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Know Your Monkey: Identifying Primate Conservation Challenges in an Indigenous Kichwa Community Using an Ethnoprimatological Approach

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Ethnoprimatology · Hunting · Ecuadorian Amazon · Folk taxonomy · Pile sorting

Abstract
Increasing pressure on tropical forests is continually highlighting the need to find new solutions that mitigate the impact of human populations on biodiversity. However, developing solutions that can tackle the drivers of anthropogenic pressure, or at least take them into account, hinges upon building a good understanding of the culture and perceptions of local people. This study aims to provide an overview of the ethnoprimatology of an indigenous Kichwa community in the Ecuadorian Amazon that maintains a traditional lifestyle but also has good access to markets. We examine whether primates are seen as a distinctive group and their relative importance as sources of bushmeat and as household pets. Pile-sorting exercises revealed that although locals generally group members of the order Primates together, tree-dwelling non-primates including sloths, coatis, kinkajous and tamanduas are also frequently classified as 'monkeys'. The perceived importance of primates to the forest and the community lay more in their potential as bushmeat, and only 1 respondent identified an ecological role for the group in terms of seed dispersal. Gaining a better understanding of local perceptions will allow for better-informed conservation decisions that are more aware of potential impacts and are more likely to gain community support.

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Introduction

Interactions between humans and non-human primates have a long history, but the need to characterize them and understand the potential benefits and disadvantages to both parties is becoming increasingly important. Recent human population increases and rapid expansion into previously undisturbed forests is consistently augmenting the intensity of interactions and expanding their scale [Fuentes and Hockings, 2010]. The combined threats of hunting and habitat loss have led to widespread primate population declines [Marshall et al., 2010; Wilkie et al., 2011; Benchimol and Peres, 2013], regardless of whether exploitation was on a commercial [Refisch and Koné, 2005; Kümpel et al., 2008] or subsistence scale [reviewed in de Thoisy et al., 2009]. Stemming species losses requires a good understanding of the motives behind interactions as well as their effects. To this end, ethnoprimatology is a subdiscipline of primatology which aims to understand the relationships between humans and primates from both perspectives. It takes into account conservation's recent trend towards developing solutions that consider the drivers of behaviour as well as the rights of local and indigenous groups and their dependency on the surrounding environment [Nekaris et al., 2010; Riley, 2010; Riley and Fuentes, 2011; Alexander et al., 2014]. There is evidence that conservation interventions which understand traditional values and beliefs are more successful [Waylen et al., 2010] and avoid worst-case scenarios where insensitive interventions alienate locals from the conservation message [Klein et al., 2007].

In the Neotropics, primates are under pressure from forest clearance and fragmentation [Cristóbal-Azkarate et al., 2005; Benchimol and Peres, 2013], hunting [Peres, 1990, 1999a; Parry et al., 2009], and tourism [de la Torre et al., 2000; Grossberg et al., 2003; Treves and Brandon, 2005; de la Torre, 2014; McKinney et al., 2015]. Studies which attempt to understand these relationships from the perspective of those exploiting and living in tropical forests currently exist for a number of indigenous Amazonian groups [Cormier, 2002; Lizarralde, 2002; Cormier, 2003; da Silva et al., 2005; Parathian and Maldonado, 2010; Papworth et al., 2013] though so far there have been no studies published on the ethnoprimatology of Kichwa communities, despite them accounting for a significant percentage of Amazonia's indigenous population (for example, just over 71% of Ecuador's indigenous population in the 2010 census [INEC, 2012]). This paper aims to address this gap and to provide insight into the attitudes toward and use of primates in a specific community that maintains many aspects of a traditional lifestyle but also has good access to markets and has taken part in a conservation programme aiming to curb the community's use of bushmeat. Considerable improvements in infrastructure and limited connection to the Internet in 2013 have opened the community to multiple outside influences, and assessing the impact of these developments on traditional knowledge and viewpoints will be important for future conservation planning.

Specifically, our paper aims to document the importance of primates as targets for bushmeat hunting in relation to other species, the scale of capture of individuals to keep as pets, and whether primates are acknowledged to play an important role in the ecology of the forest. In addition, it will investigate whether primates are recognized to form a distinct group in the community's folk taxonomy of mammals. Existing folk taxonomies for Neotropical indigenous communities repeatedly show a general distinction between arboreal and non-arboreal mammals [López et al., 1997;

Valenzuela, 2000; Koster et al., 2010], and occasionally include a third division where terrestrial mammals are split into those that burrow and those which do not [Valenzuela, 2000]. However, while these classifications appear to be broadly conserved, the animals included under each category can vary. In particular, animals classified under an arboreal group are frequently given the blanket designation of *mono* (monkey), regardless of whether they are classified as primates under western taxonomies. Kinkajous, olingoes and tayras have all been included in 'monkey' groupings [Lizarralde, 2002; Urbani, 2006; Papworth et al., 2013], which can potentially create confusion when researchers ask about the perception of primates if there is a mismatch between the definitions of western taxonomies and folk taxonomies. These animals are rarely under the same hunting pressure as monkeys in the western sense of the word, so it is important to consider whether they are included in perceptions of monkey populations and hunting preferences. Folk taxonomies are usually derived using pile sort data [López et al., 1997; Koster et al., 2010; Papworth et al., 2013], whereby participants are asked to place a set number of taxa into groups which they perceive as containing animals that are similar. One of the caveats of the most commonly used pile sort analyses is that they are sensitive to missing data [Himmelspach and Conrad, 2010], and therefore require the researcher to use only species that will be recognized by the majority of participants, or will ask participants to sort animals which they do not recognize. The latter may be particularly problematic if the folk taxonomy of the community is based upon non-morphological characters, such as diet or the time of day during which a particular animal is active. In this paper, we use analysis from social networks to overcome this caveat, allowing participants to only make classification decisions about animals that they recognize.

We hope this information can make a positive contribution towards future conservation planning in the community: firstly by achieving a better understanding of which species are under the greatest pressure as a result of hunting and the pet trade; secondly by discovering whether knowledge of the important role of primates in maintaining healthy forests as key seed dispersers is widespread, and finally by seeing whether perceptions of population change could potentially act as barriers to gaining support for conservation interventions.

Methods

Study Community

San José de Payamino is an indigenous lowland Kichwa community situated in the buffer zone of the Sumaco Biosphere Reserve in the Ecuadorian Amazon [Valarezo et al., 2001] (fig. 1). It currently consists of approximately 60 households, which are split between the village centre and the 16,800 ha of lowland rain forest owned by the community as a result of ancestral land rights granted in 1980 [Oldekop et al., 2012]. Access is via a 22-km unpaved road (completed in 2007) from the nearest market town of Loreto, or a 3-hour motor canoe journey from the town of Coca (Puerto Francisco de Orellana) on the Payamino River. Each household, aside from a small minority who live solely in the village centre, owns a finca (farm) with a small number of chacras (small clearings) for subsistence agriculture and small-scale commercial crop growing (mainly cocoa, coffee, maize, naranjilla and plantain). Though the community has exclusive extraction rights over the wildlife and forest resources in its territory, Ecuadorian national law limits legal fishing and hunting of bushmeat on land held by indigenous communities to subsistence use only. Logging is currently limited to that which is needed for the construction of houses and canoes, and that ensuing from a slash and burn agricultural regime. In

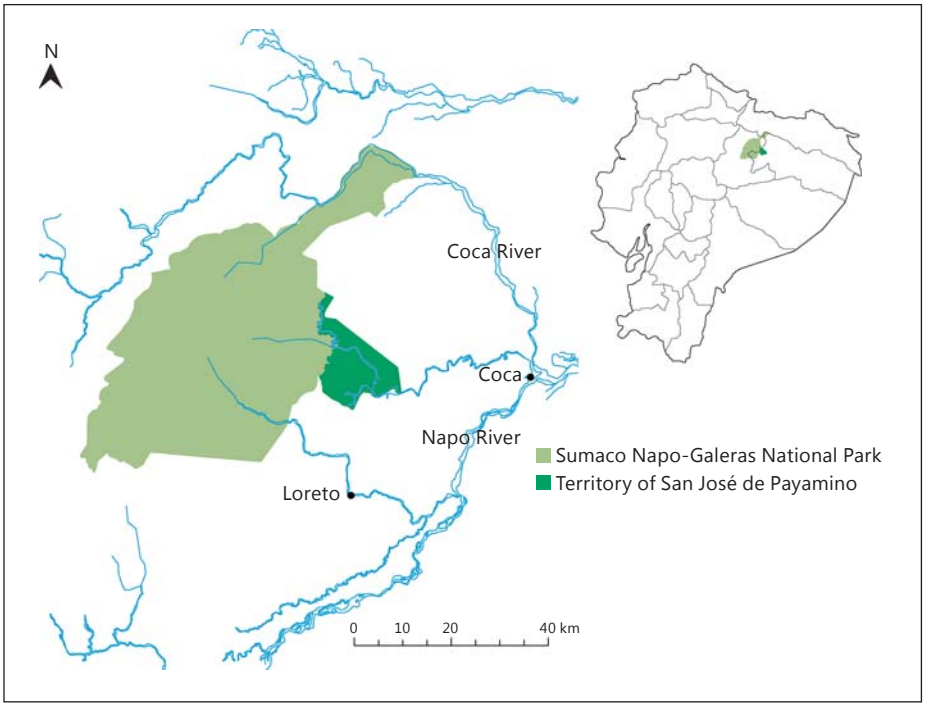

Fig. 1. Location of Payamino's territory, Sumaco Napo-Galeras National Park and major towns.

2002, the community additionally signed an agreement with *Zoos Go Wild* (an ex situ conservation programme co-ordinated by European Zoos) and Aalborg Zoo in Denmark, whose aim was to curb the extent of bushmeat hunting and illegal dynamite fishing on the community's land [Oldekop et al., 2012]. In return for an annual contribution of USD 8,000 towards community education and development projects, the community agreed to stop hunting and fishing for bushmeat markets, stop selling live animals, stop using hunting methods with a high environmental impact, and to discourage oil, logging and gold companies from entering the community territory.

Interviews

Interviews were semi-structured, allowing for flexibility to explore different topics of relevance if they arose during conversation. Each interview consisted of (1) a naming and sorting task (designed to investigate species recognition and groupings), (2) 2 ranking tasks (designed to assess the perceived importance of primates as a source of bushmeat and pets in comparison to other taxa), and (3) a question and answer session (designed as a more general discussion into the perception of primates and historical population trends). We conducted 28 interviews between July 2014 and July 2015 with 29 respondents from 22 different households (1 interview was jointly carried out by the heads of 2 households, so the results reflect the pooled opinions of 2 people). We informed the community of the project at a community meeting held in July 2014, where all members of the community were invited to take part. We then arranged meetings with willing participants via the Timburi Cocha research station's community coordinator.

C.A.S. and J.A.-V. conducted, taped and transcribed the interviews in Spanish, with the exception of 2 conducted in Kichwa using a translator from the community, and an additional 7 conducted in a mixture of Spanish and Kichwa with the translator providing clarification on in-

structions and answers. All methods were reviewed and approved by the University of Manchester Research Ethics Committee (reference 14299). We recorded each interview with permission under the understanding that responses would remain anonymous. Respondents were free not to answer any questions and were able to stop the interview at any time without providing justification, although neither of these scenarios occurred.

Identification Test and Species Groupings

The first task aimed to investigate the recognition rate of primate species, both within their own right and relative to other taxa, and to see whether primates were recognized as a single cohesive group. More broadly, it also aimed to explore which features are important in determining the groups into which mammals are classified in the folk taxonomy of Payamino. We assessed this via a species recognition test and a free pile-sorting task, which is commonly used in anthropology to assess how individuals classify items and the criteria they use to delineate different groups [Bernard, 2006].

We showed participants photographs of 22 mammal species known to be present in the area, including all 7 primate species *(Alouatta seniculus, Ateles belzebuth, Lagothrix poeppigii, Cebus albifrons, Aotus vociferans, Saimiri sciureus, Saguinus graellsi)* that were previously reported during a preliminary study consisting of informal conversations and primate surveys undertaken by C.A.S. from January to March 2014 following methods outlined in Peres [1999b]. The remainder consisted of the most commonly eaten prey and pet species as ascertained during preliminary conversations with the community and catch offtakes described in Irvine [1987]. We also included 3 decoy primate species (bald-headed uakari, *Cacajao calvus;* golden-headed lion tamarin, *Leontopithecus chrysomelas,* and vervet monkey, *Chlorocebus pygerythrus*) to try to discourage participants from guessing. We asked participants whether they recognized the species, and if so to give its name in either Spanish or Kichwa. This task was completed in all 28 interviews.

After the naming task, we removed the decoys (unless they had been misidentified as a monkey that lived in the area) and unrecognized animals, then asked the participants to group the remaining set into animals which were similar, giving no limit to the number of groups that could be made. We then asked for the reasons behind each grouping. Grouping data were available for 26 interviews. Usually free pile-sorting data are analysed using cluster analysis [Bernard, 2006]; however, these analyses are sensitive to missing values [Himmelspach and Conrad, 2010], which in our case were generated by the exclusion of non-recognized animals from each free pile-sorting task. A large number of clustering algorithms that can deal with missing values has been proposed [Kaufman and Rousseeuw, 2005], and research in this field remains active. We decided to imagine each pile in a pile sort as a group of animals seen together during a focal sample, under the assumption that animals which were unrecognized and left out of the pile sort were analogous to a scenario where an individual was not seen. This allowed us to account for missing values by applying a simple ratio index correction [see Cairns and Schwager, 1987] using SOCPROG 2.5 [Whitehead, 2009] to generate a corrected matrix. We then generated a weighted network diagram with NetDraw version 2.148 [Borgatti, 2014], using a spring embedding algorithm with node repulsion, equal edge lengths and 100 iterations. This algorithm simulates the graph model as a force system, where each node is a charged particle repelling other nodes and each edge is a spring that draws the two nodes it is connected to more closely together. Nodes are moved in each iteration in whichever direction minimizes the total energy in the system [Mutton and Golbeck, 2003]. We analysed clustering using a leading eigenvector algorithm in igraph package version 0.7.1 in R [Csardi and Nepusz, 2006]. Grouping data were available for 26/28 interviews.

Bushmeat and Pet Rankings

In the second part of the interview, we aimed to establish the perceived importance of primates as sources of bushmeat and pets compared to other taxa found in the area. Firstly, we asked respondents to select from the photographs remaining after unrecognized animals had been removed which were important as bushmeat, and to rank them from most important to least important. We purposefully left 'importance' undefined in order to investigate whether rankings

were principally driven by factors such as ease of hunting, taste or associated prestige. The reasons behind the rankings were then discussed. We calculated overall importance as bushmeat for each species using the following index based on Quinlan's [2005] method for estimating cultural salience from free listing. For each species:

$$\text{list importance} = \frac{1 + \text{number of species picked} - \text{rank}}{\text{number of species picked}},$$

then

$$\text{overall importance} = \frac{\sum \text{list importance}}{\text{n}},$$

where n is the number of interviews.

Secondly, we asked respondents to rank which of the set of recognized animals were the best pets, and to assign them ranks. Reasons behind their choices were again discussed after respondents had finished arranging. The semi-structured nature of interviews after both ranking exercises resulted in a number of discussions over preferred hunting methods, rules and uses for different types of meat, although these were not covered with every respondent. Bushmeat rankings were available for 27 interviews, pet rankings for 28.

General Discussion

In the final part of the interview, we aimed to investigate wider perceptions of primates, as well as to give an indication of what species have been seen by locals in the area and whether there had been any perceived historical changes in primate populations. In addition, we wanted to discover whether locals were aware of any important role for primates in forest ecology (for example, as seed dispersers). We asked respondents to name which primate species were found in the area, whether they had noticed any changes in their abundance and distribution, and whether they thought they were important for the community and for the forest.

Results

Identification Test and Species Groupings

All respondents identified the uakari and golden-headed lion tamarin as decoys, apart from 1 interviewee who identified the latter as a 'sukaly', or titi monkey in Kichwa. The vervet monkey was also identified as a titi by 9 respondents, and featured in 9 subsequent pile sorts, 3 bushmeat lists and 2 pet preference lists. We did not find titis during preliminary primate transects, and they were not mentioned in previous informal conversations with locals about primates found in the area, although a previous survey did find the presence of *Callicebus discolor* in a small patch of forest inside the community's territory, where the species has been heard calling [M. Gavilanez, pers. commun.].

All respondents correctly identified the armadillo, paca, agouti and red brocket deer (fig. 2). White-lipped peccaries and collared peccaries had an overall high rate of recognition, but their names *(saíno* and *wangana)* were frequently interchanged. Species varied widely in the number of names assigned to them by respondents (table 1). For example, whereas all respondents referred to red brocket deer by their Spanish name of *venado,* certain species, in particular the giant anteater, tamandua, sloth, noisy night monkey and kinkajou, were known by a wide variety of names. In the case of kinkajous and sloths, the nomenclature included the Spanish or Kichwa

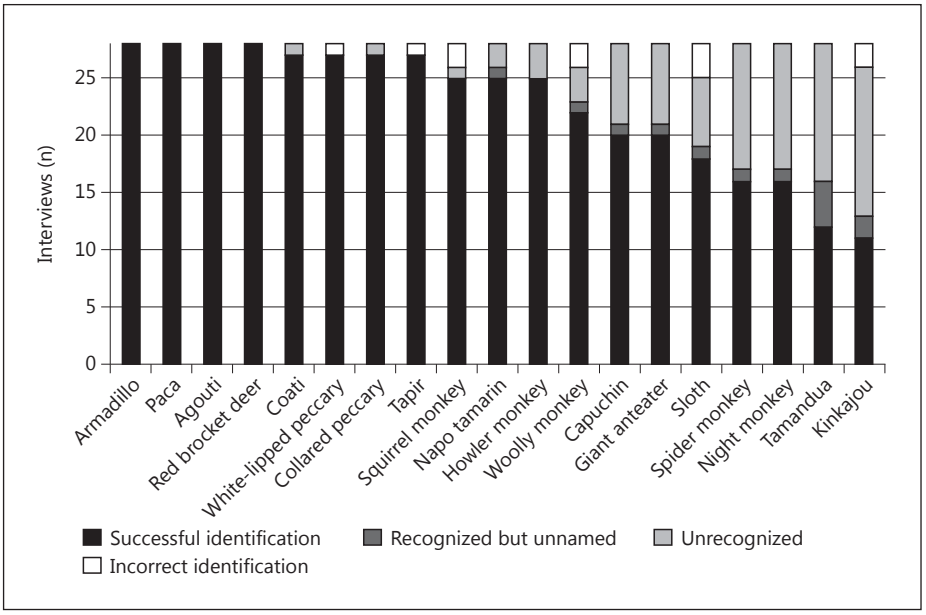

Fig. 2. Recognition rankings from 28 interviews with 29 respondents.

for monkey (e.g. *mono perezoso, tuta mono, tuta kushillu, mono nocturno*), indicating their perceived proximity to or inclusion in a monkey group.

Squirrel monkeys, Napo tamarins and red howler monkeys were recognized by over 85% of respondents. Woolly monkeys, which are thought to be found only in remote areas of the territory, were recognized by 78% of respondents; however, the recognition rate was much lower for white-bellied spider monkeys, which have the same distribution but were only recognized by 57% of interviewees. White-fronted capuchins and night monkeys also had a low recognition rate despite their recorded presence in the area [C. Stafford, pers. observation].

Figure 3 shows the consensus network across all 26 interviews from which grouping data were available. The network shows a clear clustering together of monkeys, but also some strong associations between certain primate and non-primate species. Night monkeys are strongly tied to kinkajous, which would be expected considering their overlapping names, but less strongly tied to other diurnal primates. Coatis show strong ties to both primates and non-primates. Most commonly they featured in non-primate groups (15/26 interviews), but were included in groups described as only containing *monos* on 9 occasions. In 5 of the interviews where they were grouped with other non-primates, they were placed in an exclusive group with armadillos because both were described as having a similar diet of worms. Similarly, sloths have strong associations with several species of primate but also with other arboreal non-primates, including tamanduas and coatis, and terrestrial non-primates, particularly giant anteaters. Pacas and agoutis, which may have been expected to group together frequently, were often separated because one was active by day and one by night.

Table 1. Names used by respondents during the species recognition task

Species	English common name	Names used by interview respondents
Dasypus novemcinctus	Nine-banded armadillo	Armadillo (26), pitingu (2), cachicambo (1), armallu (1)
Nasua nasua	Coatimundi	Cuchucho (23), mashu (8)
Cuniculus paca	Paca	Guanta (26), lomucha (6)
Myrmecophaga tridactyla	Giant anteater	Oso hormiguero (13), tamanoa (7), cuchipilla (1), cuchipillangi (1), mandarolo (1)
Tamandua tetradactyla	Tamandua	Susuti (5), pillán (4), tamandua (1), susu (1), kupisu (1), pillán pequeño (1)
Choloepus didactylus	Sloth	Indillama (13), perezoso (4), oso hormiguero (2), oso perezoso (1), mono perezoso (1), cucupisa (1), mono nocturno (1)
Dasyprocta sp.	Agouti	Guatusa (24), siku (4), tintin (2), tapali (2)
Mazama americana	Red brocket deer	Venado (27), venado rojo (1), shundaiku (1)
Tayassu pecari	White-lipped peccary	Saíno/saíno grande (16), wangana (11)
Pecari tajacu	Collared peccary	Wangana (14), saíno/saíno pequeño (13)
Tapirus terrestris	Lowland tapir	Danta (15), tapir (10), sacha wagra (9)
Potos flavus	Kinkajou	Tuta kushillu (5), tuta mono (4), mono nocturno (4)
Alouatta seniculus	Red howler monkey	Coto (23), mono aullador (7), mono colorado (1)
Ateles belzebuth	White-bellied spider monkey	Maquisapa (13), kushillu (2), mono araña (2)
Lagothrix lagotricha	Woolly monkey	Chorongo (22), mono lanudo (1)
Saimiri sciureus	Common squirrel monkey	Barisa (17), bariso (8), mono paisano (1)
Cebus albifrons	White-fronted capuchin	Machín (18), capuchin (1)
Saguinus graellsi	Napo tamarin	Chichico (15), ashilla (11), bebeleche (1), monito de bolsillo (1), mico (1)
Aotus vociferans	Noisy night monkey	Makuru (8), mono nocturno (4), tuta mono (3), tuta kushillu (1)

The number of respondents giving each name is shown in parentheses. Respondents sometimes gave multiple names, so totals may be higher than n = 28 interviews.

The leading eigenvector algorithm's best fit split the network into two groups (fig. 3). The first of these includes only terrestrial mammals, whereas the second group includes arboreal mammals including diurnal and nocturnal monkeys, kinkajous, coatis and sloths. Excluding weaker ties from the analysis (those with a weight lower than 0.1, which excludes 54% of ties) creates a third group consisting of the giant and lesser (tamandua) anteaters but leaves the other groups unaffected, whereas dropping those with a weight lower than 0.2 (excluding 69%) creates a further fourth group consisting of sloths, kinkajous and night monkeys. This strongly supports the conclusion that primates are seen as a distinct group, but again highlights the grey area of other arboreal mammals being occasionally included.

Bushmeat Rankings

Every species from the 22 initial photographs was included in at least 1 respondent's list, except the giant anteater and the uakari, the latter of which was never included as it was successfully identified as a decoy by 100% of respondents (fig. 4). Respondents varied in their approach to listing; 13 contributors listed a subset of species under a clear hierarchy (i.e. species were listed from best to worst, with no pairs or groups sharing the same rank), another group picked out 4 or 5 preferred species,

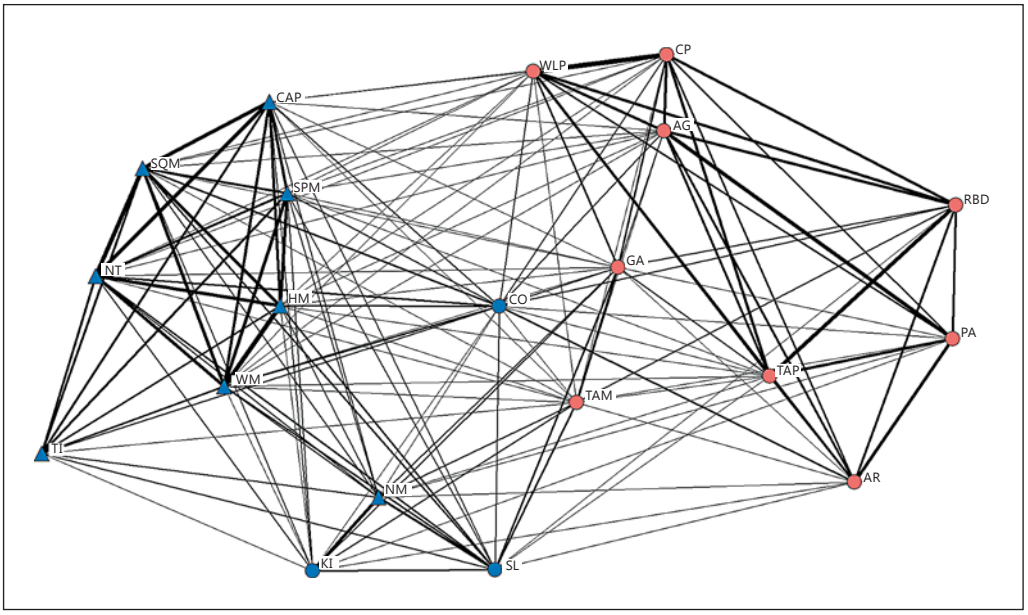

Fig. 3. Weighted network of mammals from 26 interviews, based on a simple ratio-corrected matrix. Lines are weighted by tie strength. Node locations are based on NetDraw's spring embedding algorithm with 100 iterations from a random start point. Colours denote the community allocation of each animal calculated using a leading eigenvector community algorithm. Primates are represented by triangular symbols, non-primates by circles. AG = Agouti; AR = armadillo; CAP = capuchin; CO = coati; CP = collared peccary; GA = giant anteater; HM = howler monkey; KI = kinkajou; NM = night monkey; NT = Napo tamarin; PA = paca; RBD = red brocket deer; SL = sloth; SQM = squirrel monkey; SPM = spider monkey; TAM = tamandua; TAP = tapir; TI = titi monkey (based on 9 misidentifications of vervet monkeys, and 1 golden-headed lion tamarin); WLP = white-lipped peccary; WM = woolly monkey.

then included all opportunistically caught species in a large group of the same low rank, and on 2 occasions respondents labelled every animal as being equally as important as the others.

A total of 19 respondents ranked the importance of species by preferred taste, 6 ranked animals by the ease with which they could be hunted, 2 stated that all species picked out were equally as important, and 1 did not give reasons to explain their rankings. Of those who ranked by taste preference, 6 stated that preferences also dictated the frequency with which species were hunted (therefore their top ranking species were also the most commonly eaten) but for the rest preference was not necessarily related to which species was most frequently consumed. Our hunting importance index is therefore much more indicative of preference rather than actual hunting pressure; however, for those interviews where the most commonly hunted animal was identified (n = 18), pacas came first on 8 occasions and were joint first on a further 6, whereas agoutis were identified as the most commonly hunted animal in 2 interviews and came joint first in a further 4. Red brocket deer and armadillo were also identified as joint most commonly hunted on 3 occasions each. The top 4 animals in the

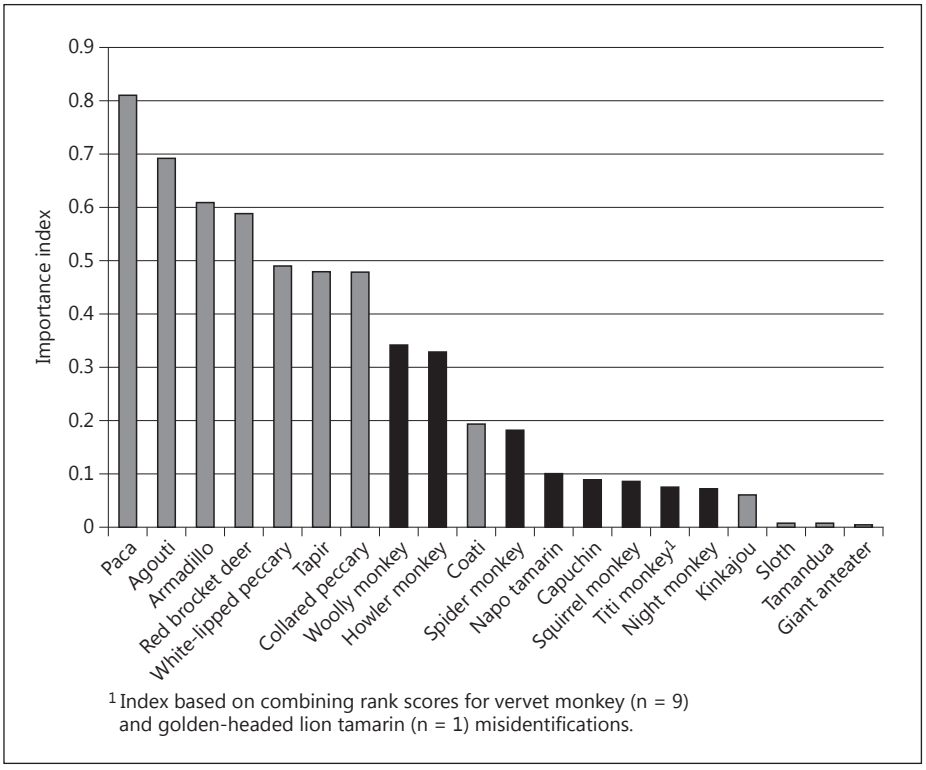

Fig. 4. Bushmeat importance rankings based on 27 interviews with 28 respondents. Primate species are highlighted with black bars.

index therefore closely correspond to the top 4 most frequently hunted species for the interviews where this is known. Respondents commonly spoke of the trade-off between taste and the difficulty and payback of catching certain species. For example, white-lipped peccaries were considered to have better meat than collared peccaries but were harder to hunt as they tend to be found much further away from fincas and live in smaller groups. Despite this, their importance ranking is higher than that of the collared peccary, which is found closer to fincas and roams in larger groups, making it both easier to hunt and to get high yields. Similarly, woolly monkeys are high-ranking despite the high effort needed to catch them (being located far from the permanently inhabited areas of the community's territory).

Primates generally occupied low ranks, but the 3 large-bodied species ranked consistently higher than small- and medium-bodied species. Woolly monkeys and howlers were noted for their good taste, but spider monkeys featured in lists much less often. One respondent commented that they were only eaten occasionally as the meat does not taste good, but other respondents ranked the meat as highly as that of woolly monkeys. Woolly monkeys were said to be eaten only on special occasions, such as weddings and festivals, and were caught on extended hunting expeditions that happened once or twice a year. Estimates given of the average number of mon-

keys being taken on each trip ranged from 2 to 20. Several respondents said they did not hunt capuchins due to their close resemblance to humans. Hunting was generally recognized to have a role in changing the behaviour of troops, for example:

'Los monos grandes como machín, como coto, esos si les matan porque son grandes para comer. Y como matan, se alejan mas de aquí y no se asoman.'

'Large monkeys like capuchins, howlers, they're killed as they're big enough to eat. And because they are killed, they go far from here and do not show themselves.' (Male, 16- to 19-year age bracket)

'Antes, mas utilizaban (monos) para comer, para hacer boda, unas fiestas … siempre utilizaban cantidad. Por sacos. Pero ahora van mas tranquilos los monos, ya ellos también no tienen miedo por lo que ya no cazan. No hacen nada y pasan sentaditos ...'

'Before, monkeys were used more to eat, to have at weddings, festivals … they always used a lot. Sack loads. But now they (the monkeys) are calmer, they're not scared anymore because they are not hunted. They don't do anything and will happily sit there.' (Male, 30- to 35-year age bracket)

Respondents listed lamping (a method of hunting nocturnal animals, whereby hunters find prey using torches to look for bright eyeshine) with shotguns as the principal method of hunting, or simply shotguns for hunting diurnal species such as woolly and howler monkeys. Six respondents also mentioned snares as an important method for catching pacas, agoutis, red brocket deer and tapirs, whereas 2 respondents said armadillos were best hunted with dogs which could find and excavate burrows.

Pet Rankings

Squirrel monkeys were the most preferred pets, followed by Napo tamarins (fig. 5). Primates are much more prominent in the pet index than the meat index, occupying 5 of the top 10 places. Tamarins and squirrel monkeys were considerably more popular than capuchins, which were frequently described as crazy or aggressive, and woolly and howler monkeys. Spider monkeys, night monkeys and titis were included in the list by a small number of respondents, and did not feature as prominently. One respondent mentioned that night monkeys had been popular pets in the past but were now less so because they were scarcer, but their comments were not repeated by any others. The principal reasons for preferring squirrel monkeys and tamarins were that they were easy to domesticate, will follow their owners to and from the jungle, adjust well to living in houses and will come and sit on their owner's shoulder. Five respondents also listed their tendency to go up into the rafters of a house and eat spiders and other pests as one of their best attributes. The top-scoring non-primates were pacas, coatis, agoutis and tapirs. The majority of reasons given for their preference referred to how they behaved similarly to dogs, following owners to and from chacras and being easy to domesticate. Peccaries (principally collared), featured in 5 lists, were considered good pets because they acted like guard dogs and would alert their owners to visitors approaching the house. Two respondents mentioned that squirrel monkeys and tapirs could be taken to Loreto and sold, although the extent to which this occurs in the community is unknown, and the practice is illegal under Ecuadorian law. Infants of larger species, including spider and woolly monkeys, tended to be taken to the community after the parent had been killed, to be kept as pets.

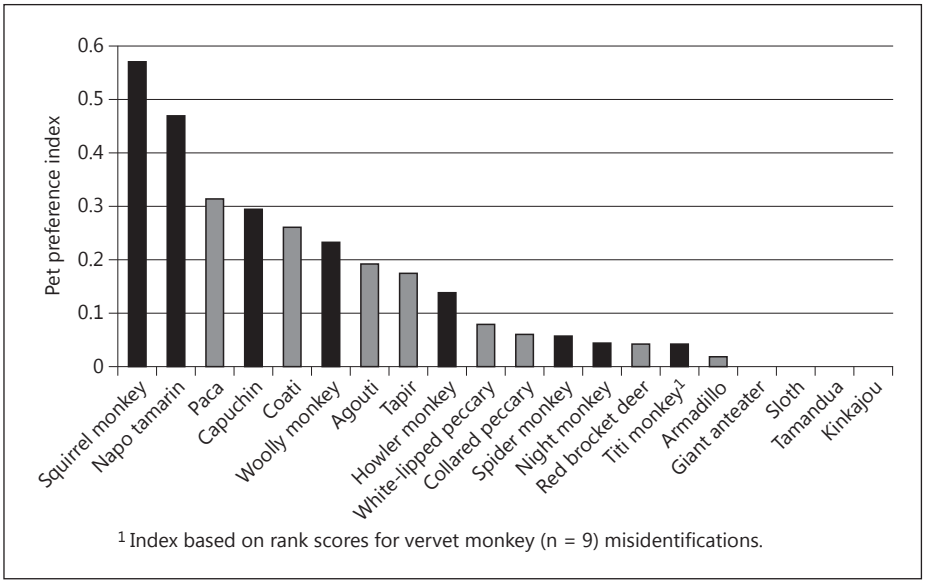

Fig. 5. Pet preference rankings based on 28 interviews with 29 respondents. Primate species are highlighted with black bars.

Of the 22 households we interviewed, 10 had kept at least 1 monkey as a pet in the past year (a total of 2 capuchins, 3 tamarins, 4 woolly monkeys and 5 squirrel monkeys), and a further 6 had owned monkeys as pets in the past (an additional 4 squirrel monkeys, 5 tamarins, 1 capuchin and 1 howler monkey). None of the households interviewed that had owned a primate still had it in their possession when the interview took place aside from 1, suggesting there is a high level of mortality and/or escape (although 1 respondent said they had let their squirrel monkey go after it became illegal to keep a wild animal as a pet, which was prohibited in the 2012 Animal Protection Law [Asamblea Nacional de la República del Ecuador, 2012]).

Question and Answer Session

All respondents had a clear idea of what monkeys they had seen in Payamino and where they could be found, indicating that knowledge about their diversity and distribution is widespread. Ninety-two percent of respondents said tamarins and squirrel monkeys were living in the Payamino area, 78% listed howlers, 67% listed capuchins, and 42% listed night monkeys. The majority of the respondents also described the presence of woolly monkeys further upstream. Spider monkeys are also found in this area, but were described by fewer respondents. Tamarins were noted to be closer to the community's populated centre than other species, and to be particularly apparent during the wild grape and guava season when groups would come out of the jungle and eat fruit from domestic trees outside houses. Night monkeys had also been observed doing this, but no respondent noted any grievance at having the monkeys engage in this behaviour. Squirrel monkeys were noted to be a more riparian species, whereas howlers came close to the community more rarely and could instead be

found in primary forest on the Armadillo Ridge, roughly a 40-min walk from the nearest finca.

Of 25 respondents asked, 8 believed the number of primates they saw had generally declined, 2 believed that numbers had increased, 2 noted increases in certain species but declines in others, and 11 said numbers had remained constant over the years. One description of population increase was attributed to a decline in the intensity of hunting, whereas another specifically cited a decrease in the popularity of monkey hunting for large festivals (the remaining 2 did not give reasons). Explanations given by respondents who thought primate numbers had decreased were not consistent; 7 of the respondents who noted a decrease cited hunting as the reason for which fewer were seen today, although another noted that the community's population increase in the past 15 years had led to more forest clearance, and that this had caused monkey populations to become fragmented over large distances. Only 1 respondent identified a specific ecological role for primates as seed dispersers, although other respondents described all animals as being equally important for the forest. Two respondents explained that monkeys were important to the forest for their own sake. The majority of interviewees who agreed that primates were important to the community did so on the basis of their potential as bushmeat, though 1 respondent said they were important as they could be kept as pets.

Discussion

Local knowledge of the distribution and presence of mammal species in Payamino remains high, reflecting the predominance of a lifestyle that is still strongly positioned within and connected to the forest. With the exception of coatis, the 7 species with the highest recognition rate were also the 7 species that scored highest on the bushmeat preference index, which suggests that species that are regularly consumed have high cultural salience. Nocturnal arboreal animals such as night monkeys, tamanduas and kinkajous had much lower recognition rates than diurnal animals; however, asking for identifications from pictures misses out other potentially important cues such as vocalizations. We could therefore have underestimated recognition rates for species such as howler and night monkeys, which are heard more often than they are seen. Future work including a range of identification cues such as audio recordings may give a truer measure of recognition. Reports of titi monkeys in the community's territory as a result of vervet monkey misidentifications also highlight the importance of local knowledge in raising awareness of species that are so rare or range limited that they may not be recorded using standard survey methodologies; though because they were only mentioned as a result of decoy misidentifications, there is still a need to corroborate these reports with actual observations.

The folk taxonomy of Payamino is based on a variety of features, including arboreality, size, diet, and whether an animal is diurnal or nocturnal. Overall however, most animals which are closely related phylogenetically clustered together in our network. An arboreal/terrestrial split in the way the community categorizes mammals is similar to the group delineations that have been found in other indigenous groups, including the folk taxonomies of Itzaj Maya [López et al., 1997], and Mayangna and Miskito communities in Nicaragua [Koster et al., 2010]. In our study, the inclusion of coatis, sloths, kinkajous and tamanduas in groups that were said to contain only

monos (monkeys) shows that the definition of 'primate' within the community is variable, and that arboreality alone is again sometimes sufficient for a species to be considered a monkey. Kinkajous were particularly likely to be included in monkey groups, which is not surprising given that *tuta mono, tuta kushillu* and *mono nocturno* were common names shared by both kinkajous and night monkeys. Our findings closely match those recorded by Papworth et al. [2013] in 3 Waorani communities and agree with the theory that the inclusion of kinkajous in a monkey category by indigenous groups is consistent across the lowland Neotropics. It also reinforces the need for researchers and conservationists to be clear about what animals are being referred to when talking about monkeys; for example, an estimation of the perceived abundance of primates is likely to be positively skewed if researchers are unaware that other arboreal mammals are being included. Aside from these confusion animals, primate species clustered together, with strong links among small-bodied species and large-bodied species.

A wide variety of species continue to be hunted despite widespread ownership of chickens (50 were donated to each household by an oil company in 2014), which suggests that the availability of easy-to-get protein from other sources is not enough to fully curtail the use of bushmeat. With regard to primates, only the 3 large-bodied species were ever given a clear ranking in bushmeat lists, whereas the remainder only featured in lower joint-ranking groups or did not feature at all. This order of importance is similar to those reported in other indigenous groups [de Souza-Mazurek et al., 2000; Franzen, 2006; Ohl-Schacherer et al., 2007], and Ecuadorian Kichwa communities [Sirén, 2004] based on offtake, indicating that our importance rankings could potentially be an accurate predictor of hunting pressure. However, even large-bodied primate species in our study had a lower prominence in the importance rankings than ungulates and rodents, which, if indicative of preference and/or hunting pressure, contrasts with other studies [de Souza-Mazurek et al., 2000; Franzen, 2006; Ohl-Schacherer et al., 2007] where woolly or spider monkeys are commonly among the top-ranking animals in terms of the number of individuals killed. Without any offtake data from Payamino, we cannot say this for certain. Lack of offtake data is clearly a caveat to our study; however, a cultural unwillingness to report recent catches is a major impediment to carrying out this work. We also assume that our sample of 28 respondents is representative of community preferences, though our responses were heavily male biased (only 2 of our 28 respondents were women), and we did not measure variation in how commonly each respondent hunted or went into the forest.

Despite these caveats, our bushmeat ranking results resemble yield patterns described in the same community by Irvine [1987], and shed light onto some historical changes. Eight of the top 10 species (paca, agouti, red brocket deer, collared peccary, tapir and howler monkey) in our ranking system coincide with the top 10 species harvested (when adjusted for weight) in the 1987 survey. However, the remaining 2 species, white-lipped peccaries and woolly monkeys, are completely absent from the 1987 reported catch list. Irvine reported that white-lipped peccaries had been missing from the Loreto plateau since the 1970s, but our data suggest that there is a population nearby which is subject to hunting. Large monkeys were equally considered to be species that were eaten only during festivals; however, in 1987 capuchins and howlers are listed as the 'deep forest' species targeted, rather than the woolly monkeys most commonly mentioned by our study as the main target animal for extended hunting trips. Descriptions of festival hunting in Payamino are similar to those de-

scribed by Sirén [2012] for the *hista* ceremonies of a Canelos Kichwa settlement in Sarayaku, eastern Ecuador. In Sarayaku's case, woolly monkeys have been completely absent from the area surrounding the village for many years, and their presence near the settlement is remembered only by elders. Similarly, only 6 respondents in Payamino mentioned a historical decline in the abundance of woolly and spider monkeys in the area immediately surrounding the community's populated centre, while other respondents asserted that the species had never been found near the community and had always been confined to higher altitudes. This latter response is indicative of the beginnings of a shifting baseline whereby respondents consider the already changed environment to be normal instead of impoverished, and use it as the baseline against which to measure further environmental degradation. This will be important to take into account if a conservation programme ever sought to reintroduce either species into the area, as there may be little support to ensure the survival of an animal that would not be expected by locals to thrive in the new habitat.

Both the substantial number of households which had kept a pet primate and the generally high ranks occupied by primates in the pet preference index suggest that offtake for the pet trade has the potential to be an issue for the preferred smaller species and an additional pressure for woolly monkeys and howler monkeys which are already targeted for their meat. Aside from its direct effect on numbers, frequent targeting of juveniles can cause considerable stress to groups [see de la Torre et al., 2000] and could account for the large flight distances observed for smaller species in the area [C.A. Stafford, pers. observation], though Napo tamarins have been reported to have very high flight frequencies even in situations where they are not hunted [Mullner and Pfrommer, 2001, cited in de la Torre, 2014]. If we extrapolate these figures for the estimated 60 households in Payamino, the community would take an estimated 38 juvenile monkeys per year from a 16,800-ha area, although it is unclear if the territory from which woolly and spider monkeys are taken is within the community's territory. We knew of at least 1 woolly monkey that had been bought from a nearby village located more closely to the border of Sumaco National Park.

Recording the ethnoprimatology of the community in Payamino allows us to highlight potential future areas of conflict and gaps in local knowledge regarding the value of primates to the forest's ecology, though the success of conservation measures aiming to place emphasis on ecological value will depend upon the perceived and actual importance of forest resources to the community. Our study also highlights the prominent position of primates as preferred pets, which is often overlooked in studies examining reasons for Neotropical primate declines. Though generally not likely to be as urgent an issue as bushmeat hunting, live captures could still be an important source of disturbance influencing distributions and behaviour if not numbers. In Payamino's case, future education aiming to shift the value of primates away from their functional value as pets or sources of meat and towards their ecological value as seed dispersers and economic potential as tourist attractions might provide an effective strategy to protect them.

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