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Unravelling the Pangolin Bushmeat Commodity Chain and the Extent of Trade in Ghana

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Abstract Pangolins (Pholidota: Manidae) are frequently hunted as a source of bushmeat in Ghana. However, no information exists with regards to the level of trade of pangolins outside of major bushmeat market surveys in Ghana. The aim of this study was to determine the level of trade among other stakeholders in the bushmeat commodity chain for pangolins in Ghana. Data were collected from 153 stakeholders using semi-structured interviews and direct observation between September 2013 and January 2014. A total of 341 pangolins were recorded to have been traded in this study period. The white-bellied pangolin (*Phataginus tricuspis*) represented 82 % and the black-bellied pangolin (*Phataginus tetradactyla*) 18 % of the observed pangolins traded by the stakeholders. Chopbar operators accounted for the highest retailer sales to consumers. The number of pangolins traded was negatively correlated to the distance between settlements and protected forest regions. The levels of pangolin trade were previously underestimated in Ghana as the pangolin bushmeat commodity chain does not form the supply chain to the major bushmeat markets where most surveys were undertaken. The Wildlife Conservation Act of 1971 (LI 685) that prohibits the hunting of pangolins can be regarded as ineffective and not serving as a deterrent to poaching.

Keywords Pangolin · Bushmeat trade · Commodity chain · Ghana · Conservation

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Introduction

Mammals are regarded as the prime source of bushmeat throughout Africa ((Fa *et al*. 2006; Ntiamoa-Baidu 1987); Fa and Brown 2009; Schulte-Herbrüggen *et al*. 2013a; Schulte-Herbrüggen *et al*. 2013b). One such group of mammals that has long been hunted throughout their range in Africa and consumed for bushmeat are pangolins (Anadu *et al.* 1988; Bräutigam *et al.* 1994; Sodeinde and Adedipe 1994; Njiforti 1996; Caspary 1999; Fa and Gracía Yuste 2001; Conservation International-Ghana 2002; Fa *et al.* 2002; Fa *et al.* 2006; Crookes *et al.* 2007; Bokhorst 2010; Foerster *et al.* 2012; Schulte-Herbrüggen *et al.* 2013a; African Pangolin Working Group 2014; Soewu and Sodeinde 2015). Evidence suggests that the current off-take levels of mammals for bushmeat purposes are unsustainable (Milner-Gulland and Akçakaya 2001; Milner-Gulland *et al.* 2003; Fa and Brown 2009). Various methods have been used to determine the sustainability of harvest with market indices being the most widely used indicator in Africa (Weinbaum *et al.* 2013). Major bushmeat market surveys have been used with relative success to determine the level of hunting pressure in Ghana (Ntiamoa-Baidu 1987; Rowcliffe *et al.* 2003; Crookes *et al.* 2005; Cowlishaw *et al.* 2005a).

While pangolins were identified among the 11 most preferred wild animal species in a survey to determine the bushmeat preferences among Ghanaians (Conservation

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International-Ghana 2002), extensive bushmeat market surveys have failed to record the actual extent of pangolins traded or the turnover rates over time (Ntiamoa-Baidu 1987; Hofmann *et al.* 1999; Cowlishaw *et al.* 2005a, 2005b). Thus far only Crookes *et al.* (2005) recorded one individual pangolin in a survey of a single large bushmeat market in Ghana between January 1987 and July 2002. Conservation International-Ghana (2002) recorded two individual pangolins in their survey of 16 major bushmeat markets in Ghana. The disparity between the lack of recordings of pangolin in bushmeat markets and the high preference for pangolin bushmeat may indicate that pangolins do not follow a typical pattern for bushmeat market in Ghana. The use of market surveys is based on the assumption that all species of concern make it to major bushmeat markets (Allebone-Webb *et al.* 2011; Kamins *et al.* 2011; Weinbaum *et al.* 2013). However, factors including sales at village level, distance to major bushmeat markets, and level of law enforcement influence the volume in these markets and should also be taken into account (Fa *et al.* 1995; Fa *et al.* 2006; Crookes *et al.* 2007; Weinbaum *et al.* 2013). Thus, the existing bushmeat market surveys may be underestimating the impact of bushmeat harvest on the natural population of pangolins in Ghana.

Although the characteristics of the bushmeat commodity chain have been investigated in Ghana (Mendelson *et al.* 2003; Cowlishaw *et al.* 2004; Cowlishaw *et al.* 2005a, 2005b; Bokhorst 2010), no attempt has been made to establish the volume and number of pangolin species traded outside major markets. As all four species of Africa's pangolins are listed as *Vulnerable* by the IUCN (2014), the primary aim of this study was to evaluate the volume and species composition of threatened pangolins that are traded along the bushmeat commodity chain in Ghana with regards to various role players and distances from protected areas.

Materials and Methods

Study Area

We conducted a reconnaissance survey to determine where pangolins are traded for bushmeat purposes outside of major bushmeat markets in Ghana. Based on this survey, 11 study sites spanning five out of 10 political administrative regions in Ghana were chosen: the towns were Nyinahin (A), Tepa (B), Wiaso (C), Konogo (D) and New Edubiasi (E) (Ashanti region), Goaso (F) (Brong-Ahafo region), Assin Fosu (G) and Dunkwa-on-Offin (H) (Central region), Anyinam (I) (Eastern region) and Wassa Nkonya (J) and Wassa Akropong (K) (Western region) (Fig. 1). Within these areas, we collected data from all known markets or bushmeat selling points. Of the study sites chosen, Conservation International-Ghana (2002) identified Konogo, Tepa, New Edubiasi and Goaso, while Osei-Tutu *et al.* (2012) identified Anyinam as major sources of supply of bushmeat. All the study sites fell under the High Forest Zone of Ghana, which is situated in the Upper Guinea Forest global biodiversity hotspot and this region is considered to have a high diversity of flora and fauna (Myers *et al.* 2000). Farming is the primary economic activity within these regions, with cocoa and maize the two most important cash crops and accounting for 95 % of the total harvest value (Ghana Statistical Service 2008). Conversion of land cover for cocoa farming as well as bushmeat hunting are major threats contributing to a reduction in biodiversity in this ecological zone (Ministry of Environment and Science 2002).

Ethics Statement

This study was approved by the ethics committee of the Tshwane University of Technology (REC Ref #: REC2013/05/008) and written informed consent was obtained from all participants interviewed. All data were anonymised to reduce the risk of harm to informants.

Data Collection

Data collection was conducted between September 2013 and January 2014 in order to cover both wet and dry seasons. This period has been described as statistically adequate by Fa *et al.* (2006) based on Fa *et al.*'s (2004) assessment of the efficiency of various methods for measuring the volume of bushmeat extracted and proportion of species traded in west and central African studies. Also, Jachmann (2008a) found this period to coincide with peaks in poaching activity in forested areas in Ghana, with the first peak during the late dry season, prior to the planting season, and the second peak in the middle of the wet season from July through to October, during which time agricultural activities are mostly limited to weeding because most crops are in their growing stage. Data collection focused on farmer hunters (who act as the primary source of bushmeat for the other stakeholders and hunt part-time to supplement their income especially during lean farming periods), wholesalers (who usually operate from their home and buy bushmeat in bulk from the farmer hunters and sell to the retailers), and chopbar operators (who are by far the most numerous group in the chain and operate cafés specialising in traditional meat stews containing bushmeat, domestic meat or fish, and have a substantial number of clientele) (Mendelson *et al.* 2003; Cowlishaw *et al.* 2004; Cowlishaw *et al.* 2005a, 2005b). Commercial hunters were excluded due to the lack of people solely dependent on hunting for their livelihood in Ghana in recent years (Kamins *et al.* 2011; Schulte-Herbrüggen *et al.* 2013a) as well as large urban bushmeat market surveys since they have failed to record pangolins (Ntiamoa-Baidu 1987;

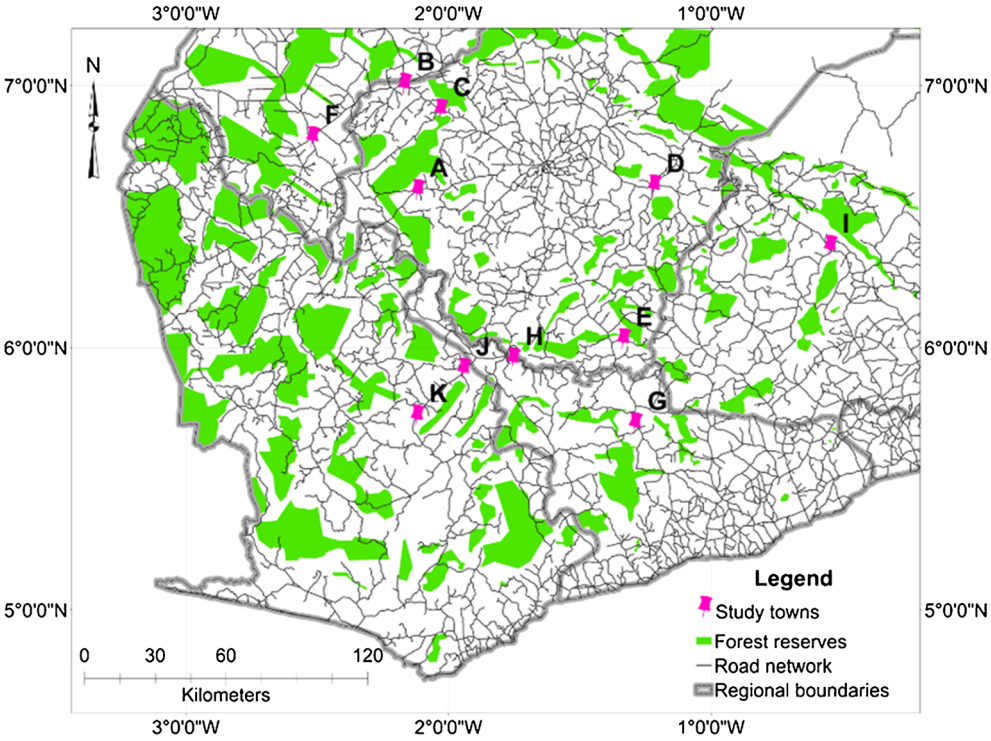

Fig. 1 Map of southern Ghana indicating study towns and protected areas

Hofmann *et al.* 1999; Cowlishaw *et al.* 2005a, 2005b) or have recorded very few (Conservation International-Ghana 2002; Crookes *et al.* 2005). Although the bushmeat commodity chain differentiates between wholesale traders and market traders (who are supposed to operate from stalls in the market), we did not see much difference between their operations at local level since they both operate from their homes and therefore we refer to both as wholesalers in this study. Bokhorst (2010) also found market traders in rural areas act more or less as wholesalers in Ghana.

We employed a purposeful sampling approach, which involves the selection of participants more knowledgeable on the study subject, and a snowball sampling approach, which is the use of a targeted population to recommend other members of that population (Babbie 2004). These approaches ensured that participants who could provide information pertinent to this study were selected as representatives of the bushmeat commodity chain.

We collected data from each stakeholder through a combination of direct observation and semi-structured interviews (as suggested by Cowlishaw *et al.* 2005a, 2005b). A total of 153 stakeholders comprising 84 chopbar operators, 48 farmer hunters, and 21 wholesalers were interviewed. In the majority of small rural communities in Ghana, buyers and sellers converge on a given location and day to buy and sell goods on a periodic basis, commonly referred to as 'market day.' In southern Ghana, a seven-day market cycle is common for many of the markets (Fagerlund and Smith 1970), so we chose this cycle for our study since most hunters usually target market days to sell their produce and may likely recall accurately the number of a particular species that they have killed or traded within a week. Hence, the interview questions focused on the number of pangolins traded by individual stakeholders within a seven-day cycle. Verbal prompts and probes were used to motivate informants and elicit information from them and the pace as well as direction of the interviews was dictated by the participants. Our key questions dealt with: (i) number of pangolins traded, (ii) the hunting technique used for capture, (iii) variation in price, and (iv) availability of storage facilities for trade. Distance from protected forest was also estimated due to the high level of poaching in protected forested reserves in Ghana (Jachmann 2008b). Direct observations were used to verify information provided by the stakeholders through seven-day market cycle visitations. We calculated the turnover rates of pangolins for the different stakeholder groups as the number of pangolins counted, observed or expected to be traded.

Statistical Analyses

All statistical analyses were completed with the statistical software package STATISTICA 12 (StatSoft Inc. 2013). We tested observed and expected pangolins traded among stakeholders using a chi-square test (χ^2). A Kruskal-Wallis one-way analyses of variance was used to test if there were any change in pangolin trade levels between study months. To determine whether distance from protected forest affected pangolin volume traded, we used simple linear regressions and Pearson's correlation coefficient (r) as a measure of the strength of association between the two variables.

Results

A total of 341 pangolins were recorded to have been traded by farmer hunters, chopbar operators and wholesalers between September 2013 and January 2014. Of this number, we physically observed 98 individual pangolins (83 carcases and 15 live individuals) of which 42 were female and 38 were male white-bellied pangolins (*Phataginus tricuspis*), and 10 were female and 8 male black-bellied pangolins (*Phataginus tetradactyla*) (Table 1). The primary route of trade for pangolin bushmeat is from farmer hunters to chopbar operators and wholesalers (Fig. 2). There was also a flow in trade from wholesalers to local chopbar operators, consumers and city wholesalers. Turnover rates were very high with significantly fewer pangolins being encountered than expected within the study period for farmer hunters ($\chi^2 = 107.25$, df = 4, $P < 0.01$), chopbar operators ($\chi^2 = 48.02$, df = 4, $P < 0.01$) and wholesalers ($\chi^2 = 25.70$, df = 4, $P < 0.01$). Most of the wholesalers had a storage facility (fridge or freezer) specifically for bushmeat, while chopbar operators also had largely multipurpose storage facilities. The mean number of pangolins traded by each stakeholder indicates that wholesalers, being the least numerous, had the largest per capita market share.

A significant difference was observed between months based on the number of pangolins traded by stakeholders (KW = 49.540, $P < 0.01$) (Fig. 3). Dunn's multiple comparisons test revealed a significantly lower trade in December 2013 over the other months with the exception of November 2013, and trade levels in November 2013 were also significantly lower than in September 2013.

The distance from protected forest areas from which pangolins are sourced had a pronounced impact on the number of pangolins being traded in that increased distance from these protected areas reduced the number of pangolins being traded significantly for farmer hunters ($r = -0.77$, $P < 0.01$), chopbar operators ($r = -0.61$, $P < 0.01$) and wholesalers ($r = -0.71$, $P < 0.01$) (Fig. 4).

Farmer hunters obtained their lowest price from wholesalers across all study sites (Ghanaian Cedi (GHC) 20, US$ = 9; where US$1 = GHC2.2 at the time of the study) and chopbar operators (GHC30, US$14), and direct sales to consumers, often located on busy roadside verges, were between GHC40 and 50 (US$18–23). Live pangolins fetched a substantially higher price, between GHC80 and 100 (US$36–45) being the highest selling price recorded at Anyinam, however the average prices did not vary much across all study sites. Wholesalers were found to be more selective in their trade with farmer hunters, rejecting badly wounded pangolins or those that had been in snares for long periods; the direct opposite applied for chopbar operators.

With regard to current hunting techniques, wire snares and shotguns were the two widely used methods: 90 % ($n = 75$) and 10 % ($n = 8$) of the observed carcases were killed using wire snares and shotguns, respectively. None of the respondents were aware of the current conservation status of African pangolins, but they were aware of laws prohibiting the hunting of game animals, including pangolin, within the closed hunting season covering the period 1st August to 1st December which fell within the study duration. Respondents attributed the scarcity of pangolins in the bushmeat market to high labour demands on cocoa farms and restrictions imposed on hunting, particularly in protected forests, rather than to a real or perceived decrease in pangolin populations. Furthermore, Forestry Commission staff were perceived by respondents as people who were there to harass them and limit their livelihood opportunities.

Table 1 Number of pangolin species physically observed to be traded by stakeholders

Stakeholder group	Phataginus tricuspis	Phataginus tetradactyla	Total
Farmer hunters	17	3	20
Chopbar operators	33	5	38
Wholesalers	30	10	40
Total	80	18	98

Discussion

Our estimates of numbers of pangolins traded in the bushmeat commodity chain suggest that pangolin harvests have been severely under-reported in previous studies. The pangolin bushmeat commodity chain, which is primarily not geared towards the major bushmeat markets, may explain the under-reporting of pangolin harvesting for bushmeat purposes in Ghana. This finding is corroborated by Kamins *et al.* (2011), who found under-reporting of the African straw-coloured fruit bat (*Eidolon helvum*) in major bushmeat market surveys in Ghana because most of their trade occurred completely outside the formal market. We found chopbar operators to be the dominant retailers in the pangolin bushmeat

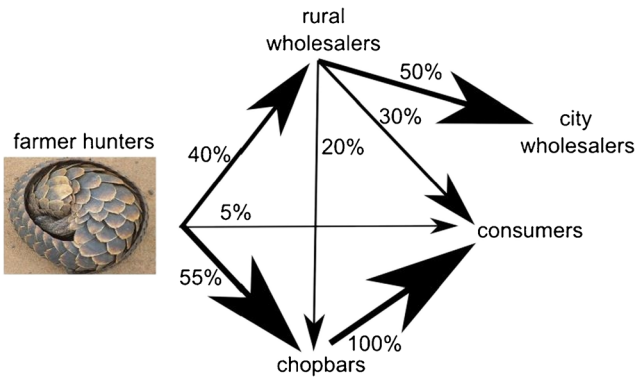

Fig. 2 Trade flow patterns in the pangolin bushmeat commodity chain

trade, accounting for the majority of sales to the public. Our finding corroborates studies by Caspary (1999) and Bokhorst (2010), who also found chopbar operators to be the main intermediaries for the sale of bushmeat in rural areas of Côte d'Ivoire and Ghana, respectively. Mendelson *et al.* (2003) and Cowlishaw *et al.* (2005a) also found chopbar operators to account for the majority of bushmeat sales to the public in urban markets in Ghana. Our findings may therefore suggest that the majority of pangolin trade is not within but outside of major bushmeat markets in Ghana (Ntiamoa-Baidu 1987; Hofmann *et al.* 1999; Cowlishaw *et al.* 2005a, 2005b).

Our per capita market share of wholesalers was consistent with other studies (Mendelson *et al.* 2003; Cowlishaw *et al.* 2004; Cowlishaw *et al.* 2005a; Bokhorst 2010), which also found wholesalers to have the largest per capita market share of the bushmeat trade due to their small number and position in the commodity chain. Cowlishaw *et al.* (2005a) found that availability of storage facilities, such as fridges, limit the volume and sales of stakeholders in the bushmeat commodity chain. However, we found that the majority of wholesalers owned a storage facility (fridge or freezer). This may increase their willingness to buy from sellers and therefore increase the per capita market share. Mendelson *et al.* (2003) found a more rapid turnover for bushmeat among stakeholders in the bushmeat commodity chain due to a lack of storage facilities. The storage capabilities of wholesalers may account for the relatively high number of pangolins in their possession compared to other stakeholders, since they were not under pressure to sell meat before it spoils. With regard to market price, our results are similar to those of Mendelson *et al.* (2003), who found that prices offered to hunters by chopbar operators were higher than those offered by wholesalers, as well as prices for live animals of the same species being twice as high.

Evidence of increased hunting during lean farming periods has been observed in Ghana (Hofmann *et al.* 1999; Mendelson *et al.* 2003; Crookes *et al.* 2007; Jachmann 2008a, b; Brashares *et al.* 2011; Schulte-Herbrüggen *et al.* 2013a). September and October are considered the non-peak season for cocoa production, the main economic activity in our study sites, requiring minimum labour input, while November and particularly December are considered peak seasons requiring high labour (Schulte-Herbrüggen *et al.* 2013b; Mull and Kirkhorn 2005). It seems likely that the high number of pangolins traded in September and October was due to the low labour demands on cocoa farms and thus increasing hunting activities. Caspary (1999) observed a similar trend in that hunting activities increase during the non-peak cocoa months of September and October in the forest regions of Côte d'Ivoire. Similar pangolin trade numbers were found in Equatorial Guinea (Fa and García Yuste 2001) although no explanations for the observed fluctuations were given. Variation in labour demand may also have been a possible cause.

While the potential value of the agricultural landscape or farmbush matrix to indigenous wildlife has been well documented (Cowlishaw *et al.* 2005a, 2005b; Crookes *et al.* 2007; Schroth and Harvey 2007; Cassano *et al.* 2008; Newmark 2008; Schroth *et al.* 2011), wildlife is disappearing from unprotected lands in Africa. Hunters are therefore increasingly focusing their efforts on the nearest protected areas simply because of the availability of more prey (Lindsey *et al.* 2013). We found that stakeholders closer to protected areas traded more pangolins compared to those further away. Our findings are consistent with those of Fa *et al.* (2006), who also found that the numbers of animals traded declined dramatically further away from the Korup (Cameroon) and Cross River (Nigeria) National Parks. Similar results have been observed in Côte d'Ivoire (Caspary 1999), Equatorial Guinea (Fa and Gracía Yuste 2001; Fa *et al.* 2005), Gabon (Foerster *et al.* 2012) and in Ghana (Schulte-Herbrüggen *et al.* 2013b). This hunting in close proximity to protected areas essentially reflects decreased time, effort and costs for hunters to find wildlife (Hofer *et al.* 2000).

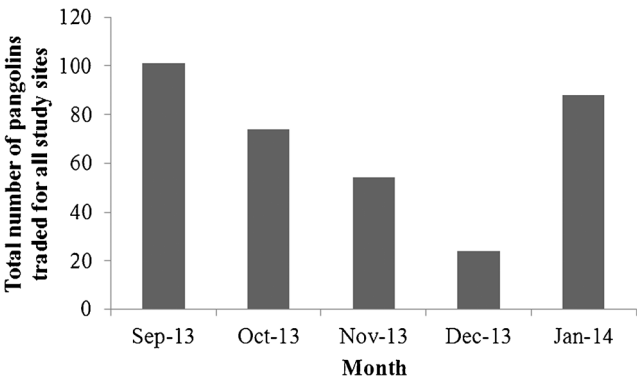

Fig. 3 Total number of pangolins traded for all study sites by all stakeholders in each study month

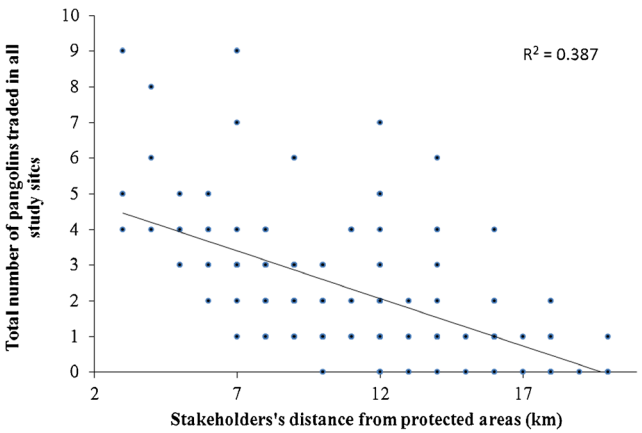

Fig. 4 The negative relationship between the distance from where pangolins are sourced in protected areas and the number traded in all sites by all stakeholders

Conservation Implications

Species, such as pangolins, with slow reproductive rates are at a higher risk of extinction (Johnson 2002) as they are less resilient and able to recover from increased mortality from human hunting pressures (Price and Gittleman 2007). Pangolins are highly susceptible to human-induced local and regional extinction since they have a reproductive rate and recruitment of only one pup per female per year (Kingdon 1971; Sodeinde and Adedipe 1994; Gaubert 2011). The impact of their high harvesting levels for both the bushmeat market and their widespread use as a source of traditional medicine in Ghana (Boakye *et al.* 2015) is compounded by extensive habitat destruction of their natural forest areas and the transformation of these habitats to crop agriculture such as oil palm and cocoa (Angelucci 2013; Asare *et al.* 2014). Furthermore, little is known about their fundamental biological and ecological traits and this knowledge is needed in order to make informed decisions with regards to sustainable levels of pangolin harvesting (Fa and Brown 2009). The reproductive seasonality, maturation, fecundity, feeding ecology, abundance, distribution and ecology of pangolins in African forests are still poorly understood (Gaubert 2011; Challender *et al.* 2014). This information is also urgently required in order to improve our ability to evaluate the impact of hunting and market demand to propose suitable pangolin conservation management actions.

All three species of African pangolin that occur within Ghana, i.e., the white-bellied pangolin (*Phataginus tricuspis*), black-bellied pangolin (*Phataginus tetradactyla*), and the giant ground pangolin (*Smutsia gigantea*), have been listed as *Vulnerable* on the recently revised IUCN Red List (IUCN 2014) and are listed on CITES Appendix II. In addition, the Wildlife Conservation Act of 1971 (LI 685) classifies pangolins under Schedule 1, prohibiting any person from hunting or being in possession of pangolins. This makes all trade in pangolins in Ghana illegal during data collection for this study due to the ban on hunting that was in place between 1st August to 1st December. Clearly, the high volume of pangolins we encountered is an indication that wildlife laws are not serving as a deterrent to the poaching of pangolins for bushmeat purposes in Ghana or are simply not being enforced. The use of snares is illegal for hunting practice in Ghana (Conservation International-Ghana 2002) and the disregard for or poor enforcement of conservation laws in Ghana may also be the reason behind their use for hunting pangolins. According to Fa *et al.* (2005), any wildlife management programme in African forests must address the issue of snares as a hunting technique. Snares are non-selective with regard to species, age and sex (Noss 1998; Fa and García Yuste 2001; Willcox and Nambu 2007) and their ease of acquisition as well as affordability in Ghana (Crookes *et al.* 2007) will allow hunters to absorb replacement costs of snares and operate in more extensive areas. In the forested regions of Ghana, increasing the policing effort in protected areas did not appear to have a significant effect on the incidence of poaching activity as the high incidence of snaring activity remained (Jachmann 2008b). According to Egbe (2001), the perception of communities about exercising their traditional hunting rights is critical to the sustainable management of wildlife but is currently not incorporated into conservation managements plans in Ghana. Placing legislative restrictions without offering alternative sources for traditional uses of bushmeat for food and medicinal purposes that have been an integral part of community members' lives for millennia now poses multiple problems in attempting to impose regulations (Ntiamoa-Baidu 1995; Pailler 2005; Amoah and Wiafe 2012). Moreover, economic and cultural drivers may render conservation laws ineffective in light of conservation agencies' low budgetary allocations, which greatly limit their ability to implement conservation legislation, particularly outside of protected areas (Jachmann 2008a, 2008b). Furthermore, the majority of the communities involved in the exploitation of threatened species are often ignorant about the conservation status of a particular species and the legal consequences of their actions. Until these communities have a better understanding of these legal implications and why they are imposed, they will be less that enthusiastic about changing their attitudes and actions (Ntiamoa-Baidu 1995; Pailler 2005). The incorporation of a conservation education component to sensitize people to the threats facing a species, the need for the protection of the species, and the actions required to ensure the survival of the species is critical to vulnerable species management programmes in west Africa (Ntiamoa-Baidu 1995). Pangolin conservation education programmes should strive to identify the stakeholders in the commodity chain, define appropriate messages for each stakeholder group and develop suitable strategies for the dissemination of information. The impacts of loss of pangolins on traditional or cultural values need to be stressed in defining this conservation message.

Conclusion

Our study reveals that the pangolin bushmeat trade was previously underestimated in Ghana. This is likely due to lack of monitoring within the bushmeat community chain that results in the underestimation of their harvest levels. In light of the current extent of hunting and trading in pangolins, the bushmeat trade should be monitored more effectively and regularly to predict off-take levels. Furthermore, laws are currently in place for the protection of African pangolins in Ghana, but there is a great deal of evidence to suggest that they are ineffective. In addition improving enforcement of these laws, education and awareness creation within the general public with regards to the conservation status of African pangolins

may provide a mechanism towards changing local community attitudes towards their conservation and, in so doing, reduce their harvest.

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Compliance with Ethical Standards

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

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