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Research Article

Trade and ethnozoological use of African lorisiforms in the last 20 years

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Abstract

Trade in primates is considered a major impediment to primate conservation globally. The bushmeat trade in West and Central Africa is considered largely unsustainable and represents one of the main threats to biodiversity. Furthermore, the use of primates in traditional practices and medicine includes a third of the African primate species. Little is known about the trade in the African mainland lorisiforms; pottos, angwantibos and galagos. Aiming to fill this knowledge gap we created an online survey, conducted a literature review, and analyzed CITES trade records, focusing on the last two decades. We obtained 188 questionnaire responses from researchers and people working in 31 different countries in sub-Saharan Africa. We found a total of 33 publications reporting on trade in African lorisiforms, and CITES records indicate that almost 2000 lorisiforms were traded internationally from African range countries. Fifty-three percent of respondents provided meaningful details about aspects of the trade in African lorisiforms from 50% of the range countries. Galagos were reported by respondents in larger numbers than pottos and angwantibos, and mainly occurred in the pet trade. Pottos were the most frequently mentioned taxon in the literature, when all trade types were combined. Across all of the sources (online survey, literature and CITES database), trade in pottos and angwantibos was reported from 12 countries, and galagos from 23 countries. Trade was reported to occur mainly within rural settings (64%), potentially indicating that demand is not high enough to fuel long distance trading. However, as seen in the Asian lorisiforms, once quantitative studies were conducted, the threat that trade posed became alarmingly apparent and is now considered a major impediment to their conservation. Our insight into the trade of African lorisiforms should be followed up with concerted studies, with an emphasis on quantifying trade to the species level.

Introduction

When establishing primate conservation and management strategies it is vital to take into account the cultural, social, economic and traditional roles primates play for humans, and to consider the interaction between humans and nonhuman primates (Lee, 2010; Alves, 2012). Ethnoprimateology attempts to integrate the interests and concerns of humans with those of primates (Lee, 2010; Alves, 2012). Interactions between humans and nonhuman primates have occurred throughout their coexistence; however, with a growing human population, more sophisticated hunting technologies, and increasing human access to isolated forest areas, primate populations are under more threat than ever (Bennett et al., 2002; Alves, 2012). Today, habitat loss and the unsustainable trade of primates are considered the main threats to primate conservation globally (Juste et al., 1995; Milner-Gulland and Bennett, 2003; Grieser-Johns and Thomson, 2005; Nijman, 2005; Strier, 2011; Nekaris, 2013a,b). The main types of trade in primates internationally and within countries (domestic) are those for bushmeat, biomedical use, traditional medicine and practices, and as pets, photo props or trophies (Alves et al., 2010; Nijman et al., 2011; Nekaris, 2013a,b; Bush et al., 2014; Nijman et al., 2015; Osterberg and Nekaris, 2015).

In Africa the trade in primates is thriving, with the bushmeat trade presenting the largest threat especially to forest-dwelling species (Cowlishaw and Dunbar, 2000; Brashares, 2003; Linder et al., 2013; Covey and McGraw, 2014; Schwitzer et al., 2014a). This is especially apparent in Central and West Africa, where 48 out of Africa's 111

species of primates are found to occur in the bushmeat trade (IUCN, 2014; Taylor et al., 2015). Among the most commonly recorded primate species in the bushmeat trade are the guenons (*Cercopithecus* spp.) and the vervets (*Cercocebus* spp.) (Fa et al., 2005; Albrechtsen et al., 2007; Cronin et al., 2010; Linder and Oates, 2011; Covey and McGraw, 2014). To illustrate the magnitude of the trade Fa and Brown (2009), in an overview of hunting across Africa, noted that on average primates comprised some 20% of all mammals hunted. Focusing on the Cross-Sanaga region of Nigeria-Cameroon, this amounts to ~250000 primates being extracted annually (Fa et al., 2006). In addition, 32% of the African primate species are traded for medicinal and traditional practices (Alves et al., 2010). Both in the bushmeat trade and the trade for traditional practices, diurnal and nocturnal primates are prominently traded (Fa et al., 2005; Albrechtsen et al., 2007; Alves et al., 2010; Cronin et al., 2010; Linder and Oates, 2011; Covey and McGraw, 2014; Svensson and Friant, 2014). In contrast, the trade in primates for pets in Africa appears to focus on the larger, diurnal primates (Van Lavieren, 2008; Kabasawa, 2009; Hicks et al., 2010; Stiles et al., 2013; Ebua et al., 2014; Healy and Nijman, 2014), whilst the smaller bodied (often nocturnal) primates are prominent in the pet trade in the Neotropics and Asia (Bairrão Ruivo et al., 2005; Nekaris et al., 2010; Parathian and Maldonado, 2010; Nijman et al., 2011).

Until the last decade, nocturnal species were often excluded from studies of trade, possibly because researchers could not identify them or considered them less threatened and not worth noting (Ratajczak, 1997; Nekaris and Nijman, 2013; Svensson and Friant, 2014). New data reveal, however, that these cryptic primates are increasingly threatened by trade (Shepherd et al., 2005; Maldonado et al., 2009;

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Nijman and Nekaris, 2014). In the Neotropics, the owl monkey (*Aotus* spp.), is rarely hunted for food but is extracted from the wild to meet the demand for the pet trade (Parathian and Maldonado, 2010), and for biomedical research (Maldonado et al., 2009). One study in 2007–2008 estimated that annually 4000 owl monkeys were traded between Peru, Colombia and Brazil (Maldonado et al., 2009). In Asia, Shepherd et al. (2005) and Nijman et al. (2015) found slow lorises (*Nycticebus* spp.) to be amongst the most common primates in Indonesian animal markets. Slow lorises are traded in increasingly large numbers, both as pets and for traditional medicine, across Asia (Nekaris and Jaffe, 2007; Nekaris et al., 2010). No study has yet been able to quantify the total offtake of slow loris species, but quantified examples show that this trade is large and severe. For example, in one market town in Myanmar it was extrapolated that around 2000 Bengal slow lorises (*N. bengalensis*) were traded annually (Nijman et al., 2014). In Japan 74 slow lorises (mainly pygmy slow lorises (*N. pygmaeus*), greater slow lorises (*N. coucang*) and *N. bengalensis*) were found in the pet trade during a 2-month period (Musing and Nekaris, 2015) and in Sumatra 714 *N. coucang* were found for sale over 66 market surveys (Shepherd, 2010). In Madagascar, political instability and disintegration of taboos have caused an increase in the use of lemurs for human consumption (Barrett and Ratsimbazafy, 2009; Schwitzer et al., 2014b), and the pet trade, with more than 28000 lemurs estimated to have been sold as pets since 2010 (Sussman et al., 2003; Reuter et al., 2015).

Svensson and Friant (2014) provided some of the first quantified evidence of trade in African lorisiforms, namely pottos (*Perodicticus* spp.) and angwantibos (*Arctocebus* spp.), mainly from Nigeria, and urged for further studies on trade of these species to understand the impact it has on them. Trade could very well be an overlooked threat to the other African lorisiforms (i.e. the galagos) as well. Until recently the true extent of species-richness in the African lorisiforms was underestimated, but at present at least 3 species of potto, 2 species of angwantibo and 18 species of galagos (*Euoticus* spp., *Galago* spp., *Galagooides* spp., *Otolemur* spp., *Sciurocheirus* spp.) are recognized (Nekaris, 2013a,b). All of these species are listed on the IUCN Red List as Least Concern, except for the Malawi galago (*Galagooides nyasae*) (listed as Data Deficient), mountain dwarf galago (*Galagooides orinus*) (Near Threatened) and Rondo dwarf galago (*Galagooides rondoensis*) (Critically Endangered) (Bearder, 2008; Butynski et al., 2008; Perkin et al., 2008). While deforestation and habitat conversion is generally identified as being a threat to these species, it is only for the West African potto (*Perodicticus potto*) and Calabar angwantibos (*Arctocebus calabarensis*) that hunting is listed as a threat, albeit a localized one (Oates and Bearder, 2008; Oates et al., 2008). So few data are available on these species, however, that even at long-term field sites such as Gombe Stream and Bwindi Impenetrable National Parks, it is not fully known which lorisiforms occur (Nekaris and Nijman, 2013). As such, extrapolating any threats across the whole range of any given species is virtually impossible due to a paucity of data.

While the domestic trade in African lorisiforms is inadequately documented, all international trade, being subjected to the provisions of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) should be properly registered. The Convention came into effect in 1975, and with Angola joining in 2013, all African primate range countries are now signatories. The African lorisiforms are listed on Appendix II of CITES, thus regulating their international trade (CITES 2015). In 2003 the African Union revised the African Convention on the Conservation of Nature and Natural Resources. Under this Convention Article IX exists to regulate domestic trade, possession of, or transportation of wildlife, or products from wildlife. The Convention also serves to enable the implementation and enforcement of CITES. Many African countries are yet to ratify the African Convention; the African Union is strongly encouraging all states to become members (IUCN Environmental Law Programme, 2004).

Aiming to fill the knowledge gap regarding domestic and international trade of African lorisiforms, we created an online survey, conducted a literature review, and analyzed international trade records

stored in the CITES trade database. Filling this knowledge gap will advance our understanding of trade, such that policies can be implemented on the ground with greater precision and potential success. In turn this also allows us to identify priorities for future research and management agendas. For practical reasons we restricted our research to the last 20 years, and aimed to answer the following questions: 1) In which mainland African countries are lorisiforms traded? 2) How frequently are individual species or genera of lorisiforms found in the trade, and is there any indication of the number of animals traded each year? 3) What are the main human uses of lorisiforms in Africa and how does this vary geographically?

Methods

Online survey

We compiled data using an online questionnaire created in SurveyMonkey (2015), collecting responses between 24 November 2014 and 17 July 2015. We chose to conduct the survey online as it is thought to be ideal for rapid assessments, allowing for anonymous, inexpensive and rapid collection of data (Couper et al., 2007). The downside of using an Internet-based method is that only those with access to the Internet can participate, and our choice of English may have precluded observers from Francophone countries to participate. Invitations to participate in the survey were distributed by e-mail and shared on the social media sites Facebook and Twitter. The target audience was people who had lived or worked for a minimum of at least one month in African countries. The questionnaire focused on observations of African lorisiforms in markets and/or other information pertaining to their trade. The questions were generally closed-ended, marking one of several boxes. All multiple-choice questions included an optional “other” category and a text field where descriptive qualitative data could be added for clarification purposes.

All respondents were informed of the purpose of the study and were able to withdraw at any moment. The questionnaires followed the ethical guidelines for Internet-mediated research as proposed by the British Psychological Society (2013).

Literature review

We conducted a systematic literature review of publications (journal articles, theses, book chapters, and unpublished reports) from studies that contained both quantitative and qualitative data on the trade of lorisiforms for bushmeat and on the ethnozoological uses of them. We used the following keywords in our online searches: trade*, pet*, bushmeat*, traditional medicine in combination with potto, angwantibo, galago or bushbaby; this search was conducted both in English and in French. Once we had an initial list, we then searched specifically for trade in African lorisiforms in country-specific reports. We used Google, Google Scholar and ISI Web of Science, as well as the OFF-TAKE database (www.offtake.org; Taylor et al., 2015), a database on the exploitation of terrestrial wild species that contains information on exploitation, harvest, and use. While a large number of languages are spoken in the African lorisiform range countries, we focused on the English and French literature only because of the prevalence of these languages in scientific reports coming out of Africa.

CITES trade database analysis

We downloaded data on the export of African lorisiforms from the CITES trade database for the period 1994–2013 (data from 2014 or 2015 was not yet available or incomplete) (CITES, 2015). For four 5-year periods we established the number of live individuals that were exported from range countries as well as the number of dead individuals. The latter was restricted to bodies, skins, and trophies as to avoid possible double counting (a skin and a skull exported on two separate occasions could be derived from the same individual). Again to prevent double counting, we excluded all re-exports (that is when an individual is exported by one country after it has been imported from another). Import data (reported by the importing country) and export data (reported by the African range country) did not always agree, and

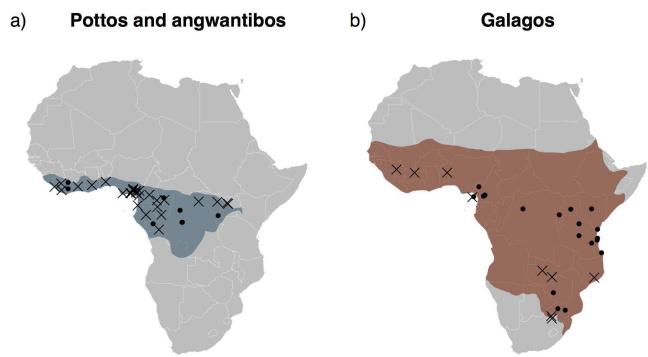


Figure 1 – Locations of observation of trade in pottos and angwantibos (a) and galagos (b), including family distributions. • Online questionnaire responses; × Literature review findings.

here we cross-checked the data and included the largest overall totals by comparing data from importing and exporting countries. Finally, for all species we determined the proportion of wild-caught individuals (source code W; to which we added 11 individuals for which the origin was not known – source code U – and 1 that was confiscated – source code I), relative to those that were born in captivity (source codes R, F, C). This allowed us to compare the proportion of wild-caught vs captive-born lorisiforms exported from the different regions. By its very nature, the CITES trade database only holds records of international trade, trade that is reported (either by the importing Party and/or the exporting Party), and, to a lesser degree, seizure data. It does not hold information on domestic trade or the illicit trade.

Data analysis

All data were entered in an excel database, allowing us compare the reported usage of lorisiforms in trade and the settings in which trade was reported. We compared pottos and angwantibos with galagos for the number of publications and the number of countries from where trade has been reported relative to the number of countries in which both taxa occur. International trade volumes were compared with respect to species composition and 5-year time windows. We ran non-parametric statistics (Chi-square test χ^2), binomial and Fisher's exact probability tests) in SPSS version 21.0, accepting significance when $p<0.05$ in a two-tailed test.

Species identification

African lorisiform taxonomy is far from resolved and especially when considering the 20 year time period covered by our research the number of species recognized has changed considerably. A classic example of this is the work by Charles-Dominique in the 1970s who studied Demidoff's dwarf galago (*Galagooides demidovii*) in Gabon, but only years later it was realized that his study species in fact comprised 2 species (*G. demidovii* and Thomas' dwarf galago *G. thomasi*) (Charles-Dominique, 1977; Wickings et al., 1998). While many respondents on the online survey were very specific with regards to species identification, others reported merely the presence of “pottos” or “small galagos” in trade, without specifying species details. The different species of potto and angwantibo have an allopatric distribution, and sympatric galagos often differ dramatically in size (Nekaris, 2013a,b); using locality information provided on the online survey in most cases we were able to narrow the identification down to the species level. When published literature used outdated taxonomies, we changed these into current taxonomies (Nekaris, 2013a,b), using information provided in the publication (e.g. when *Perodicticus potto* was mentioned for Democratic Republic of Congo (DRC) this was changed to Milne-Edward's potto (*P. edwardsi*) as this reflects our current understanding of potto taxonomy and distribution). Reports of exports or imports in the CITES trade database are conservative in the taxonomy employed, with for instance only one species of potto recognized – here we followed the same principle by correcting the species names as to reflect our current un-

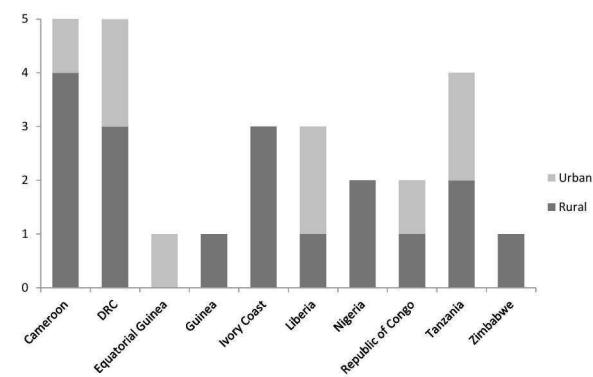


Figure 2 – Observations of trade in African lorisiforms in urban or rural settings from 28 respondents, showing a preponderance of trade in urban settings; DRC = Democratic Republic of Congo.

derstanding of lorisiform taxonomy and distribution. In all cases where we were not able to identify or infer the species involved, we retained the record to the next most resolved taxonomic level.

Results

Responses, geographic coverage and reported use

We obtained 188 online questionnaire responses from researchers and people working in 31 countries in mainland Africa. Respondents identified themselves as wildlife researchers, field ecologists and biologists, veterinarians (or graduate students in these fields), sanctuary workers, journalists, gold miners or other African residents. Fifty-three percent (99/188) had observed or heard of usage and trade of African lorisiforms, and could provide meaningful details about aspects of the trade. Combined these respondents had worked in 21 countries, representing 50% of all African lorisiform range countries (Fig. 1). A smaller proportion of these (25/99) had observed African lorisiforms for sale first-hand in 11 countries (namely in Cameroon, DRC, Equatorial Guinea, Guinea, Ivory Coast, Liberia, Nigeria, Republic of Congo, Tanzania, Uganda and Zimbabwe).

The reported purpose of trade of African lorisiforms from respondents was in equal numbers for pets (62% of the respondents reporting trade, N=61), bushmeat (50% of the respondents, N=49), or traditional practices (46% of the respondents, N=46) ($\chi^2=3.29$, df=1, $p=0.07$). More respondents reported trade in lorisiforms to occur in rural settings (including along roads and village markets) than in urban settings (such as in wildlife markets in cities or at central bus stations) (18 vs 10 respondents: binomial test, $p=0.049$) (Fig. 2).

From our literature search we obtained a total of 33 publications (published since 1994) containing information/data on the trade in African lorisiforms. Combined, these covered the trade and use of lorisiforms in 38% of the range countries (Tab. 1, Fig. 1).

In total, trade in pottos and/or angwantibos was reported from 12 countries (12 from the literature, 8 from the online survey and 3 from the CITES trade database), and trade in galagos was reported from 23 countries (7 from the literature, 17 from the online survey and 16 from the CITES trade database). The sources for records of trade differed significantly between the two lorisiform taxa ($\chi^2=9.99$, df=2, $p=0.01$); the number of reports of trade in pottos and/or angwantibos from the literature was significantly higher ($\chi^2=9.16$, df=1, $p<0.01$), and, conversely, the number of countries that reported trade in pottos and/or angwantibos in the CITES trade database was significantly lower ($\chi^2=4.64$, df=1, $p<0.05$) than what was expected on the basis of a uniform distribution.

Trade in pottos and angwantibos

Twenty-four respondents indicated that they had knowledge of pottos and/or angwantibos in trade. In the literature, including all aspects of trade, pottos were the most frequently occurring taxon, being men-

Table 1 – Occurrence of trade in African mainland lorisiforms reported in the literature. B=bushmeat trade; P=pet trade; T=trade for traditional practices; n.r.=no usage reported; —=not present in this country.

Country	Pottos / Angwantibos	Galagos	Source
Benin	T	T	1
Cameroon	T, B	n.r.	2; 3; 4; 5; 6; 7; 8; 9
CAR	T, P	T	7
DRC	B	n.r.	10; 7
Equatorial Guinea	B	B	11; 12; 13; 14; 15; 16; 17
Gabon	T	n.r.	7
Guinea	B	B	18; 19
Ivory Coast	T, B	T	20; 21; 22
Liberia	B, P	n.r.	23; 24; 7
Mozambique	—	B	25
Nigeria	T, B, P	n.r.	26; 3; 7
Republic of Congo	T, B	n.r.	27; 28; 29; 7
South Africa	—	T, B	30
Uganda	T, B	n.r.	31
Zambia	—	T	32; 33

1) Djagoun et al., 2013; 2) King, 1994; 3) Fa et al., 2006; 4) Willcox and Nambu, 2007; 5) Abugiche, 2008; 6) Bobo et al., 2014; 7) Svensson and Friant, 2014; 8) Whytock et al., 2016; 9) Ngoufo et al., 2014; 10) Musibono et al., 2010; 11) Juste et al., 1995; 12) Fa and Garcia Yuste, 2001; 13) Keylock, 2002; 14) Oates et al., 2004; 15) Albrechtsen et al., 2006; 16) Albrechtsen et al., 2007; 17) Cronin et al., 2010; 18) Ziegler et al., 2002; 19) Gaubert et al., 2015; 20) Caspary, 1999; 21) Hofmann et al., 1999; 22) Yaokokore-Beibro et al., 2010; 23) Greengrass, 2011; 24) Bene et al., 2013; 25) Fusari and Carpaneto, 2006; 26) Akani et al., 2015; 27) Mbete et al., 2011; 28) Loubelo, 2012; 29) Mbete, 2012; 30) Whiting et al., 2011; 31) Olupot et al., 2009; 32) Alves et al., 2010; 33) Baskind and Birbeck, 2005.

tioned in 21 of the publications, followed by angwantibos, which were mentioned in 7 publications.

Golden angwantibos (*Arctocephalus aureus*) were observed in the bushmeat trade in DRC and the Republic of Congo, and either *A. aureus* or *A. calabarensis* was observed as bushmeat in Cameroon (2 respondents). *Perodicticus potto* was observed in the bushmeat trade in Ivory Coast and Liberia, and possibly Nigeria, while *P. edwardsi* was observed in Cameroon, Republic of Congo, DRC and possibly in Nigeria. The East African potto (*P. ibeanus*) was observed in the bushmeat trade in Uganda. The numbers of pottos or angwantibos in the bushmeat trade were rarely quantified and if so, often varied widely even from similar regions. Occurrence of pottos and/or angwantibos in the bushmeat trade was reported in the literature from 12 countries, covering most of these species' ranges (Tab. 1, Fig. 1).

One respondent reported the presence of *A. calabarensis* in the pet trade in Cameroon (Fig. 3), whereas 7 respondents reported that *P. potto* was found in the pet trade in Liberia and Guinea, and *P. edwardsi* and *P. ibeanus* in DRC (Fig. 3). Data from the literature on pottos in pet trade is scarce with only *P. potto* reported as pets in Liberia, *P. edwardsi* in Nigeria and either *P. edwardsi* or *P. ibeanus* in DRC (Svensson and Friant, 2014).

Finally, both pottos and angwantibos are reportedly used for medicinal and/or traditional practices, the former in a range of countries, the latter in just a few. One respondent reported that *A. aureus* (burnt remains and skin) was being sold for traditional practices in the Republic of Congo. We found no report of angwantibos being used for medicinal or traditional practices in the post-1994 literature.

The skins and charred remains of *P. ibeanus*, offered for sale for traditional practices in DRC, was reported by 1 respondent, and another respondent reported skins and charred remains of *P. edwardsi* for sale in the Republic of Congo (Fig. 3). Eight publications reported on trade of pottos for traditional practices, including traditional medicine, ornamental use, and as protection charms, spanning 8 countries (Benin, Cameroon, Central African Republic (CAR), DRC, Ghana, Ivory Coast, Republic of Congo and Uganda). Reports from Ivory Coast, Nigeria, and CAR indicate that pottos are used by local people for protection and strength (Caspary, 1999; Ngoufo et al., 2014; Svensson and Friant, 2014). Reports from Cameroon, Nigeria, and Republic

of Congo mention potto parts (bones, skin, meat, etc.) as a cure to heal burns, whereas in Nigeria it is used to cure coughs and diseases such as gonorrhea (King, 1994; Loubelo, 2012; Svensson and Friant, 2014).

Trade in galagos

Fifty-two respondents indicated that they had knowledge of galagos in trade. Twelve respondents had observed galagos for sale first-hand (in Cameroon, DRC, Equatorial Guinea, Ivory Coast, Nigeria, Tanzania, Uganda and Zimbabwe), but galagos traded for bushmeat was also reported (South Africa). Of the galagos, the northern lesser galago (*Galago senegalensis*) was mentioned most frequently in the 33 publications regarding all aspects of trade (N=5), followed by the Bioko squirrel galago (*Sciurocheirus alleni*) (N=4). Less frequently mentioned were *G. demidovii*/*G. thomasi* (N=3), thick-tailed greater galago (*Otolemur crassicaudatus*) (N=2) and southern lesser galago (*Galago moholi*) (N=2).

Garnett's greater galago (*Otolemur garnettii*) was observed in the bushmeat trade in Tanzania by 2 respondents; it was also reportedly fed to the hunting dogs on the Tanzanian island of Zanzibar during the tourist low season, when waste food was scarce. *Otolemur crassicaudatus* and *G. moholi* were observed in the bushmeat trade in Zimbabwe. The respondent from Zimbabwe reported on taboos against hunting/trading galagos, as people in the rural areas tend to believe they possess evil powers due to their red eye-shine. Occurrence of galagos in the bushmeat trade was reported in 10 publications, covering 5 countries of these species' ranges (Tab. 1, Fig. 1). Taboos against eating meat of African lorisiforms was also reported from Cameroon by King (1994) where it was believed that if pregnant women eat this meat they would give birth to "ugly and deformed" babies.

Based on the respondents' answers, galagos were the most frequent African lorisiform taxon in the pet trade (54%; N=32). Three respondents reported the presence of the Tanzania coast dwarf galago (*Galagooides zanzibaricus*), *G. senegalensis* and *O. garnettii* in the pet trade in Tanzania, mainly in urban situations, and 1 respondent reported the presence of *O. garnettii* in the pet trade in Kenya. These 4 respondents reported galagos to be common pets among the expat community in Kenya and Tanzania. Two respondents observed *G. moholi* in the pet trade in Zimbabwe and South Africa. The one respondent from South Africa further reported to hear people often talk about having had *G. moholi* as pets during their childhood. In Cameroon, galagos (unspecified taxa) were also reported to be sold as pets in urban settings, more specifically in Yaounde's city markets. We found no reports of galagos occurring in the pet trade in the literature.

Finally, galagos were reported by 20 respondents to be used in medicinal and/or traditional practices in Cameroon, CAR, Kenya, South Africa, Tanzania and Uganda. One respondent reported on *G. moholi* or *O. crassicaudatus* being sold for traditional practices in South Africa. Two respondents reported skins of *O. garnettii* in Tanzania and of unknown galago species in Cameroon being sold in traditional medicine markets. One respondent, native to Uganda, reported traditional healers using galagos in their practicing. Another respondent reported on the use of products from galagos by the Batwa people in Uganda. Batwa women would prepare a drink/food with the products from galagos for their husbands to consume and this was believed it would keep them from cheating. Six publications reported on the trade of galagos for traditional practices, including traditional medicine and as good luck and/or protection charms, spanning 4 countries (Benin, Ivory Coast, South Africa and Zambia) (Tab. 1). In the literature on traditional practices, *G. moholi* was mentioned in 2 publications and *G. senegalensis* in 2, whilst *O. crassicaudatus* was mentioned in 1. Out of the publications 3 reported that galagos were sold in traditional medicine markets but did not specify the usage (*O. crassicaudatus* in South Africa: Whiting et al., 2011; *G. senegalensis* in Benin: Djagoun et al., 2013; *G. senegalensis* in Ivory Coast: Yaokokore-Beibro et al., 2010). One publication reported on *G. moholi* being used to stop babies from crying and as a charm for love, as well as used by athletes to increase endurance (Zambia: Alves et al., 2010). One publication reported that some people believe that *G. moholi* could be used to treat



Figure 3 – (A) *Arctocebus aureus* hunted for bushmeat in Republic of Congo in 2010 (photograph courtesy of J. Dewilde). (B) Infant *Perodicticus ibeanus* in the pet trade in Northern DRC in 2008 (photograph courtesy of C. Hicks). (C) Family of *A. calabarensis* kept as pets in Cameroon in 2012 (photograph courtesy of S.M. Denny). (D) *Otolemur garnettii* for sale as pets in United Arab Emirates in 2009 (photograph courtesy of E. Al-Ghalib). (E) Skin of *P. ibeanus* for sale in Lusambo area, DRC in 2014 (photograph courtesy of Lukuru Foundation).

epilepsy (Zambia: Baskind and Birbeck, 2005). The traditional practices using African lorisiforms described in the literature and by the respondents refer mainly to current practices and beliefs.

International trade

Over the 20 years prior to 2013 a total of 1930 African lorisiforms were exported by African range countries, and reported to the CITES Secretariat (Tab. 2). The majority of these comprised live trade (i.e. 1876 individuals, or 97%). While the overall trade in dead lorisiforms is small, representing a mere 3% of all international trade, *G. senegalensis* is proportionally traded as dead specimens in larger numbers than all the other species combined ($\chi^2 = 5.11$, df=1, $p < 0.05$). The different species are not traded internationally in equal numbers ($\chi^2 = 4204$, df=8, $p < 0.0001$). When comparing pottos with angwantibos it is clear that the former is traded in significantly higher numbers than the latter ($\chi^2 = 6.43$, df=1, $p < 0.01$) and when comparing all the galagos, it is clear that *G. senegalensis* is traded in larger volumes than all the other species combined ($\chi^2 = 3126$, df=1, $p < 0.0001$). Twice, a single *G. zanzibaricus* was exported as trophies from Zimbabwe to the USA (1997) and the Dominican Republic (1999) (note that Zimbabwe is not a range country for *G. zanzibaricus* suggesting that perhaps another species was

involved). Only 10 angwantibos and 10 southern needle-clawed galagos (*Euoticus elegantulus*) were reportedly exported (both species from Cameroon to Japan in 1999) and only 25 *P. potto* (24 of which were exported from Guinea to the Czech Republic in 2008). Other species were traded in larger numbers, i.e. *G. moholi* (255 individuals), *G. demidoff* (460 individuals), and *G. senegalensis* (1002 individuals). The largest exporter of African lorisiforms is Guinea with 24 *P. potto*, 455 *G. demidoff* and 848 *G. senegalensis*; of these, 980 went to Japan. Zambia is the next largest exporter, with 180 *G. moholi* and 85 *O. crassicaudatus*, all being imported by Japan, followed by South Africa (29 *O. crassicaudatus*, 35 *G. senegalensis* and 67 *G. moholi*), which exported to at least 15 countries. The largest importer of African lorisiforms is Japan, with a combined total of 1325 individuals over the 20 year period; the next largest importer is the Czech Republic with 136 individuals. A further 21 countries imported smaller numbers.

Different numbers of African lorisiforms were traded in the four 5-year time periods between 1994 and 2013 ($\chi^2 = 2104.3$, df=3, $p < 0.0001$). The highest numbers were reported for the period 1994-1998 (totaling 1336 individuals) and the lowest in 2009-2013 (25 individuals). For almost all species the largest numbers were traded in the 1990s, and from 2004 onwards only *G. senegalensis* is still traded in

Table 2 – Export of pottos, angwantibos and galagos out of African range countries (1994–2013), showing the number of live/dead specimens exported during four 5-year time periods and the proportion of trade that comprised wild-caught individuals.

Species	1994–1998	1999–2003	2004–2008	2009–2013	Wild-caught %
<i>Arctocebus</i> spp.	0 / 0	10 / 0	0 / 0	0 / 0	100
<i>Perodicticus</i> spp.	0 / 0	0 / 1	24 / 0	0 / 0	100
<i>Otolemur crassicaudatus</i>	98 / 6	24 / 2	10 / 0	5 / 2	95
<i>Euoticus elegantulus</i>	0 / 0	10 / 0	0 / 0	0 / 0	100
<i>Sciurocheirus alleni</i>	0 / 0	10 / 0	0 / 0	0 / 0	100
<i>Galago demidoff</i>	380 / 0	80 / 0	0 / 0	0 / 0	100
<i>Galago moholi</i>	190 / 1	39 / 1	14 / 0	10 / 0	80
<i>Galago senegalensis</i>	642 / 12	70 / 5	258 / 11	4 / 3	99
<i>Galago zanzibaricus</i>	0 / 0	0 / 1	0 / 0	0 / 0	100
<i>Galago</i> spp.	1 / 6	0 / 2	0 / 0	0 / 1	100

appreciable numbers (Tab. 2). In the most recent five years only small numbers were traded. The largest annual number of animals exported in recent years was in 2008 when 100 *G. senegalensis* were exported by Guinea to Thailand.

The vast majority of trade (95%) comprised wild-caught individuals, and only South Africa reported the export of captive-bred individuals: *O. crassicaudatus* (14), *G. senegalensis* (23) and *G. moholi* (55). These were all reported with a source code C, meaning that they are at least second generation offspring of parent stock that themselves were born in captivity, and none were reported with a source code F, indicating individuals born in a captive environment from wild-caught parent stock.

Discussion

The data we present here is an attempt to quantify the trade in African lorisiforms, how this varies between taxa and between countries, and how it may affect their conservation. Our findings show that trade of African lorisiforms is wide spread, with records from at least 24 countries, encompassing the entire geographic range of the major taxa (Fig. 1). Both families of the African lorisiforms are traded, although in seemingly small numbers compared to the nocturnal primates in Asia and the Neotropics, where for example in the tri-border area of Peru, Brazil and Colombia owl monkeys (*Aotus* spp.) were estimated to be traded in thousands annually (Maldonado et al., 2009), and in Asia where the annual trade of slow lorises (*Nycticebus* spp.) in certain markets can amount to several thousand individuals (Nijman et al., 2014). Once quantitative studies were conducted in Asia, the threat that trade posed became alarmingly apparent (Nekaris and Jaffe, 2007; Nijman and Nekaris, 2014; Nijman et al., 2014). Single events may also increase the trade of lorisiforms almost overnight, as in the case of the “tickling slow loris” video which went viral online in 2009 and caused an upsurge in the pet trade of the slow lorises (Nekaris et al., 2013).

Reports of trade in pottos and/or angwantibos occurred throughout their distribution (Fig. 1) except in the southernmost part of their range, i.e. southern DRC and northern Angola. Likewise, we found no records of trade of galagos in the northern part of their range. We do not think that the absence of reports from these areas indicate an absence of trade, rather its absence reflect the general low levels of focused research conducted in these often politically unstable regions.

Whilst the second research question, regarding the frequency that individual species or genera of lorisiforms are found in the trade, could not be quantifiably answered, it is evident from our online survey and literature review that both African lorisiform families do occur in all trades. The purposes for hunting and trading African lorisiforms described from the respondents were reported in equal numbers, but in the literature bushmeat was the most reported type of trade, and then pottos and/or angwantibos were the most commonly reported.

For bushmeat hunting, we found high levels of concordance between our online survey and that which has been reported in the literature, with indeed most of the trade being reported from Central and West Africa (Bowen-Jones and Pendry, 1999; Covey and McGraw, 2014; Fa et al., 2014; Taylor et al., 2015) and smaller numbers in South Africa

and Mozambique (Fusari and Carpaneto, 2006; Whiting et al., 2011). Perhaps unexpectedly, our study revealed the occurrence of lorisiforms in the East African bushmeat trade as well, albeit in small numbers. Previous studies on bushmeat hunting and trade have focused on Central and West Africa, whilst studies in South and East Africa focused more on trophy hunting (e.g. Caspary, 1999; Fa and Garcia Yuste, 2001; Fa et al., 2006; Bene et al., 2013; Taylor et al., 2015, reflecting differences in both economy and attitudes to wildlife.

The roles of taboos in the conservation of primates has been highlighted for different taxa from a range of countries (golden crowned sifaka (*Propithecus tattersalli*) and crowned lemur (*Lemur coronatus*) in Madagascar (Wilson et al., 1989; Vargas et al., 2002), black-and-white colobus (*Colobus polykomos*) and mona monkey (*Cercopithecus campbelli*) in Ghana (Fargey, 1992; Saj et al., 2006), Kloss' gibbons (*Hylobates klossi*) on the Mentawai Islands, Indonesia Mitchell and Tilson (1986), Javan slow loris (*Nycticebus javanicus*) on Java, Indonesia (Nijman and Nekaris, 2014), red faced spider monkey (*Atelus paniscus*) in Guyana (Luzar et al., 2012), black howler monkeys (*Alouatta pigra*) in Belize (Jones and Young, 2004)) but hitherto the role of taboos in the conservation of African lorisiforms has been rarely reported (but see Carpaneto and Germi, 1989, King, 1994 and Ngoufo et al., 2014). In Madagascar the tradition of not eating lemur meat due to taboos is weakening (Barrett and Ratsimbazafy, 2009), and there are some indications that taboos related to African lorisiforms are perhaps not as strong as they used to be (cf. Keylock, 2002). However, due to the lack of baseline data this is difficult to quantify.

Our research highlighted the apparent importance of the pet trade as a potential impediment to the conservation of African lorisiforms. The use as pets was the most reported trade of both pottos and galagos, and these taxa are kept as pets throughout Africa. While the pet trade in pottos has been highlighted before (Svensson and Friant, 2014), data from the online survey suggest that galagos are even more frequently kept as pets. In Africa, the pet trade in lorisiforms seems to be at least in part opportunistic, as a by-catch from hunting (Hicks et al., 2010; Svensson and Friant, 2014), although some targeted hunting does occur as well (Svensson and Friant, 2014). In our online survey the majority of galagos were reported to occur in the pet trade from Tanzania, Kenya and South Africa, where they were mainly reported to be kept by expats, or sold in urban locations (bus stations or city markets). Pottos and angwantibos on the other hand were more commonly reported to be traded in small village markets and along the roads, or infants kept by hunters who killed the adult pottos and/or angwantibos. Galagos park their infants whilst foraging and often these infants are believed to be abandoned, and consequently “rescued” (Nekaris, 2013a), thus providing an avenue into the pet trade.

From our online survey we found that most observations of African lorisiforms for sale were made in rural areas, which coincides with previous studies (Fa et al., 2006; Svensson and Friant, 2014). This seems to show that the trade in African lorisiforms is localized to villages, potentially indicating that demand is not high enough to fuel long-distance trade. But is the trade of African lorisiforms becoming more common and posing a major threat? A small number of respondents sug-

gested that African lorisiforms were likely considered too small to be sold in wildlife markets and that they were either eaten in the forest by the hunters as a “snack”, or brought home as food (Fig. 3). However, Svensson and Friant (2014) provided anecdotal evidence of a shift from larger to smaller game, including angwantibos, as a result of overhunting in the Republic of Congo.

Traditional uses varied throughout the ranges of the African lorisiforms, with pottos and/or angwantibos being used in mystical rituals, ornamental use and to give strength to the user, whereas galagos were used in traditional medicine and as good luck charms. As such pottos were mainly reported to be used by local people and traditional healers, whereas galagos, in addition, were used even by health care workers in hospitals (cf. Baskind and Birbeck, 2005).

The international trade in African lorisiforms from range countries, as reported to the CITES Secretariat, by and large comprises wild-caught individuals, thereby potentially having a negative impact on their conservation. Fortunately, the numbers traded internationally have clearly diminished in recent years, and only *G. senegalensis* is still traded in appreciable numbers. Japan stands out as one of the larger importers. Musing and Nekaris (2015) found that the demand for *Nycticebus* spp. as pets is increasing in Japan and the illegal import of these nocturnal species is on the rise. Although the low export numbers reported to CITES does not indicate a major threat to these primates and their conservation, it would be prudent to monitor trade of the African lorisiforms into Japan (both from range countries and elsewhere) to ensure it does not exceed agreed levels.

Research agenda and the road ahead

This study could be seen as a first preliminary attempt to quantify the nature and the magnitude of the trade in African lorisiforms, thereby raising perhaps more questions than it answers; the data we managed to compile do allow us to make suggestions for a future research agenda and to plan for the road ahead in terms of the management of lorisiforms throughout Africa. It is clear from our online survey and from the literature that there are clear deficiencies in identifying African lorisiforms in trade (as well as in the wild: Nekaris and Nijman, 2013). The inability to narrow down which species are traded in what quantities, because of taxonomic uncertainties and identification problems, may distort our understanding of the conservation of these African lorisiforms, and to what extent trade acts as an impediment to the conservation of individual species. While the trade and ethnozoological uses of African lorisiforms may appear to be small-scale, its impact may nevertheless be significant in certain areas and at certain times, especially when trade is considered in conjunction with other anthropogenic pressures.

Our data are parallel to those collected for Asian lorisiforms in the 1990s; at that point trade was not considered a threat to Asian lorisiforms and is now seen to be the greatest threat (Nekaris, 2013b). Our insight into the trade of African lorisiforms should be followed up with concerted studies, with an emphasis on quantifying trade to the species level. Further research is necessary to fill this knowledge gap, in particular more field studies to assess population size and trends of African lorisiforms, but also ensuring that these species are included in surveys monitoring offtake, including interviews with hunters/traders to better understand harvest and trade. The primary responsibility for this lies with the government agencies responsible for natural resource management, but it is clear that academic institutions both in range countries and elsewhere have a role to play. Further research would also aid in revising the IUCN Red List threat categories of the African lorisiforms, to potentially include hunting and trade as threats.

It must be ensured that the species that are traded are consistently and accurately identified and recorded. Different names/synonyms used by different parties (international conventions, national government agencies, NGOs, and academics) leads to confusion about the actual identity of the species, thus hampering traceability and assessment of the magnitude of the trade.

The use of African lorisiforms as nutritional resources, as pets and in traditional practices may have been sustainable in the past, but with

globalization and an ever increasing human population being dependent on a depleting natural resource base, this may no longer be the case. It seems imperative to quantify the use of African lorisiforms in at least a part of their range so as to be able to assess its potential impact. We also recommend further study on the existence of taboos prohibiting the use of these primates as they may exist “under the radar” to understand the role this might have for their conservation. Given the limited data we have on the occurrence and abundance of the African lorisiform taxa, we suggest to initiate these studies in Central Africa (DRC, Republic of Congo, CAR). 

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Author's Galley