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People's Knowledge of Illegal Chinese Pangolin Trade Routes in Central Nepal

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Abstract: Chinese pangolin populations are declining globally due to illegal wildlife trades in its range countries, especially China and Vietnam, where the largest markets for this species exist. Identifying the trade routes is crucial for developing conservation plans for the pangolin and understanding the attributes of the individuals involved in the illegal trade. We aimed to identify local trade routes and the socio-economic status of people involved in pangolin trades from the Gaurishankar Conservation Area [a Protected Area (PA)] and the Ramechhap district [a non-Protected Area (non-PA)] of Nepal. We found that pangolin traders were typically poor, illiterate, unemployed, male, and of working age (17–40 years old). Confiscation rates of pangolin parts were higher in non-PAs than Pas as the illegal trade routes seemed to differ between the PAs and non-PAs. From 2014 to 2018, the prices of pangolin scales in PAs and non-PAs increased by 50% and 67%, respectively. Our results highlight locals facilitating the trade of pangolins, therefore we recommend the need for other income generating sources such as ecotourism or providing incentives to promote local industries as well as to establish Community Based Anti-Poaching Units among range countries and trade route countries to control the trade of this globally threatened species.

Keywords: Nepal; pangolin; poor communities; protected area; traders; unemployed; working age group

1. Introduction

Illegal trades act as a major threat to the conservation of pangolins in Africa and Asia [1] and has resulted in local and international overexploitation of pangolins for meat and traditional medicine, particularly in China and Vietnam [2–6]. Most pangolins consumed in China and Vietnam are trafficked from neighboring Asian countries, even though the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) banned international commercial trade for the wild pangolin and its body parts [7,8]. Bans on international trade may not ensure the conservation of pangolins unless there are also changes in consumer behavior [9]. Emerging evidence also suggests that allopathic medicines are unlikely to become substitutes for wildlife-derived traditional

medicines [10]. Domestication or wildlife farming could also potentially address public demand for these endangered species [11], though wildlife farming has been proposed as a form of demand reduction, despite the increasing evidence that indicates it is not successful in reducing demand, including for pangolins [11,12].

Chinese pangolins (*Manis pentadactyla*) inhabit the Asian countries of Bangladesh, Bhutan, China, India, Lao PDR, Myanmar, Thailand, Vietnam [6], and the mid-hills region of Eastern and Central Nepal [2,8,13,14]. The current population of Chinese pangolins in Nepal is unknown, but the species is considered threatened due to anthropogenic activities, such as poaching for wildlife trade, and habitat fragmentation [2,8,13,14]. It is illegal to hunt and kill pangolins in Nepal under Nepal's National Parks and Wildlife Conservation Act 1973. Currently, the Chinese pangolin occupancy in Nepal is greater in protected areas than in non-protected areas due to the influence of human activities including agricultural practices, poaching, and development, primarily outside protected areas [15]. As a result of its overexploitation and illegal trade [1,5,6], the Chinese pangolin is categorized as Critically Endangered on the International Union for Conservation of Nature (IUCN)'s Red List of Threatened Species [6] and is listed in Appendix I of CITES [16]. In Nepal, the Chinese pangolin is classified as one of the most threatened species due to exploitation, agricultural practices, poaching, and development [2,14], and is protected by national law with all forms of trade banned.

The illegal wildlife trade is heavily influenced by the socioeconomic characteristics of local people [17]. Poor socioeconomic status, including poverty, unemployment, illiteracy, and lacking alternative livelihoods, drive people to participate in illegal wildlife trade [18]. Wildlife poaching activities are increasing at an alarming rate due to the growing demand in consumer markets and the high percentage of poverty in wildlife source areas [19]. Arguably, poorer communities would be less involved in wildlife poaching or trade if there was less of a demand from wealthier communities [20–22].

The primary detrimental factor in illegal wildlife trade is the high profit levels associated with the wildlife poaching [20], driven by wealthier communities [23]. Consequently, wildlife species become increasingly rare as the prices of wildlife parts, derivatives, and products increase exponentially [24]. In many developing countries, the income from illegal trade activities is often vital for sustaining the livelihoods of wildlife traders [23]. Reducing the incidences of wildlife poaching is impossible without elevating the household economies of these poachers [25]. Therefore, mitigating the effects of wildlife trade at the grassroots level should consider fulfilling the short-term goals of local communities [26]. Locals living in close proximity to wildlife thus have more incentives to manage this resource [27]. However, local people lack the luxury of supporting the conservation of wildlife species, as they are fully dependent on the wildlife's resources for their survival [26]. Additionally, indigenous people often associate with or participate in hunting wildlife as a fundamental part of their tradition, culture, or religion [19], and restrictions placed upon their practices are problematic.

Most illegal Chinese pangolin trades from Nepal are known to be motivated by the demand from China. However, specific information on the trade routes from Nepal to other countries, and information regarding people involved in Chinese pangolin trade is largely unknown [28,29]. Effective pangolin conservation requires the identification of trade routes and information on people involved in ongoing trades for developing site-specific management plans and strengthening enforcement. In this study, we aimed to identify existing wildlife trade routes, as well as the socio-economic status of people involved in Chinese pangolin trades to inform conservation management strategies. We expected that the pangolin trade would occur along multiple trade routes to reduce detection by authorities and would be influenced by the socio-economic status of local people, which can vary based on land protection status.

2. Methods

2.1. Study Area

The study area included the protected area (PA) of Gaurishanker Conservation Area (GCA: 27°34′13.97″–28°10′22.06″ N; 86°22′52.35″–86°11′5.25″ E), established in 2010, which covers 2175 km^2,

and the adjacent non-protected (non-PA) Ramechhap district (27 ° 49′55.04″–27 ° 14′44.14″ N; 86°9′0.47″–86°27′7.11″ E), which covers 1546 km² in central Nepal (Figure 1). The GCA ranges in elevation from 1100 to 7134 m above sea level, with land ranging from subtropical forests to alpine and bare rock areas. There are nearly 12,000 households within the GCA [30]. Within the study area, Tamang is the largest ethnic group, representing 25.8% of the population, followed by Sherpa (22.4%) and Chhetri (18.4%) [31,32]. Other ethnic groups include Newar, Thangmi, Gurung, Brahman, Jirel, Kami, Damai, and Sarki. The Ramechhap District has an elevational range of 488 to 6909 m above sea level, and there are 43,883 households within this district [32]. Dominant vegetation in both areas include the sweet orange (*Citrus sinensis)*, the common pear (*Pyrus communis),* the Nepali hog plum *(Choerospondias axillaris)*, the gros feuille (*Litsea monopetala),* and the grey down balsam tree (*Garuga pinnata)*. These areas support threatened mammal species including the red panda (*Ailurus fulgens)*, the Asiatic black bear (*Ursus thibetanus),* the snow leopard (*Panthera uncia)*, the Chinese pangolin, as well as common species such as the barking deer (*Muntiacus vaginalis)*, the small Asian mongoose *(Herpestes javanicus),* the rhesus macaque (*Macaca mulatta),* and the grey langur (*Semnopithecus schistaceus)* [8,33].

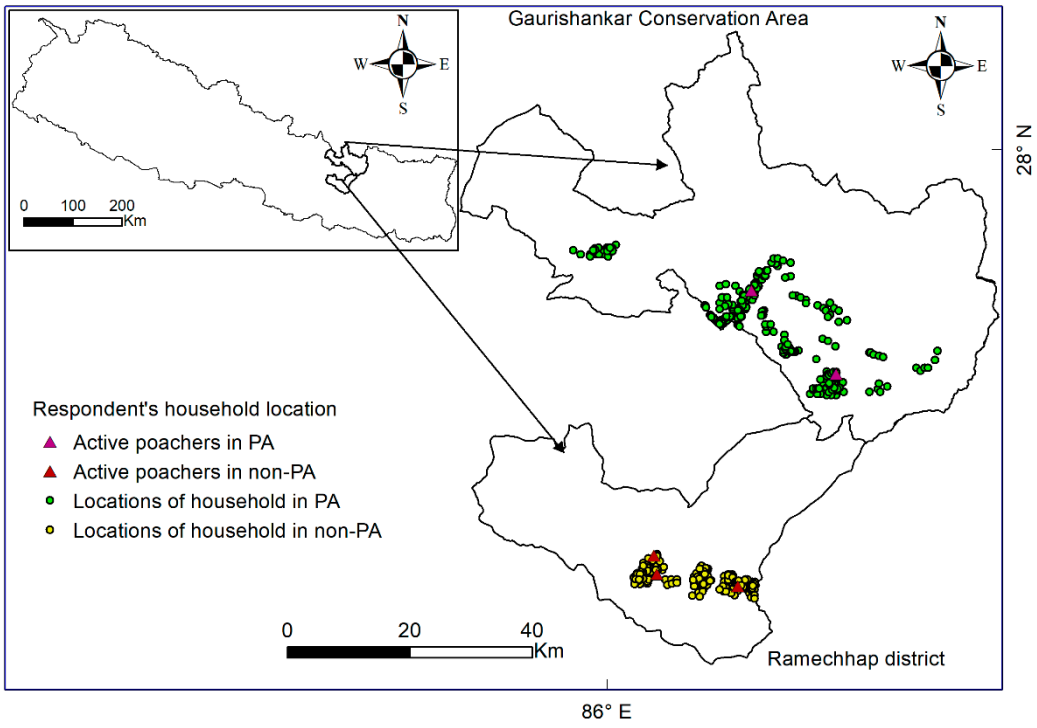

Figure 1. Locations of households (circles) surveyed in central Nepal to characterize the trade of the Chinese pangolin.

2.2. Data Collection

We obtained lists of households within the GCA and the Ramechhap district from rural municipalities. We then determined the sampling size for the number of households selected using Slovin's method ($n = N/(1 + Ne^2)$) with 95% confidence intervals, where n = sample size, N = total number of households available, and e = standard error of sample. Following Slovin's method [34], we determined that a minimum of 388 households from the GCA (PA) and 399 from the Ramechhap district (non-PA) were necessary to obtain a suitable sample size for analyses. Therefore, we considered the minimum amount of samples required to be 400 households from each area in order to conduct a survey using semi-structured questionnaires between October 2018 and April 2019.

We used two sampling approaches to obtain survey information [35]: (1) random household sampling used to gather information about the demographic status of respondents, and (2) purposive snowball sampling from people living in the study area. Though this sampling approach does not

represent the entire population, it does provide detailed information on the socio-economic status of traders involved in pangolin poaching, illegal trade routes used by traders, the price dynamics of pangolin scales from the last five years (2014–2018), and other information related to the poaching and trading of pangolins. We used snowball sampling to maximize information on the poaching and trading of pangolins. Further, we used two questionnaires for our sampling: one contained only questions on demographic status that were completed by all respondents, and a second containing questions regarding the poaching and trading of Chinese pangolins that was completed only by respondents familiar with these issues (Supplementary Table S1). We additionally asked these respondents about the reasons for hunting pangolins, including whether they knew about pangolin trade routes, the price of pangolins, whether pangolin trade was increasing or decreasing, who was involved in the pangolin trade, and whether the respondent was personally involved in the pangolin trade. We determined the price at which pangolin scales had been sold within the last five years from respondents during the purposive snowball sampling.

Purposive snowball sampling was done at the beginning of the survey, whereby the first respondents were selected through consultation meetings with members of local conservation institutions (i.e., the Gaurishankar Conservation Area Project of the GCA and the Divisional Forest Office of the Ramechhap district). The number of households selected for snowball sampling was 225 per area (the GCA and the Ramechhap district, respectively). Due to the sensitive nature of poaching, we signed a letter to ensure them that we would maintain their confidentiality and anonymity to facilitate accurate responses. The remaining households (n = 175 from each area) were selected using random sampling.

We gathered information from respondents over the age of 16 years, and recorded their educational (literate or illiterate (i.e., no formal education), employment (employed or unemployed), inhabitant (indigenous or immigrant) [36], and socio-economic statuses (sufficient income for daily livelihood or not), and sex (male or female).

We then collected information on pangolin seizure from the Gaurishankar Conservation Area Project and the Divisional Forest Office, as well as published news from 2014 to 2018. From seized records, we also obtained information on sex, age group, and ethnicity of individuals involved in the trade, along with the locations and quantities of scales seized. We also interviewed active poachers (N = 5; PA = 2, non-PA = 3) who were previously involved in illegal pangolin trades. All aspects of this study were approved by the Department of National Parks and Wildlife Conservation (Permission number: 564/075-076). We used Fisher's exact test, or the Chi-squared test, and the Kruskal–Wallis test for binary and numeric responses, respectively, to examine the differences in demographics of those within the PA and those in the non-PA.

3. Results

The respondents from the PA and the non-PA had similar demographics and socio-economic backgrounds (Table 1), except for the greater percentage (52.2%) of respondents from the PA who had sufficient income from agriculture alone to support their livelihoods compared to the non-PA respondents (39.9%) (χ^2 = 6.5, p = 0.01). Although agriculture was the primary occupation in both areas, crop production was less common in the non-PA due to the occurrences of more extreme weather (S. Sharma, personal observation).

Table 1. The demographics and socio-economic backgrounds of interviewed respondents from protected (n = 400) and non-protected areas (n = 400) in central Nepal, 2019.

Variable	Protected Area	Non-Protected Area	Statistics
Sex	Female = 48.8% Male = 51.2%	Female = 49.7% Male = 50.3%	Fisher's exact test, two-tailed, p = 0.83
Age (years)	Median = 29	Median = 28	Kruskal–Wallis test, χ^2 = 2.13, p = 0.14
Occupation	Agriculture = 69.1%	Agriculture = 74.1%	Fisher's exact test, two-tailed, p = 0.63

Education	Literate = 86.9% Illiterate = 13.1%	Literate = 84.2% Illiterate = 15.8%	Fisher's exact test, two-tailed, $p = 0.31$
Religion	Hindu = 54.2% Buddhist = 42.3% Christian = 3.5%	Hindu = 56.1% Buddhist = 39.7% Christian = 4.2%	Fisher's exact test, two-tailed, $p = 0.56$ (Christian excluded because of small sample sizes)
Family size	Median = 5	Median = 5	Kruskal–Wallis test, $\chi^2 = 0.9$, $p = 0.34$
Overall income	87.4% sufficient	82.7% sufficient	$\chi^2 = 0.5$, $p = 0.47$
Overall income from agriculture	52.2% sufficient	39.9% sufficient	$\chi^2 = 6.5$, $p = 0.01$

3.1. Characteristics of Traders/Poachers

Respondents stated that most of those who participated in pangolin trades only did so as a consequence of their low socio-economic status, and 49.1% (PA: 56.3%, non-PA: 42%) of respondents knew the traders and poacher's socioeconomic status. Most traders were male (PA: 92%, non-PA: 100%) and were of working age ((PA: 78.2%, non-PA: 100%) between 17 and 40 years old). Most people involved in the pangolin trade were indigenous (PA: 89.3%, non-PA: 96%), unemployed (PA: 92%, non-PA: 94.7%), illiterate (PA: 96%, non-PA: 100%), and lived in poverty (PA: 96%, non-PA: 98.2%). Among the five interviewed active poachers, all were male, unemployed, and poor; four belonged to indigenous groups and were illiterate.

Most respondents did not know why poachers would hunt pangolin (52.9%), although about one-quarter of respondents (25.9%) stated that pangolins were taken mainly for food and money (PA: 15.5%, non-PA: 10.9%); whereas 13.6% respondents speculated pangolin was hunted for food only (PA: 6%, non-PA: 7.6%) or money only (7.6%, PA: 4.3%, non-PA: 3.3%). All active poachers said they were involved in the trade for money.

3.2. Trade Reports

We found 32 (8 in PAs, 24 in non-PAs) arrests regarding the illegal trade of Chinese pangolins from 2011 to 2019. There were 12 times more scales seized from non-PAs (542 kg) than from PAs (45 kg). Men were predominantly involved in the pangolin trade (PA: 75%; non-PA: 94%), and all traders involved were of working age. One of the active traders started in the pangolin trade at the age of 17, and others became active when over 40 years old. People of many ethnic groups were reportedly involved in poaching of pangolin; most frequently, the poachers were of Tamang (non-PA) and Sherpa (PA) groups (Figure 2). Over 68.8% of pangolin seizure cases were reported from non-PAs (Kathmandu: 46%, Sindhupalchowk: 18.8%, Terai region bordering India: 7%, and Nuwakot, Bhaktapur and Sarlahi: 3.1%) and from PAs (Sindhupalchowk border with China: 21.9% and Dolakha: 3.1%).

3.3. Trade Routes and Prices

Though 29.2% of respondents (PA: 21.2%, non-PA: 8%) thought that the poaching of Chinese pangolins had stopped or decreased, whereas 50.9% (PA: 27.9%, non-PA: 22.7%) thought that poaching had not stopped or decreased. From both the PA and non-PA, Chinese pangolins (including the live animal and their scales or skins) were reported traded to China from the Nepal–Tibet border. About 48% ($n = 192$) of respondents identified three illegal trade routes from the PA; of whom (1) 31% ($n = 124$) mentioned the GCA–Lamabagar–Lapchi–China route, (2) 11% ($n = 44$) mentioned the GCA–Sindhupalchok–Tatopani–Kodari–China route, and (3) 6% ($n = 24$) described the GCA–Kathmandu–Kalani/Galchi/Tokha–Betrawati–Dhunche–Rasuwagadi–China route (Figure 3). Four trade routes were suggested from the non-PA: (1) Ramechhap–Kavre–Sindhupalchok–Tatopani–Kodari–China (27% of respondents), (2) Ramechhap–Solukhumbu–Namche Baazar (9% of respondents), (3) Ramechhap–Dolakha–Lamabagar–Lapchi–China (7% of respondents), and (4) Ramechhap–Kathmandu–Kalani–Galchi–Tokha–Betrawati–Dhunche–Rasuwagadi–China (2% of respondents). Only one respondent from the non-PA said they traded pangolin scales through the Ramechhap–

Kavre–Sindhupalchowk–Tatopani–Kodari–China route, whereas other active poachers hesitated to share their illegal trade route.

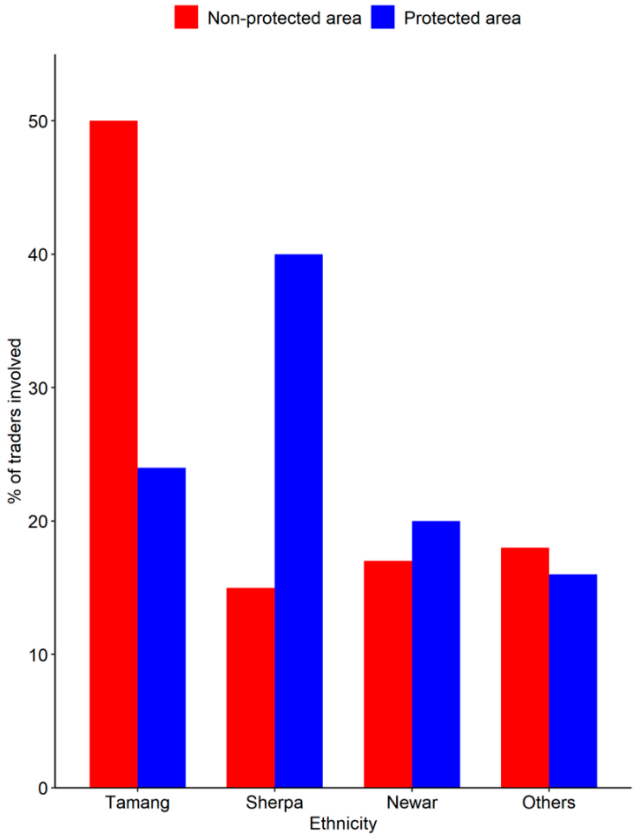

Figure 2. Members of various ethnic groups who were involved in illegal pangolin trades in central Nepal.

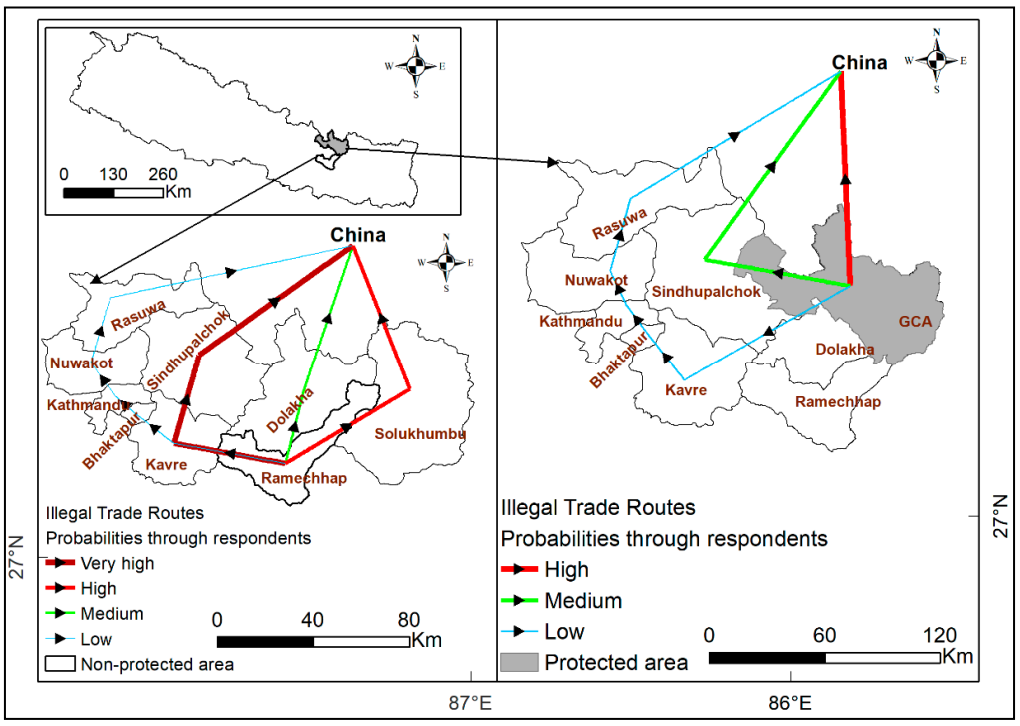

Figure 3. Illegal trade routes for Chinese pangolins and their parts in protected and non-protected areas in central Nepal.

About 22% of respondents (PA: 15%, non-PA: 7%) believed they knew the cost of pangolin scales. They also stated that the price of pangolins scales had increased by 33% in the PA and by 38% in the non-PA between 2014 and 2018. The average reported price in the PA was 12,000 NPR/kg (USD $109/kg) in 2014 and 18,000 NPR/kg (USD $163/kg) in 2018; in the non-PA, the cost per kg of pangolin scales was 15,000 NPR/kg (USD $136/kg) in 2014 and 25,000 NPR/kg (USD $218/kg) in 2018 (Figure 4). One of the active poachers from the PA stated that he sold pangolin scales at the rate of 11,000 NPR/kg (USD $96/kg) in 2011, whereas two active poachers from the non-PA stated that prices for the scales in 2010 and 2011 were 12,000 NPR/kg (USD $109/kg) and 13,000 NPR/kg (USD $114/kg), respectively.

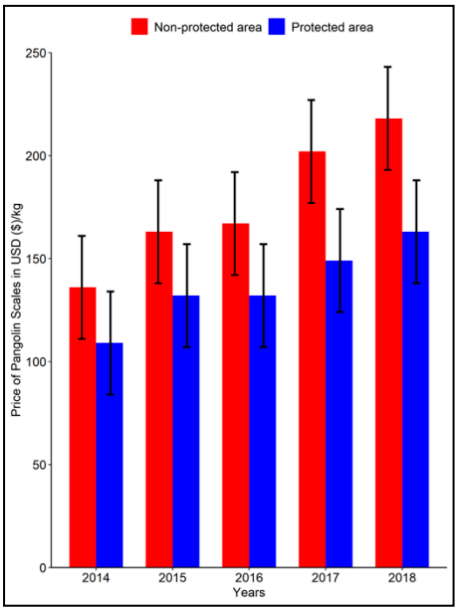

Figure 4. Chinese pangolin scales' price per kg. The price was based on the seized samples between 2014 and 2018.

4. Discussion

The illegal trading of Chinese pangolins in Nepal is influenced by the socio-economic status of traders. Poorer people were more likely to be involved in the pangolin trade, as poaching and selling the animal and their parts contributed substantially to their economic livelihood [37,38], with poverty being a key driving factor of the illegal wildlife trade [25,39–42]. The cost to purchase pangolin scales is lower in Nepal than in other countries such as Myanmar (USD $190–290/kg; [43]), China (USD $759.15/kg), or Vietnam (USD $484.91/kg; [44]). The price, which continues to increase, is likely due to an increase in transits, connections of traders with middlemen, an increasing demand, and an increasing scarcity of pangolins, as their population continues to significantly decline due in part to trade. The higher prices outside PAs might be due to more frequent connections with middle persons who raise prices. However, lower prices reported from people living inside the PA may be because people believe that pangolins are important to ecosystem services [29], which could reduce the perception of the value of pangolin scales. Nevertheless, all reported prices of pangolin scales are high relative to the annual median income of people in Nepal (USD ~$1026; https://data.worldbank.org/country/nepal <accessed on 30 September 2019>), providing further support for people's willingness to become involved in illegal trade. Finally, unemployed people were also engaged in the pangolin trade, as time spent unemployed would allow more time to be spent in these illegal activities [45].

Individuals may also be involved in the pangolin trade for simple sustenance reasons, as eating pangolins can offer a source of protein and selling them can offer an income they may not otherwise have [46,47]. The individuals selling pangolins often use their traditional knowledge of pangolin body parts for medicines; however, the majority of them do not know the reasoning behind these

uses (S. S. personal communication). This type of knowledge lacks in other countries' indigenous people (e.g., the Hmong people in Laos) [48]. Cultural norms in the male-dominated Nepalese society, such as the freedom males have to engage with others without restriction from their family, could explain the greater involvement of men in the pangolin trade [49,50]. In addition, men are generally more likely to admit to sensitive behaviors compared to women [51].

Due to family member expectations for people of working age to contribute economically to household livelihood, people of the working age group may be more likely to become involved in wildlife trade [45]. Consequently, more people of working age in Nepal were involved in the pangolin trade. Similarly, illiterate people of working age in this study were likely involved in the illegal pangolin trade to obtain adequate financial resources to meet basic needs, as suggested by Katuwal et al. [4], due to highly limited employment opportunities [38,41]. Providing more income generating opportunities (e.g., ecotourism) and keeping this revenue within local communities might further motivate people to conserve pangolins. Further, incorporating additional agricultural technologies and animal husbandry practices will also assist in the conservation of pangolins, as most local people already have positive attitudes toward wildlife conservation [52]. In addition, strict enforcement of existing rules and regulations regarding wildlife and an increased awareness of the legal protection status of species might motivate people towards the conservation [52]. Information regarding the legal protection of these species and their conservation could also be integrated into school curricula.

From the results, we found that people from both the PA and non-PA were involved in the pangolin trade, but poachers from each area used different trade routes. Nevertheless, the final destination in Nepal was typically the border to China [4,28,38]. Illegal wildlife trades generally occur through a complicated network of locations and routes to avoid detection before its final destination [53,54], and this was supported by our findings. Likewise, Katuwal et al. [4] found alternative routes for illegal pangolin trade activities, and most traders transported pangolins and their derivatives to the border with China, though the traders may have transported the wildlife products to China through India due to the open border between Nepal and India [55]. Nepali people were banned from crossing the border to China after an earthquake in 2015; consequently and soon thereafter, people began to use the Kathmandu–Kerung route for trading [56]. This may explain the large number of current alternative trade routes we identified in this study. The Kathmandu–Tibet highway has since reopened; thus, traders may again be using this route.

To help mitigate the pangolin trade, we recommend the establishment of community-based anti-poaching units to work in coordination with district-level Wildlife Crime Control Bureau and central-level Wildlife Crime Control Bureau and National Wildlife Crime Control Coordination Committee for working together for enhancing law enforcement. We suggest also including the South Asia Wildlife Enforcement Network in a system to collaborate to reduce wildlife crime among the range countries and trade route countries. Based on this information, we recommend that the Nepalese government take additional steps to control pangolin trade, for example, increasing anti-poaching patrols in areas of known or suspected pangolin trade. These anti-poaching units can establish relationships with local law enforcement officials and people who collectively can inform anti-poaching units of illegal trade as well as increase awareness of illegal activities and promote the need for pangolin conservation.

From our findings, we suggest that the socio-economic status of local people has facilitated illegal pangolin trading in central Nepal. We further found that the higher price of pangolin parts outside Nepal, particularly in China, coupled with the low annual income of Nepali may be facilitating the increased transport of pangolins and their derivatives among an increasing number of alternative routes to the Chinese border. We recommend continued efforts by the Government of Nepal to increase local peoples' income through income-generating sources such as ecotourism, or by providing incentives to promote other local industries. We also recommend more diligent patrolling along reported trade routes and an increase in security along the China–Nepal border to reduce transboundary transportation of Chinese pangolins and their body parts in collaboration with

local people. Finally, reducing the demand for pangolins from within China could reduce incentives for their illegal trade [e.g., 20] and instead promote the conservation of this species long-term.

Supplementary Materials: The following is available online at www.mdpi.com/2071-1050/12/12/4900/s1, Table S1: People's knowledge of illegal Chinese pangolin trade routes in central Nepal.

Author Contributions: Conceptualization, S.S., H.P.S., and H.B.K.; formal analysis, S.S., H.P.S., and H.B.K.; funding acquisition, S.S. and J.L.B.; investigation, S.S. and C.C.; writing—original draft, S.S., H.P.S., and H.B.K.; writing—review and editing, S.S., H.P.S., H.B.K., C.C., and J.L.B. All authors have read and agreed to the published version of the manuscript.

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