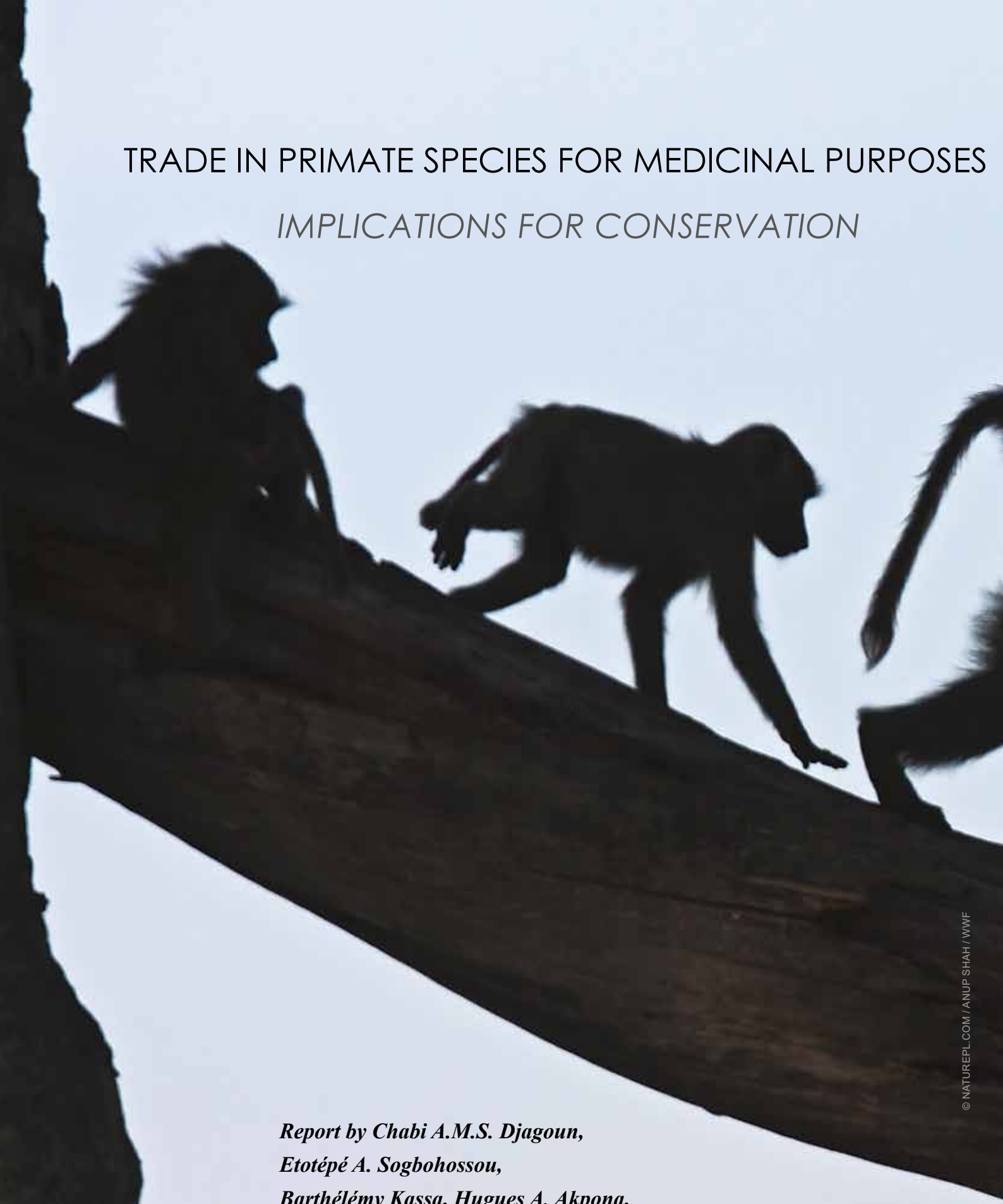
TRADE IN PRIMATE SPECIES FOR MEDICINAL PURPOSES

IMPLICATIONS FOR CONSERVATION



© NATUREPL.COM / ANUP SHAH / WWF

Report by Chabi A.M.S. Djagoun, Etotépé A. Sogbohossou, Barthélémy Kassa, Hugues A. Akpona, Isidore O. Amahowe, Joël Djagoun and Brice Sinsin

IN SOUTHERN BENIN:

Introduction

Primates are among the most persecuted of animals, relentlessly hunted for their meat and fur, or killed for stealing crops in fields that were once their home (Mittermeier *et al.,* 2007; Taylor *et al.*, 2015, Ripple *et al.,* 2016). In some cultures and contexts (e.g. Hindu practices across Asia and among the Fon people in Benin), primates are viewed as sacred; in others, such as in China or Japan, they are considered mythical creatures of cunning and deviousness, while for most of the world's subsistence farmers living in close proximity to monkeys and apes, they represent a significant crop pest (Alves and Rosa, 2013). Their role in folk practices has been recorded in different socio-cultural contexts throughout the world.

In southern Benin, primates are commonly used in traditional medicine, both for the treatment of ailments and for folkloric or magical purposes, such as improving relationships and attaining good fortune. The authors conducted interviews with animal-based medicine traders in six main cities of southern Benin. In order to estimate the use value and fidelity level of the different primate species and their products, the authors asked questions related to their origin and their uses.

This study is a preliminary assessment of primates for animal-based medicine purposes in southern Benin and aims to provide an overview of the use of primates in traditional folk medicine in that location. The specific objectives were: (1) to assess the diversity and the use value of each primate species in relation to their conservation assessment using IUCN criteria; (2) to identify the origin of the primates found in targeted markets; and (3) to evaluate the ethno-medicinal purposes of these animals. Further investigation is required to increase our understanding of the harvesting and trade of these species, and to assess the impacts caused by commercial exploitation.

Family of baboons *Papio* sp.

Background

The Government of Benin is party to the Convention on Biological Diversity (CBD) Global Strategic Plan for Biodiversity 2011–2020 and endorses its 20 Aichi Biodiversity Targets (CBD, 2010). In the Fifth National report of Benin on Biodiversity for CBD, it was highlighted that the Aichi Targets are not on track to meet the 2020 deadline. In that report, it was pointed out that wildlife species face a number of complex challenges including depleted resources, competition for habitats used by wildlife, overharvesting and poaching, and changing habitats. In order to address wildlife conservation and ensure sustainable livelihoods, decisions at multiple levels across multiple sectors need to be guided by information on the state of all wildlife conservation. However, numerous challenges hamper access to, and use of, wildlife data in Benin, including scarcity of scientific research, gaps or other inadequacies in indicators, datasets and capacity. In this context, mobilising traditional knowledge of wildlife species could be useful in the management of some threatened species.

Various studies have addressed the conservation concerns arising from the use of medicinal products from primates, especially because many of them are threatened species (Ahmed, 2001). The importance of primates in the traditional folk medicine of different ethnic groups in Benin has frequently been overlooked, even though there is widespread anecdotal evidence for their use as medicine. Such uses represent important threats to certain primate populations. There is therefore a need to improve our limited understanding of the use of primates and the specific impacts of these practices and to formulate some recommendations regarding the public health risk, as it is well recognised that numerous infectious diseases can be transmitted from animals to humans (i.e. zoonoses), especially within the primates order (Wolfe and Fuentes, 2007).

Legislation

Hunting is permitted in Benin under authorisation from the government, but is limited to certain species. According to Law N° 2002-16 of 18 October 2004 on wildlife protection in Benin and Decree N° 2011-394 of 28 May 2011, setting the modalities of conservation and sustainable management of fauna and its habitats in the Republic of Benin, the Senegal Bushbaby *Galago senegalensis*, White-thighed Black-and-White Colobus *Colobus vellerosus* and Red-bellied Monkey *Cercopithecus erythrogaster* are integrally protected; the Vervet Monkey *Chlorocebus tantalus*, Patas Monkey *Erythrocebus patas*, Mona Monkey *Cercopithecus mona*, and Olive Baboon *Papio anubis* are partially protected and may be hunted outside protected areas, while other primate species are not listed. Despite these hunting restrictions, poaching represents the major threat to this taxonomic group in Benin (Nobimè *et al.,* 2008).

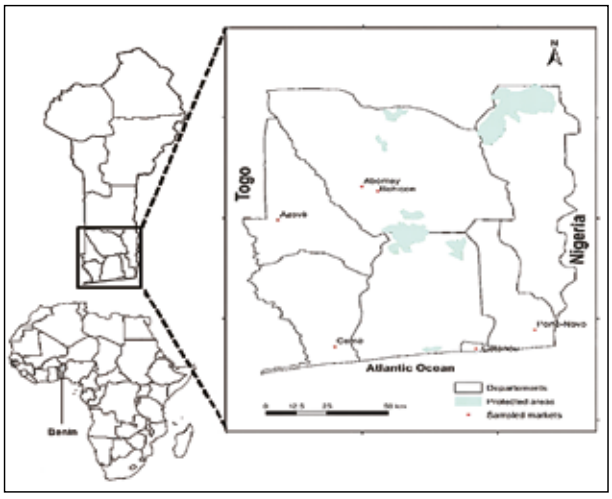


Fig. 1. Location of sampled markets in southern Benin.

Methods

Identification of study sites

This study, undertaken between March and June 2012, required the full contribution of traditional healers, who are the principal holders of knowledge of ethno-therapeutic resources. The choice of animal-based medicine markets has a double advantage because concerned actors combine their profession as traditional healers and as traders. Markets were selected based on their proximity to protected areas, their scale (local,

City	Ethnic groups[1]	Sample size	Description of interview location
Cotonou	Fon	20	International market of Dantokpa and the biggest market in Benin.
Porto–Novo	Goun	20	The market in administrative capital of Benin and close to wetlands (Ouémé valley, Hlan river) part of Ramsar[2] site 1,017 and close to Nigeria.
Comè	Mina	15	Close to wetlands (Ramsar site 1,018), close to Togo.
Azové	Mina	10	Close to wetlands (Ramsar site 1,018), close to Togo.
Abomey	Fon	15	A city of great historical and cultural importance and attached to traditions.
Bohicon	Fon	15	A city of great historical and cultural importance and attached to traditions.

Table 1. Sample size of markets and identification of study sites in southern Benin.
[1]the local language used is called the same as the ethnic group; [2]https://www.ramsar.org/fr/zone-humide/benin

national or international), and dominant ethnic groups in the area. Considering all these aspects, 95 animal-based medicine traders were interviewed in the animal markets in six main cities of southern Benin (Table 1; Fig. 1). All interviewees were males over 40 years old.

Data collection

The authors visited outdoor markets, occasional markets (markets set up for special events), and outlets selling religious articles, where products derived from wildlife are commonly sold (e.g. Fig. 2). Data were collected on the medicinal importance of each primate species, as well as their functions and uses, the organs requested, the prices of each primate by-product, the species richness and abundance of specimens displayed and their likely origin of supply. The species diversity recorded was based on the interviews and from direct observations.

Data analysis

In order to determine their status classifications, all recorded primate species were checked against the IUCN Red List Categories and Criteria version 3.1 (http://www.iucnredlist.org/), Benin's official list of endangered species (Neuenschwander *et al.,* 2011) and against the Appendices of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) (https://www.cites.org/eng/app/appendices.php). The authors calculated the use value for each species, a quantitative method that illustrates the relative importance of a species known locally. This value was calculated using the following formula: UV=ΣU/*N,* where: UV is the use value of a species; U the number of times a species was mentioned as being in use by a survey participant/interviewer; *N* is the number of informants. The relative abundance of each primate species was assessed by calculating the ratio of the number of individuals represented by body parts out of the total per category. The fidelity level (FL) indicates the percentage of informants claiming the use of a certain animal species for the same medicinal purpose (Friedman *et al.,* 1986). It is useful for identifying the informants' most preferred species for treating certain ailments. The FL was calculated as follows:

$$FL(\%) = \frac{N_p \times 100}{N}$$

Where N_p is the number of informants that claim a use of a species to treat a particular disease, N is the number of informants that use the animal as a medicine to treat any given disease. The authors also performed the Pearson correlation analysis to understand the relationship between the percentage of the traders selling primate species and the average selling price of the items for sale.

Results and Discussion

Primate species traded on the animal-based medicine market in Benin

In the markets studied, the trade in primate body parts for animal-based medications was shown to be common

© WWF-US / NATURAL HABITATS

▲ **Olive Baboon *Papio anubis***

© ZANVO 2018

© DJAGOUN 2011

© DJAGOUN 2014

▼ **Fig. 2. Patas Monkey *Erythrocebus patas* heads (below left), and the hand and skin of a Chimpanzee *Pan troglodytes* Djougou market (below right); the skulls of different primate species (bottom) on display at Dantokpa international market, southern Benin.**

Patas Monkey *Erythrocebus patas*

practice in southern Benin. Eleven primate species occurring in Benin were recorded at the animal-based medicine markets. Of these, nine were found to be offered or traded at select markets in southern Benin; apart from the species that were observed for sale, it was not always possible for the authors to verify whether all those being offered by the sellers were available; in addition, two species that do not occur in Benin—gorillas *Gorilla* sp. and Chimpanzees *Pan troglodytes* (Fig. 2) (Sinsin and Kampmann, 2010)—were also recorded, although were the least commonly recorded primate species for sale. Chimpanzee and gorilla species are listed in CITES Appendix I and, as such, international trade in these species is prohibited; the specimens on display must therefore have been illegally imported. The species most commonly sold—recorded to be offered for sale by more than 50% of the traders—were Vervet Monkey, Patas Monkey, Mona Monkey, Olive Baboon and Senegal Bushbaby. The use value (UV) of all primate species used for zoo-therapeutic purposes ranged from 0.04 to 0.57. The species which had the highest use value were White-thighed Black-and-White Colobus (0.57), Vervet Monkey (0.35), Olive Colobus *Procolobus verus* (0.28), Patas Monkey (0.21). Conversely, Olive Baboon (0.04), Potto Gibbon *Perodicticus potto* (0.06), Chimpanzee (0.08), Demidoff's Galago *Galagoides demidoff* (0.08) and Senegal Bushbaby (0.09) were the least used. Table 2 summarises the primate species used for medicinal purposes, the commonly traded species, the use value of a species and the conservation status.

The principal origin of the primate products displayed in the markets was Nigeria, but several countries of West and Central Africa also feed the trade in primate products on sale in Benin. All species are believed to have both medicinal and magical values, however their use for magical purposes predominates.

The abundance of species sold in the traditional medicine markets partly mirrored the same trend of species abundance in their natural habitat (Nobimè *et al.,* 2008). This was true for some species such as the Patas Monkey, which is very common throughout the country, but not for other species; specimens of species threatened in Benin, such as the Mona Monkey, were found with almost all the traders interviewed.

Species	Frequency of traders selling the species (%)	Use-value of a species[1]	IUCN Red List[2]	Benin Red List[3]	CITES listing[4]
Mona Monkey *Cercopithecus mona*	97.3	0.13	LC	VU	II
Patas Monkey *Erythrocebus patas*	85.3	0.21	LC	LC	II
Olive Baboon *Papio anubis*	75.1	0.04	LC	LC	II
Vervet Monkey *Chlorocebus tantalus*	68.8	0.35	LC	LC	II
Senegal Bushbaby *Galago senegalensis*	30.5	0.09	LC	LC	II
Demidoff's Galago *Galagoides demidoff*	23.6	0.08	LC	LC	II
White-thighed Black-and-White Colobus *Colobus vellerosus*	20.4	0.57	VU	EN	II
Potto Gibbon *Perodicticus potto*	25.4	0.06	LC	LC	II
Chimpanzee *Pan troglodytes*	11.2	0.08	EN	[5]	I
Olive Colobus *Procolobus verus*	10.4	0.28	LC	EN	II
Gorilla *Gorilla* sp.	9.7	0.15	CR	[5]	I

Table 2. The diversity, abundance, use value and conservation status of primate species traded for zoo-therapeutic purposes across southern Benin.

[1]Higher figure indicates higher use value; [2]http://www.iucnredlist.org/; [3]See: Neuenschwander *et al.,* 2011; [4]https://www.cites.org/eng/app/appendices.php; [5]not occurring in Benin

Source of primate species traded in southern Benin

According to information received from traders, most of the primates and other animals sold in Benin markets come from the country's national parks or gazetted forests. However, although most of the primates on sale occur in Benin, the authors discovered that traders also imported them from other African countries. The traders identified 10 countries from where wildlife products derived from primates are imported (Fig. 3). Primates in the traditional medicine markets in Benin primarily come from Nigeria (34%), followed by Burkina Faso (16%), Ghana (14%), Niger (11%), Togo (8%), Gabon (5.6%), Côte d'Ivoire (4.8%) and Mali (3%). Central African countries as a source of supply, including Congo and Cameroon, were cited only by 2.5% and 2% of traders respectively. The fact that more than 30% of the primates traded at the animal medicine markets were reported to have come from Nigeria is likely attributable to Nigeria's close proximity. Moreover, Nigeria is more densely forested compared to Benin's other neighbouring countries such as Burkina Faso and Niger, which are in the Sahelian region (CILSS, 2016) and have lower densities of primates. Establishing the impact of traditional medicine on wildlife is notoriously difficult because traders are reluctant to reveal the exact source of their stocks, which is why the data collected relate to the country of origin only. The authors' findings on the source of the primates traded on the traditional medicine market in Benin suggest the existence of transnational organised wildlife crime as the trade is undertaken without CITES permits. The authors also suspect that the efforts of border security forces in controlling primates and other species being imported into Benin are hindered either by corruption or circumvention of current border management policies.

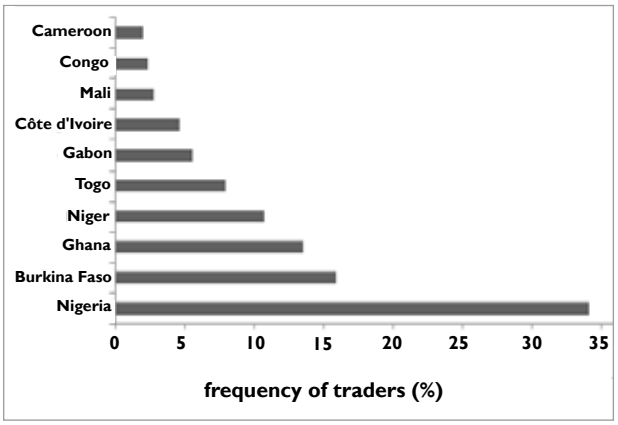


Fig. 3. The origin of imported primates offered on traditional medicine markets in southern Benin.

Source: trader interviews

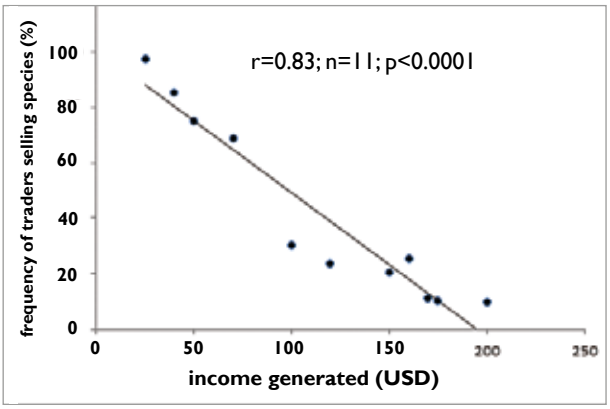


Fig. 4. Correlation between the percentage of traders selling primate species and the average selling price of the given species in southern Benin.

Primate consumption levels and species rarity vs. selling price

Primates were mostly sold as individual body parts, and bones and skulls were the most frequently documented items (n=564). Senegal Bushbabies recorded at the markets were mostly live specimens owing to customer preference, according to the sellers, but also possibly because their small size enables poachers to transport specimens to market more easily and discreetly compared with other primates. On average, primate traders (n=20) sold to seven customers per day, but this ranged from two and up to 30 customers on a very busy day. However, no data were available on the actual turnover of specific species and the rate at which stocks were replaced. The authors found a positive and significant correlation between the percentage of traders selling a primate species and the average selling price of the given species in southern Benin markets ($r=0.83$; $n=11$; $p<0.0001$, Fig. 4). Therefore, the rarer a species is on the market, the more expensive it is. It would have been interesting to assess the number of individuals of each species traded in the markets in order to assess the importance of the trade to the natural population depletion, especially for endangered species. As most of the time only parts of the bodies were found, this was not possible. Only prohibitively expensive DNA analysis would allow such estimation (Scott, 2008).

Traditional uses of primate species

While the body parts of some wildlife species sold in southern Benin markets all have medicinal uses, for others only some parts are used. These can be from live or dead animals. However most parts are traded or used in their raw and dried forms. The following animal parts/products are sold separately as remedies: bones, skins, tails, furs, skulls, bile, hands, legs and teeth. The zoo-therapeutic value of primate species was classified into two categories: medicinal or magico-religious value. Table 3 records the medicinal or the magico-religious value of the primates with their degree of fidelity level in citation. Different ways of preparing and administering such remedies were reported by the interviewees. Frequently,

when used for medicinal purposes, the body parts are sun-dried, crushed into powder and applied to the part of the body that needs treating. For magical purposes, the body part is used alone or in conjunction with other products. A slightly greater number of parts are used for magical purposes than for medicinal purposes. This also shows the importance of magic in traditions in Benin. Alves *et al.,* (2008) reported on the commercialization of similar raw materials used as remedies in certain Brazilian cities owing to the similarity in *vodoun* culture practiced in both countries, according to the history of the slave trade. Primates are commonly associated with myths in the faiths of different countries and used in magical or religious rituals (Mittermeier *et al.,* 2007). The species most used for medicinal purposes are the Mona and Patas Monkeys, while the ones preferred for magical purposes are Demidoff's Galago and Olive Colobus. This could be explained by the greater availability of the Mona and Patas Monkeys compared to other primate species (Campbell *et al.,* 2008). Indeed, numerous animal species are hunted or poached for their meat rather than for their supposed medicinal use (Ripple *et al.,* 2016). Nevertheless, there is often an overlap between the two purposes, and transmission of diseases can occur in both instances. Unfortunately, the potential health risk of animal-based medicine is ignored by the actors involved. Several species of monkeys have been identified as harboring infectious diseases transmissible to humans, with potentially grave consequences (Still, 2003). Organs and various tissues, including bones and bile, can be a source of Salmonella infection, causing chronic diarrhoea and endotoxic shock, but also the recently emerging disease Ebola that can *inter alia* be caused by the consumption of infected primate parts. The possibility of transmission of other serious and widespread zoonoses such as tuberculosis or rabies should be considered whenever animal tissues from unknown sources are handled and used as remedies (Alves and Rosa, 2007). Additionally, it is essential that traditional drug therapies be vetted by a government and/or independent health agency regarding benefit/risk issues. Unfortunately, little research has been done to prove the claimed clinical efficacy of primate products for medicinal purposes. The use of animals for medicinal purposes is a component of traditional knowledge that is increasingly becoming more relevant to discussions on conservation biology and within multilateral environmental agreement negotiations (e.g. the CBD discourse on "Traditional Knowledge"), public health policies, and sustainable management of natural resources, biological prospection, and patents.

Conservation Implications

This study confirms that several primate species are used in traditional folk practices in Benin. The species are usually collected in the wild and many are threatened by overharvesting according to Linder and Oates (2011). Despite the fact that the link between trade and the current status of primates in Benin is not well known, or understood, the extent of the trade and the decline of most primate populations in their natural habitat suggests that the problem is important, and that there is an urgent need to monitor the volume of the trade and its impact on primate populations. In Benin, the authors found that the rarest species on display were more expensive than more commonly available species. This may be an important factor in the reduced numbers of a given species as

Vervet Monkeys were among the primate species reported to be the most commonly sold during the survey period in southern Benin.

selective hunting is carried out to supply demand and make more profit. In addition, as reported by the interviewees, the rarer a species is and the more difficult to hunt, the more likely it is used as a traditional medicine ingredient. For the rarest mammal species, demand almost exceeds supply. Thus, the high prices and corresponding demand for some of these species increases hunting pressure, as the traders likely prefer to display high value, rare species. The authors found that 92% of respondents were not aware of the IUCN or Benin Red List conservation status of the species they traded. However, they did confess to being aware that some primate species sold are protected by law and that they were prepared to take the risk of being arrested. Also, many are likely to be illegally traded from neighbouring countries. This indicates an extensive lack of awareness crucial for the effectiveness of conservation strategies. It is important to remark that the use of certain animal remedies may have been more understandable in the past, when no other therapeutic alternatives were available, and when most species were probably plentiful in their natural habitat and the extent of the trade was on a smaller-scale. There is a need to incorporate indigenous knowledge systems and facilitate the effective participation of local communities in policy making and implementation concerning the sustainable use and conservation of biodiversity resources through participatory management. The trade of several of these primate species is illegal in Benin and there is a need for effective law enforcement. Moreover, the presence of gorillas and Chimpanzees in the markets surveyed raises both conservation concerns as well as concerns over the effective implementation of CITES in Benin (see also CITES Secretariat, 2017). Corrupt security agents and porous borders in Benin are suspected to be the main drivers of likely illegal trade in contravention of CITES. It is also important to raise awareness of the status of endangered species and of the Benin Red List. There are numerous reasons to re-evaluate the medicinal use of primate products in traditional medicine. In doing so, account should be taken of the rarity of some species, the unnecessary suffering that hunting incurs, and the possible health risks linked to the administration of animal-based remedies.

SPECIES	TYPE OF USE / VALUE	BODY PARTS	USES	FIDELITY LEVEL(%)
Vervet Monkey *Chlorocebus tantalus*	Medicinal	Bile	Malaria, jaundice, heart problem, gout	68.8
	Magic	Skull	Drive off evil spirits when kept in the house	45.3
Mona Monkey *Cercopithecus mona*	Medicinal	Skin	Burns, area of fractured bone and sprains	97.3
	Magic	Head	Drive off evil spirits	38.2
Patas Monkey *Erythrocebus patas*	Medicinal	Bone	Against snakebite	85.3
	Magic	Skull	Accident prevention	15.3
Olive Baboon *Papio anubis*	Medicinal	Tibia bone	Assist children who take longer to start walking	75.1
	Magic	Bones, teeth, claws	Charms	61.2
White-thighed Black-and-White Colobus *Colobus vellerosus*	Medicinal	Bone	Burns, wounds	20.4
	Magic	Body	Preventive measure from snakebite	60.3
Olive Colobus *Procolobus verus*	Medicinal	Bone	Cure different body ailments	74.4
	Magic	Body	Protection against evil influences/ manipulation and appeasing witches	80.2
Senegal Bushbaby *Galago senegalensis*	Medicinal	Bone	Burns, wounds	30.5
	Magic	Skull/head	Make spirit association with a fetish	10.3
Demidoff's Galago *Galagoides demidoff*	Medicinal	Bile/fat	Jaundice, malaria, gout, burns, wounds	23.6
	Magic	Skull	Frighten the enemy and witches	91.5
Gorilla *Gorilla* sp.	Medicinal	Bone	Cure different body ailments	9.7
	Magic	Head/skull + fore hind arms	Protection against evil influences/manipulation	79.3
Chimpanzee *Pan troglodytes*	Medicinal	Male organs	Aphrodisiac/potency for men	11.2
Potto Gibbon *Perodicticus potto*	Magic	Body	Protection against evil influences/ manipulation and appeasing witches	1.3

Table 3. Categories of diseases treated with primate species in surveyed cities.

Acknowledgements

This study was financially supported by the American Society of Primatology through a grant provided to Chabi Adéyèmi Marc Sylvestre Djagoun. IDEA WILD supported the fieldwork equipment through a grant provided to Dr Djagoun. The authors are grateful to the traders who participated in this research. They also acknowledge Gboja Mariano Houngbedji for his assistance during the field data collection phase. The authors would also like to thank Roland Melisch and Sone Nkoke Christopher of TRAFFIC, and two anonymous reviewers for their helpful comments on an early draft of this manuscript.

References

Ahmed, A. (2001). Illegal trade and utilization of primates in India. Wildlife and protected areas: non-human primates of India. *ENVIS Bulletin* 1:177–184.

Alves, R.R.N., Lima, H.N., Tavares, M.C., Souto, W.M.S., Barboza, R.R.D. and Vasconcellos, A. (2008). Animal-based remedies as complementary medicines in Santa Cruz do Capibaribe, Brazil. *BMC Complementary and Alternative Medicine* 8:1–9.

Alves, R.R.N. and Rosa, I.L. (2007). Zootherapeutic practices among fishing communities in North and Northeast Brazil: a comparison. *Journal of Ethnopharmacology* 111:83–103.

Alves, R.R.N. and Rosa, I.L. (2013). *Animals in Traditional Folk Medicine: Implications for Conservation*. Springer-Verlag, Berlin Heidelberg.

Campbell, G., Teichroeb, J. and Paterson, J.D. (2008). Distribution of Diurnal Primate Species in Togo and Bénin (Technical Report). *Folia Primatol* 79:15–30. doi.org/10.1159/000108383

CILSS (2016). Landscapes of West Africa—a window on a changing world. *U.S. Geological Survey EROS*, 47914 252nd St, Garretson, SD 57030, USA.

CITES Secretariat (2017). Status of legislative, progress for implementing CITES. https://cites.org/sites/default/files/eng/com/sc/69/inf/E-SC69-Inf-20.pdf

Friedman, J., Yaniv, Z., Dafni, A. and Palewitch, D. (1986). A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev desert, Israel. *Journal of Ethnopharmacology* 16: 275–287.

Linder, J.M. and Oates, F. (2011). Differential impact of bushmeat hunting on monkey species and implications for primate conservation in Korup National Park, Cameroon. *Biological Conservation* 144:738–745.

Mittermeier, R.A., Ratsimbazafy, J., Rylands, A.B., Williamson, L., Oates, J.F., Mbora, D., Ganzhorn, J.U., Rodríguez-Luna, E., Palacios, E., Heymann, E.W., Kierulff, M.C.M., Yongcheng, L., Supriatna, J., Roos, C., Walker, S., and Aguiar, J.M. (2007). Primates in peril: the world's 25 most endangered primates, 2006–2008. *Primate Conservation* 22:1–40.

Neuenschwander, P., Sinsin, B. and Goergen, G. (2011). *Protection de la Nature en Afrique de l'Ouest: Une Liste Rouge pour le Bénin. Nature Conservation in West Africa: Red List for Benin.* International Institute of Tropical Agriculture, Ibadan, Nigeria.

Nobimè, G., Gaoué, O.G. and Sinsin, B. (2008). Distribution des espèces de primates au Benin et ethnozoologie. *International Journal of Biological & Chemical Sciences* 2(3):346–354.

Ripple, W. J., Abernethy, K., Betts, M.G., Chapron, G., Dirzo, R., Galetti, M., Levi, T., Lindsey, P.A., Macdonald, D.W., Machovina, B., Newsome, T.M., Peres, C.A., Wallach, A.D., Wolf, C. and Young, H. (2016). *Bush meat hunting and extinction risk to the world's mammals.* Royal Society Open Science, 3:160498. http://dx.doi.org/10.1098/rsos.160498

Scott, B.C. (2008). A truer measure of the market: the molecular ecology of fisheries and wildlife trade. *Molecular Ecology* 17:3,985–3,998.

Sinsin, B. and Kampmann, D. (2010). Atlas de la Biodiversité de l'Afrique de l'Ouest. Tome 1, Vol 1. Cotonou & Frankfurt. 691 pp.

Still, J. (2003). Use of animal products in traditional Chinese medicine: environmental impact and health hazards. *Complementary Therapies in Medicine*, 11:118–122. doi:10.1016/S0965-2299(03)00055-4

Taylor, G., Scharlemann, J.P.W., Rowcliffe, M., Kümpel, N., Harfoot, M.B.J., Fa, J.E., Melisch, R., Milner-Gulland, E.J., Bhagwat, S., Abernethy, K.A., Ajonina, A.S., Albrechtsen, L., Allebone-Webb, S. Brown, E., Brugiere, D., Clark, C., Colell, M., Cowlishaw, G., Crookes, D., De Merode, E., Dupain, J., East, T., Edderai, D., Elkan, P., Gill, D., Greengrass, E., Hodgkinson, C., Ilambu, O., Jeanmart, P., Juste, J., Linder, J.M., Macdonald, D.W., Noss, A.J., Okorie, P.U., Okouyi, V.J.J., Pailler, S., Poulsen, J.R., Riddell, M., Schleicher, J., Schulte-Herbrüggen, B.J., Starkey, M., van Vliet, N., Whitham, C., Willcox, A.S., Wilkie, D.S., Wright, J.H., Coad, L.M. (2015). Synthesising bushmeat research effort in West and Central Africa: a new regional database. *Biological Conservation* 181:199–205.

Wolfe, L.D. and Fuentes, A. (2007). Ethnoprimatology: Contextualizing human and nonhuman primate interactions. In: Campbell, C.J., Fuentes, A., MacKinnon, K., Panger, M. and Bearder, S.K. (Eds), *Primates in Perspective*. New York, Oxford: Oxford University Press, Pp. 691–702.

Chabi A.M.S. Djagoun (*corresponding author*)
Email: dchabi@gmail.com
Etotépé A. Sogbohossou[1], ***Barthélémy Kassa***[1], ***Hugues A. Akpona***[1,2], ***Isidore O. Amahowe***[2], ***Joël Djagoun***[1], ***Brice Sinsin***[1]

[1]*Laboratory of Applied Ecology, Faculty of Agronomic Sciences, University of Abomey-calavi, 01BP526 LEA-FSA, Cotonou, Benin.* [2]*Direction Générale des Forêts et des Ressources Naturelles, BP. 393 Cotonou, Bénin.*