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Short communication

Quantifying the bat bushmeat trade in North Sulawesi, Indonesia, with suggestions for conservation action

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ARTICLE INFO

Article history:

Received 6 October 2014

Received in revised form 5 January 2015

Accepted 5 January 2015

Available online 10 January 2015

Keywords:

Bushmeat

Conservation initiatives

Flying foxes

Indonesia

Market surveys

ABSTRACT

The intense consumption of flying foxes in North Sulawesi, Indonesia has raised hunting pressure and extirpation is expected to spread into other regions. To assess local cultural attitudes towards bats for formulating a targeted conservation campaign, we conducted a survey of consumption practices of bats in 2013 at the eight major markets near Manado. Locals eat flying foxes at least once a month, but the frequency increases tenfold around Christian holidays. Approximately 500 metric tons of bats are imported from other provinces, with South Sulawesi as the main provider at 38%. No action has been taken to conserve the bats, as continued abundance in the market masks the effects of the bushmeat trade on wild populations. We suggest: (1) engaging churches as conduits for environmental education and quota enforcement; (2) legal regulation of interprovincial trade; (3) substituting bats with a sustainable option; (4) involving local students as campaigners to ensure higher receptiveness from local communities. Grassroots conservation initiatives combined with enforcement of existing laws aim to affect change on a local level, which has been successful in other conservation programs. These efforts would not only progress bat conservation, but conservation of other rare, endemic mammals common to the bushmeat trade.

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1. Introduction

Old World fruit bats (Pteropodidae) are more significantly threatened than other bat taxa, with the highest number of critically endangered species, due to excessive hunting (Mickleburgh et al., 2002; Schipper et al., 2008). This practice occurs in countries with high levels of bat abundance, low levels of food security, and lack of legal regulation, which fits the profiles of many Southeast Asian countries (Jenkins and Racey, 2008; Scheffers et al., 2012). The bushmeat trade favors flying foxes (genus *Pteropus* and *Acerodon*) because of their large body size and tendency to aggregate in large colonies, increasing ease of capture (Mickleburgh et al., 2009). Lengthy reproductive cycles and low reproductive rates make it difficult for flying fox populations to withstand the intensity of the bushmeat trade, eventually leading to local extirpation (Hodgkison et al., 2003). Declines in abundance and diversity of bats, particularly flying foxes, have serious implications for the persistence of many plants that rely on them as seed dispersers and pollinators (Clayton and Milner-Gulland, 2000). Moreover, hunting and consumption of bats raise concerns about public health, as flying foxes are increasingly recognized as natural reservoir

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<http://dx.doi.org/10.1016/j.gecco.2015.01.003>

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hosts for emerging infectious pathogens (Breed et al., 2007). Previous spillover events of Ebola virus and coronavirus in Africa and Asia were caused by increased contact between bats and humans at bushmeat markets (Smith and Wang, 2013). These risks pose a real economic and societal challenge, but may be reduced by increased education. However, before preventative actions can be taken, a clearer understanding of why people consume bushmeat must be acquired.

Hunting of flying foxes has contributed significantly to their decline in Southeast Asia (Breed et al., 2007). The greatest demand for flying foxes stems from North Sulawesi, Indonesia, where they are now locally extirpated (Lee et al., 2005). This intense market force has resulted in heightened hunting pressure throughout the rest of Sulawesi (Brooks et al., 1999; Lee et al., 2005). Of mammalian wildlife recorded by road patrols at the provincial border, large bats were the most frequently encountered in searches of trucks or other large cargo vehicles heading into the province (Lee et al., 2005). Since Lee et al. (2005), no other study of the bushmeat trade in Sulawesi has been conducted and it is anecdotally believed that the trade has intensified but with no quantitative evidence. Despite the listing of all flying foxes as CITES Appendix I or II, they are not considered as threatened by the Indonesian government. CITES promotes nation-specific assessment efforts for threat categorization, but recognizes that, should there be a lack of expertise, the recommended CITES listings should be adopted. Instead, Indonesian law allows the hunting and trading of unprotected animals, including bats, with a legal permit (Law Number 5 year, 1990; Government Act Number 8 year, 1999). There is no legal enforcement, especially at the local level, and the legally mandated quota for inter-provincial trade of unprotected animals by Indonesian Institute of Sciences, (Lembaga Ilmu Pengetahuan Alam, LIPI) and Natural Resources Conservation Agency (Balai Konservasi Sumber Daya Alam, BKSDA) has not been implemented yet (Broad et al., 2003; Shepherd, 2006).

Conservation campaigns for bats in Sulawesi are desperately needed, but previous initiatives failed to consider local culture as part of the solution (Onibala and Lautung, 2007). Successful awareness initiatives would decrease the demand for bats, and reduce pressure overall, as hunters were primarily from North Sulawesi. Some studies were able to quantify the intensity of the flying fox trade in North Sulawesi, but lacked the input of the local villagers (the primary stakeholders) that initiate and sustain the bushmeat trade (Mickleburgh et al., 2009). Understanding local perceptions of bats is essential to successful long-term efforts in conservation and will provide insight on how proposed local legislation may be enforced to ensure local population persistence. In this paper, we report on quantitative and anecdotal evidence of current levels of the flying fox trade leading to declining population size and understand the contributing cultural or sociological factors to consumption in North Sulawesi from the perspective of locals. We used this information to better inform and design future conservation strategies.

2. Material and methods

Manado, the capital of North Sulawesi province, Indonesia, is the center of the high intensity bushmeat trade in Indonesia. The predominantly Christian population is not prohibited from eating wildlife like bats and boar, unlike other parts of Indonesia where a majority of people are Muslim and must observe halal dietary restrictions (Lee et al., 2005). Eight markets scattered throughout the province represent the trading hubs for bushmeat: Karombasan (PK) and Beserhati (PB) in Manado; Airmadidi (PAi) in North Minahasa; Tomohon (PT), Kawangkoan (PKa), and Langowan (PL) in Minahasa; and Amurang (PA) and Motoling (PM) in South Minahasa (Fig. 1). Using a questionnaire modified from Harrison et al. (2011), a total of 71 respondents (31 vendors and 40 consumers) were interviewed from January to February 2013. The questionnaire was modified to reflect the different ethnic groups that occur in Sulawesi and conducted in the local dialect of the respondent. We removed hunter-related questions and focused on interviewing vendors and buyers directly at the market because hunters were in other provinces where there are flying fox colonies at the time of this study. Detailed information on hunting methods was not the focus of this study.

We defined a “vendor” as a person selling the bats at the market and a “consumer” as the person who came to the bat vendors and wanted to buy a bat—all were asked the same set of questions. Every person was asked if he or she wanted to be interviewed and we only approached available consumers for interviews. No incentive was given to the respondents and questioning was not met with any resistance, so answers were considered to be truthful. We recognize that the number of respondents may be too small for any significant statistical analyses, but that is the total number of vendors in the entire trade network at the time of this study. We therefore supplement quantitative evidence with anecdotal evidence regarding attitudes towards flying foxes and population trends volunteered by the respondents. Respondents also volunteered additional information the relation of the bushmeat trade to religious events, the market network, and methods of preparing bats. Some of the vendors have sold bush meat for over ten years, including a vendor in PK who was able to provide a detailed history of the flying fox trade since he was one of the first bat vendors.

In a precursory awareness survey (Appendix 1) in August 2013, we interviewed 15 individuals from each group (local villagers and local university students) to assess the level of flying fox knowledge and provide a basis for determining whom to approach to act as local ambassadors. These were new questions that were created in Bahasa Indonesian and translated to English for this manuscript. We asked every previously identified consumer if they were available to be interviewed as local villager respondents. The interview was conducted in the local dialect and questions were modified according to local daily conversational practices to avoid potential biases. Students were chosen at random from the biology program at Sam Ratulangi University. Fisher’s exact test was used to test for significant differences in levels of knowledge between the local villagers and university students. As the student group learned about ecology and conservation in university classes prior to this study, this group was expected to know significantly more about bats and conservation compared to local villagers.

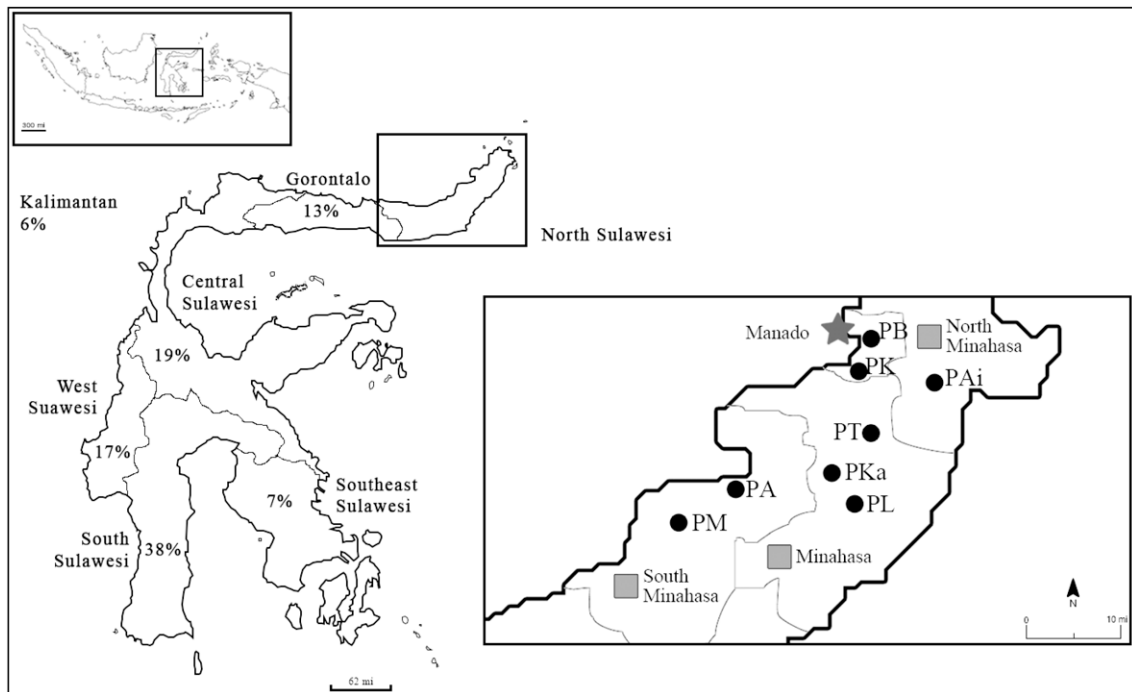


Fig. 1. Locations of eight major bushmeat markets in North Sulawesi province, Indonesia, as indicated by large black circles and survey results of percentages of imported bats from other provinces. The three squares indicate the regency name, with Manado regency highlighted by a star.

Their higher level of knowledge would indicate the utility of education as an awareness tool and identify if there would be a difference in using the students as ambassadors for a flying fox conservation program.

3. Results

3.1. Local history of consumption

According to anecdotal evidence, the consumption of flying foxes, locally called *paniki*, has been in North Sulawesi culture for decades. Before the bushmeat market existed in its current form, local villagers often hunted flying fox for private consumption using guns. Due to the economic rewards from selling bats, some became vendors and sold them in traditional markets starting in the 1970s. The ease with which bats could be obtained increased the spread of consumption to its current levels, making it available even at some modern supermarkets in Manado (*pers. obs.*). Anecdotal evidence from the vendors suggests that Kalimantan (Borneo) is a more recent source of flying foxes since it was not previously known as a source, and only comprised a small percentage of total flying foxes sold in the North Sulawesi market. However, the exact location of the source in Kalimantan is unknown and requires further investigation. Kalimantan has its own flying fox trade (Harrison et al., 2011) and it is possible that the trade is expanding. The trade of wild boar and pythons from Kalimantan to North Sulawesi would provide ample opportunity for the transport of flying foxes as well. The constant, massive influx of bats from other provinces causes most vendors and consumers to think that the number of bats in the market has remained the same throughout the decades, with a few even believing that bat populations were increasing. This corroborates findings from other studies that suggest an increase in the supply of flying foxes since 2004 from external areas (Lee et al., 2005).

The two native species of flying foxes sought in the traditional markets are *Pteropus alecto* (Temminck, 1837) and *Acerodon celebensis* (Peters, 1867). The two are easily distinguishable from one another based on their different sizes and coloration. A third gray–white species was described by 10% of respondents, though none were found in the market and villagers were unable to provide an estimate of size, therefore species identity could not be confirmed. Some villagers described this species as a smaller and incredibly rare bat while SMT was on collecting expeditions in 2012, and could potentially be *Neopteryx frosti*. Its rarity and some of the local villagers' belief that it is a “bat god” (a spiritual being of sorts due to its unique coloration) makes it very unlikely that it will be found in markets by chance. All flying foxes found in North Sulawesi markets originate from other provinces, with South Sulawesi indicated as the main import source by 38% of the vendors in the questionnaire (Fig. 1). The only bat colonies found by SMT in northern Sulawesi during other collecting expeditions were in the neighboring province of Gorontalo. Local villagers at the source populations rarely eat flying foxes since they are Muslim and believe that consumption is not halal. Almost all the flying foxes were already dead by the time they reached the market, with the exception of Beserhati, where live bats from Gorontalo were sold. All bats were roasted to diminish the amount of hair, and

then the mammary glands and fat layers around the neck were removed prior to selling. Bats could be prepared in two ways: (1) seasoned with coconut milk and a bundle of spices called *rampa daun* (lemongrass, basil, pandanus palm leaf, turmeric leaf, lemon leaf) or (2) fried with chilli in the common *rica rica* style in Indonesian cuisine.

3.2. Consumption survey results

From the survey results, we found that local ethnic groups have the strongest ties to bushmeat consumption, particularly the Minahasa and Sangir tribes, which constitute the majority of vendors (97%) and buyers of flying foxes (85%). North Sulawesi is one of the few provinces in Indonesia with a Christian majority, and individuals strongly maintain their identity by using different religious beliefs as indicators. One way in which this difference manifests itself is through the lack of dietary restrictions for Christians, and the consumption of bushmeat is seen as reinforcement of one's identification as part of the group.

Locals believe that during holidays or other special occasions (e.g. birthdays, weddings), they should serve several types of "unique meat" (*daging unik*) to enliven the atmosphere. Despite its name, "unique meat" belies the level of abundance and ubiquity at which it occurs in the market. "Unique meat" encompasses any kind of meat not available through domestication (e.g. beef, pork, chicken, duck) and refers to wild animals such as: endemic black macaques (*Macaca nigra*), pythons from Kalimantan (*Python reticulatus* or *P. curtus*) (Stuebing, 1991), water monitors (*Varanus salvator*), Sulwaesi wild pigs (*Sus celebensis*) (Milner-Gulland and Clayton, 2002), and Bornean bearded pigs (*Sus barbatus*). Species are valued by rarity, and occasionally available in the market in limited quantities. Flying foxes are commonly found in the market, making them considerably cheaper and more accessible than these other types of "unique meat". The price of other bushmeat varies from Rp 20,000 to 60,000 (US\$2.00 to \$6.00), depending on the season, market, and availability of stock. These "unique meats" can only be found in North Sulawesi, making it the iconic local delicacy of the province.

According to the vendor survey responses, approximately 30–50 kg of flying foxes are sold each day, with an increase to 100–300 kg on Saturdays and Mondays. The average weight of *P. alecto* is 674 g (Churchill, 2008), equivocating that to about 45–75 individuals sold per day and 150–445 individuals sold during the Saturday and Mondays. Flying foxes are sold both by weight and by individual with a high variance in price (Rp 7500–45,000 or US\$0.75 to \$4.50) corresponding to individual size. All of the vendors indicated in the responses that they earned over Rp 30,000,000 (~US\$3000) annually, and this was the major form of income for them. Though they also stated that exact amounts were difficult to recall and may vary between vendors, by their estimates, they had a net income of Rp 50,000,000 (~US\$5000) annually. Exact financial data were not available from Harrison et al. (2011), but in both their study and ours, selling flying foxes was the major source of income for vendors (Harrison et al., 2011). Comparison to prices in the past cannot be made, as Lee et al. (2005) did not address income earned.

Peaks in bat trade coincide with special occasions, potentially reaching 300 kg/day. The highest intensity is in December as part of Christmas and New Year festivities (60%–70%). While more people consumed a single bat daily, the overall volume of bats consumed was higher during religious celebrations (Table 1). Significant increases in consumption coinciding with holidays suggested that peak consumption was tied to celebration of religious events, as respondents cited the holidays specifically. A secondary peak occurs during the months of June through August, which coincides with local celebrations of Blessing Day (*Pengucapan Syukur*), a traditional harvest holiday with varying dates between areas. A minor increase in consumption may also occur around Easter. Locals also believe that eating the liver and heart of flying fox can cure asthma. Very few people were deterred from eating bats due to their smell or appearance and viewed bats as a reliable protein source. Local villagers consider flying foxes clean animals because they live in the forest and only eat fruits. All respondents eat bats at least once a month and showed no preference towards any particular sex or species for consumption (Table 1). The local villagers expressed that they would not feel any negative feelings, such as anger or disappointment, if they could not eat bats, but it is normalized in their current behavior because it is so readily available. Because of this availability, locals are unaware of the impact of consumption on natural habitats.

3.3. Awareness survey results

Based on the awareness survey, local villagers have a significantly different understanding of the bats as compared to university students (Fisher's Exact Test, $p < 0.05$) (Fig. 2). Students are aware of the ecological role of flying foxes, and express that it was important to initiate conservation action, whereas the locals do not. However, students do not know very much about the specifics of the species nor the bushmeat trade (importing mechanism, severity of trade, impact of hunting, number consumed). Neither group has any awareness of the potential disease risk that the bushmeat trade poses.

4. Discussion

The bushmeat trade that previously existed only on a local level increased in intensity over the past few decades and developed into a sophisticated multi-province trade network. The markets in North Sulawesi are connected via a distribution network, with Tomohon, Langowan, and Motoling at the center as supply hubs for other markets by receiving bats from external sources directly. Tomohon established itself as the main market by maintaining a stockpile of bats as inventory. There is no precise pattern for trade between markets, making yearlong roadblocks unlikely to be consistently effective. As

Table 1

Consumption survey results with consumers as respondents. For responses related to uses and peaks of bat consumption, respondents could choose more than one answer. In other questions, respondents were only able to choose one answer. The largest response category for each question is highlighted in bold.

		# of respondents	%
(a) Uses	Daily consumption	30	57
	Special event	17	32
	Catering/restaurant	6	11
(b) Consumption intensity	1–3	16	40
	4–6	7	18
	7–9	4	10
	>9	4	10
	Variable	9	22
(c) Sex preference	Male	4	10
	Female	1	3
	No preference	35	87
(d) Species preference	<i>P. alecto</i>	8	20
	<i>A. celebensis</i>	3	8
	No preference	29	72
(e) Peaks of bat consumption (according to sales by vendors)	January	3	7
	April	0	0
	June	4	9
	July	7	16
	August	1	2
	December	29	66
(f) Peaks of bat consumption (according to buyers)	January	3	5
	April	5	9
	June	2	4
	July	9	17
	August	0	0
	December	35	65

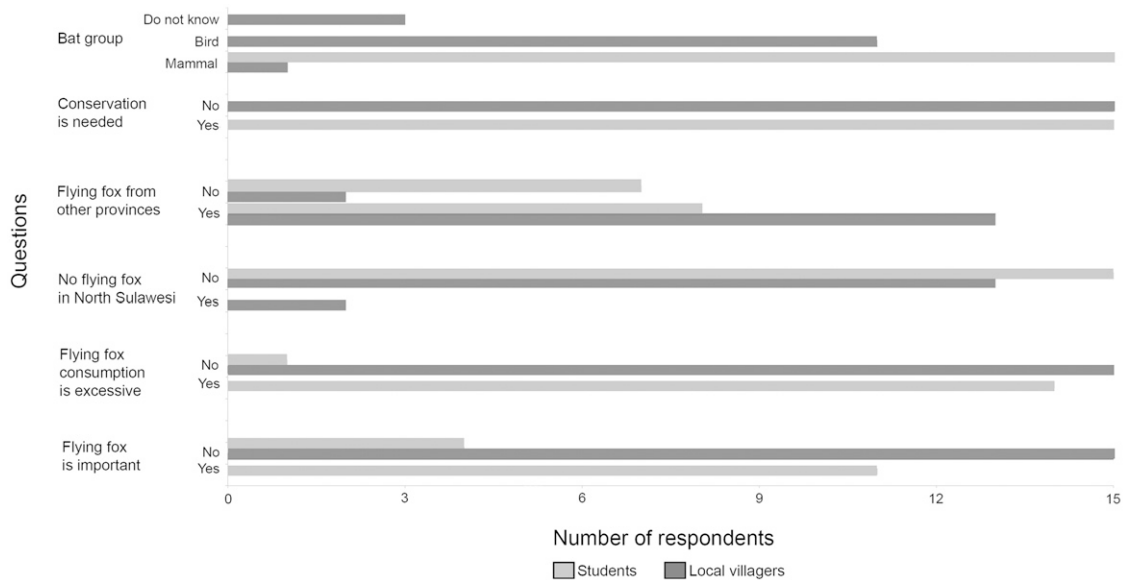


Fig. 2. Responses to questions from precursory awareness survey of local villagers and university students.

previously discussed here, most bats are unprotected by law, but hunting and trading can only be conducted with a legal permit (Law Number 5 year, 1990; Government Act Number 8 year, 1999). However, there is no legal enforcement to ensure hunters and traders have permits. Furthermore, the legally mandated quota for inter-provincial trade of unprotected animals set by LIPI and BKSDA has not been implemented yet (Broad et al., 2003; Shepherd, 2006). The BKSDA in North Sulawesi, which acts as the executor for the quota focuses mostly on endemic animals, and the enforcement of trade of other animals was a lower priority. Cooperation with BKSDA to implement the quota for unprotected species, such as bats, is a crucial

step for establishing proper conservation management in North Sulawesi. Focusing conservation efforts on hub markets can improve efficacy of conservation efforts given limited available resources and educators at the start of the campaign, since they may provide the greatest gains if conservation efforts are successful.

Encouraging hunters to release females is very important to maintaining the reproductive capacity of remaining populations. Juveniles caught accidentally should be raised and rehabilitated, though there are no available facilities to do so presently. Lee et al. (2005) reported similar patterns of trade in other endemic mammals, and suggested legal recommendations and research efforts that have not materialized in the past decade. Placing some level of risk (e.g., a fine) on the traders may discourage them from partaking in importing bats, which currently has no risk involved at all.

Alternative sources of income for locals are needed for successful implementation of bat conservation initiatives not only in North Sulawesi, but in other provinces as well. In Jatinegara Market, Jakarta, *Pteropus vampyrus* (the large flying fox) is sold at much lower quantities (15 individuals per day) but at much higher prices (Rp 300,000, or US\$30). The bats are bought only occasionally for medicinal purposes, as buyers believe that consumption of the liver can treat asthma (Croes, 2012). In Kalimantan, the sale of bats constitutes 81%–100% of the income of most vendors (Harrison et al., 2011). There are other animals that can be sold, but because acquiring bats has such low risk involved (e.g. no law enforcement against unsustainable harvesting), it is an attractive economic opportunity for locals. Substituting bats with other forms of sustainable meat is an important step for conservation. Prohibiting the sale of bats without an alternative income source for vendors will cause resistance against any conservation programs.

We also propose the following grassroots approaches to conservation and raising awareness based on what we have learned of local culture:

1. Church engagement—All respondents were Christian and peak consumption corresponds to Christian celebrations, suggesting that the practice of eating flying foxes is tightly connected to the religion. Religion plays a large role in the daily lives of North Sulawesi people, and is a large part of their personal identity. By collaborating with churches and priests, we can slowly introduce sustainability education to older people who would not be exposed to it otherwise. Setting a specific quota per month through the church may be a way to more effectively and immediately introduce limits than through legal enforcement. Introducing environmental awareness as part of the Sunday school curriculum is a good way to introduce conservation to children as well. Conservation initiatives will have to start with very general concepts such as the benefits of forests and wildlife. The church can promote real action as a sign of piety instead of just rhetoric by encouraging people to reduce consumption of bushmeat, actively learn about the environment, and protect their forests.
2. Student ambassador programs—Conservation programs must engage students from local universities as ambassadors to remote villages, where hunting may persist, to establish levels of trust necessary for long-term conservation efforts to succeed. Any outside intervention may be a trigger for conflict, as it could be perceived as an attack on their Minahasan identity. Local students are interested in acting as conduits for environmental education campaigns, but many do not have the means to access information about the issues. Most students speak the local dialect, and can effectively communicate with people in rural areas, but they do not speak English at all. All information must be presented to them in Indonesian, meaning there must be a training seminar first by an Indonesian expert, of which there is only a handful at present. This gathering is also a good networking opportunity for the students, some of whom expressed an interest in working with bats but lacked mentorship at academic institutions.
3. Meat substitution—Locals are willing to accept captive-bred bats as a replacement for wild bats. However, breeding bats for commercial markets has never been attempted and many challenges exist before this option may even be considered. Wild boar or snake meat cannot act as a substitute, since they are imported from Kalimantan and also threatened by overhunting. Currently, the primary substitute for bats is feral dogs and cats, which are also considered “unique”, and already sold by vendors in the markets. These animals are more easily bred and may be the only sustainable options in the future. With the increasing demand for “unique meats”, the vendors of flying fox may need to switch to selling dogs and cats, since it is the only form of “unique meat” that can be farmed in some manner to maintain the supply needed to meet demand. Access to a reliable source for this shift in the type of “unique meat” sold will need further research.
4. Local conservation initiatives—While we agree with the need for government intervention, efforts at a national level are part of a long-term strategy and will likely be too slow to have an immediate impact on bat populations. Involving local villagers and considering their culture will make conservation efforts less interventionist and likely be better received by the community it impacts. Examples can be made of *Selamatkan Yaki* (“Save Yaki”) and the *Alliance for Tompotika Conservation* (AITo), both organizations that have achieved success in integrating conservation training with sustainable growth of local communities (Hilser, 2012; *Alliance for Tompotika Conservation*, 2011). Both cooperate with forestry departments and the local people to enforce environmental protection (Melfi, 2010). Cooperation with initiatives in other provinces is also important, as they too need to understand the value of the bats to protect them from North Sulawesi hunters. In areas where flying fox colonies still persist, it may be beneficial to pursue the establishment of small, locally managed special conservation sites (e.g. Baral et al., 2014).

5. Conclusion

Our suggestions for conservation action focus on low-cost intervention methods to encourage involvement by Indonesians. Putting new laws in place are part of a long-term strategy, but there are already some that must be properly implemented to benefit bat conservation. Our approach aims to decrease demand gradually to relieve hunting pressure, while

also placing protective measures for the few remaining large colonies. Conservation action for flying foxes may have the effect of benefitting endemic mammal conservation overall in Sulawesi. Sulawesi remains a relatively poorly explored island, and the bushmeat trade threatens species that are likely unknown to science as well. The desire for “unique meat” is not restricted to flying foxes, and the more the locals understand the connection between the health of the ecosystem to their own well-being, the greater the chance animal populations have of persisting.

Acknowledgments

We thank all participants who kindly shared their experiences with bats and partook in this study, and Auren Andaluisa Erfina who acted as the local translator. We are grateful for comments from Yasman, Dimas Haryo Pradana, Felicia Lasmana, and two anonymous reviewers who have greatly improved this manuscript. All research protocols were approved by Universitas Indonesia. Funding for this study was provided by the Nagao Natural Environmental Foundation Programme to Sheherazade, the Fulbright Student Research Fellowship and American Indonesia Exchange Foundation to SMT, and in part by the American Philosophical Society through the Lewis and Clark Fund for Exploration and Field Research to SMT. Funding sources did not have any involvement in the research conducted.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at <http://dx.doi.org/10.1016/j.gecco.2015.01.003>.

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