 2021).

Wyler, L. S., and Sheikh, P. A. (2008). *International Illegal Trade in Wildlife: Threats and U.S. Policy*. Washington, DC: Congressional Research Service.

Xing, S., Bonebrake, T. C., Cheng, W., Zhang, M., Ades, G., Shaw, D., et al. (2020). "Meat and medicine : historic and contemporary use in Asia," in *Pangolins. Science, Society and Conservation*, eds D. W. S. Challender, H. C. Nash, and C. Waterman (Cambridge, MA: Academic Press), 227–240. doi: 10.1016/B978-0-12-815507-3.00014-9

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.