CONVENTION SUR LE COMMERCE INTERNATIONAL DES ESPECES
DE FAUNE ET DE FLORE SAUVAGES MENACEES D'EXTINCTION

Trentième session du Comité pour les animaux
Genève (Suisse), 16 – 21 juillet 2018

Questions spécifiques aux espèces

Espèces terrestres

GRANDS SINGES (HOMINIDAE SPP.)

1. Le présent document a été préparé par le Secrétariat.

2. À sa 17esession (CoP17, Johannesburg, 2016), la Conférence des Parties a adopté les décisions 17.232 et 17.233 sur les *Grands singes* comme suit:

   À l'adresse du Secrétariat

   17.232 *Le Secrétariat collabore avec le groupe CSE/UICN de spécialistes des primates, le GRASP[1] et d'autres spécialistes, et, sous réserve que des fonds suffisants soient disponibles, produit un rapport relatif à l'état des grands singes et à l'impact relatif du commerce illégal et des autres pressions sur cet état, en vue d'un examen par le Comité permanent.*

   Directed to the Standing Committee

   17.233 *Le Comité permanent examine le rapport préparé conformément à la décision 17,232 et, s'il y a lieu, élabore des recommandations pour des actions futures qui seront examinées à la 18 e session de la Conférence des Parties.*

Historique

3. À la 69e session du Comité permanent (SC69, Genève, novembre 2017), le Secrétariat a rendu compte verbalement des actions engagées en vertu de la résolution Conf. 13.4 (Rev. CoP16) *Conservation et commerce des grands singes*. Il a expliqué que, pour ce qui concernait la décision 17.232, il avait d'abord espéré que le rapport serait prêt pour soumission à la présente session, mais que pour diverses raisons cela n'avait pas été possible. Pour faire avancer l'étude, un calendrier révisé avait été proposé par le GRASP, la CITES et l'Union internationale pour la conservation de la nature (UICN), calendrier qui avait été accepté par le Comité permanent, de sorte que le rapport sur la situation des grands singes sera soumis pour examen à la 70e session du Comité permanent (SC70).

4. Il avait également été proposé que, dans la mesure où cette étude est en grande partie de nature scientifique, la contribution du Comité pour les animaux serait tout à fait souhaitable. Le président du Comité pour les animaux a indiqué que celui-ci examinerait volontiers le rapport prévu dans la décision 17.232 dès qu'il l'aurait reçu et ferait part de ses observations. Le Comité permanent a demandé au Secrétariat de soumettre le rapport en question au Comité pour les animaux pour examen à la présente session (SC69 Summary Record).

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[1] *GRASP = Great Apes Survival Partnership, initiative de l'Organisation des Nations Unies vouée à assurer la survie à long terme des chimpanzés, gorilles, bonobos et orangs-outans, et de leurs habitats en Afrique et en Asie (www.un-grasp.org).*

5. Le Comité permanent a créé un groupe de travail intersessions sur les grands singes chargé d'examiner le rapport entrepris par le Secrétariat conformément aux dispositions de la décision 17.232, ainsi que toutes les recommandations que pourraient formuler le Comité pour les animaux, et d'en rendre compte à la 70e session du Comité permanent, rapport accompagné de projets de recommandations. Les membres du groupe de travail sont : Canada (président), Chine, États-Unis d'Amérique, France, Indonésie, Malaisie, Nigéria, Royaume Uni de Grande Bretagne et d'Irlande du Nord, Thaïlande et Union Européenne, ainsi que la Fondation Born Free, la Convention sur les espèces migratoires, l'Organisation des Nations Unies pour l'alimentation et de l'agriculture, l'Union internationale pour la conservation de la nature, TRAFFIC, la Wildlife Conservation Society, Wildlife Impact et l'Association mondiale des zoos et aquariums.

6. Le secrétariat de GRASP a préparé une ébauche de rapport en collaboration avec nombre de spécialistes, notamment ceux du Groupe de spécialistes de la Commission de la sauvegarde des espèces (SSC) de l'UICN, laquelle figure en annexe au présent document. Cette ébauche a été revue par la Commission scientifique de GRASP et le Groupe des spécialistes des primates, section des grands singes, de l'UICN. Le Comité pour les animaux est invité à l'examiner et à communiquer les observations et recommandations qu'il pourrait avoir à formuler.

7. Un rapport final révisé sera préparé pour la SC70, en tenant compte des observations du Comité pour les animaux et de celles du groupe de travail intersessions sur les grands singes du Comité permanent.

Recommandation

8. Le Comité pour les animaux est invité à examiner le rapport présenté en annexe et à communiquer au Secrétariat ses éventuelles observations, remarques et recommandations, lesquelles seront portées à l'attention des auteurs du rapport avant qu'ils ne finalisent celui-ci pour soumission au Comité permanent.

9. Le Comité pour les animaux pourrait souhaiter envisager de créer à la présente session un groupe de travail intersessions chargé d'effectuer cet examen.

Great Apes Status Report

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Report to the CITES Standing Committee on the Status of Great Apes

1. Introduction

The 65th meeting of the Standing Committee of the Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES) mandated the CITES Secretariat (SC65, Doc37) to collaborate with the IUCN SSC Primate Specialist Group, the Great Apes Survival Partnership (GRASP) and other experts, to prepare a report on the status of great apes and the relative impact of illegal trade and other pressures on their status, for consideration by the Standing Committee. This report constitutes fulfilment of the mandate received from the CITES Secretariat and will address distribution and abundance trends related to all great ape species and sub-species, as well as threats to their conservation.

All great ape species (chimpanzee, eastern gorilla, western gorilla, bonobo, Bornean orangutan, Sumatran orangutan and Tapanuli orangutan) face significant conservation threats and are listed as either Endangered or Critically Endangered by the IUCN Red List of Threatened Species (IUCN, 2017) and in Appendix I of CITES (CITES, 2017). Great ape populations in Africa and Asia are threatened by the combined impacts of habitat loss, poaching, disease and illegal trade. It is illegal to kill or capture great apes and to trade live animals or their body parts in all great ape range states (IUCN, 2017). However, despite legal protection, law enforcement remains a major challenge in many countries, and poaching, especially the illegal domestic (and some international, albeit mostly regional, between neighbouring countries) trade in bushmeat, is the most significant threat to the survival of most great apes.

This report examines the current distribution of African and Asian great apes, as well as the temporal population trends (changes over time) and the main threats to their survival. It also highlights current conservation challenges and provides a list of recommendations to the CITES parties and the CITES Secretariat.

2. African great apes

2. 1. Current distribution of African great apes

African great apes occur in 21 countries across Equatorial Africa (Figure 1). There are four species and nine taxa overall (Table 1).

Table 1: The African great apes

Genus	Species	Subspecies
Gorilla 2 species	**eastern gorilla** *Gorilla beringei* 2 subspecies	**Grauer's gorilla** *Gorilla beringei graueri*
		mountain gorilla *Gorilla beringei beringei*
	western gorilla *Gorilla gorilla* 2 subspecies	**Cross River gorilla** *Gorilla gorilla diehli*
		western lowland gorilla *Gorilla gorilla gorilla*
Pan 2 species	**chimpanzee** *Pan troglodytes* 4 subspecies	**central chimpanzee** *Pan troglodytes troglodytes*
		eastern chimpanzee *Pan troglodytes schweinfurthii*
		Nigeria-Cameroon chimpanzee *Pan troglodytes ellioti*
		western chimpanzee *Pan troglodytes verus*
	bonobo *Pan paniscus*	**No subspecies currently recognized**

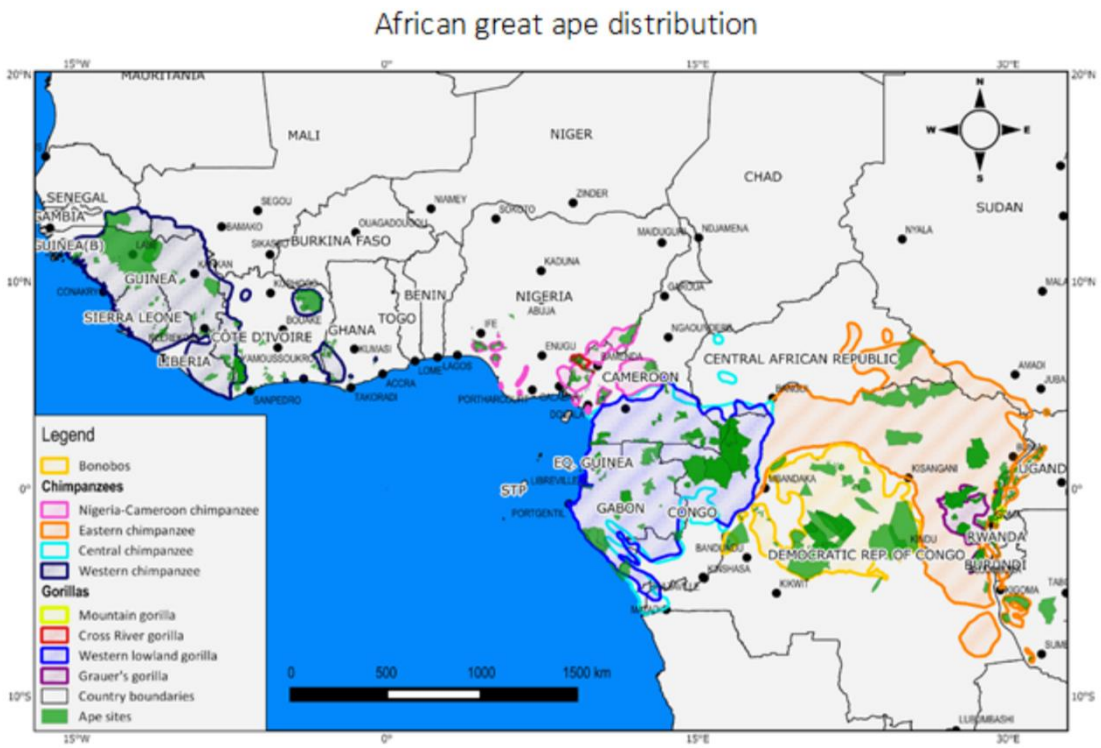

Figure 1: Geographicdistribution of African great ape taxa and sites (IUCN SSC A.P.E.S. database, 2017[2]), Max Planck Institute for Evolutionary Anthropology.

2.2. African great ape population sizes

The African great ape population estimates in this report are based on surveys conducted in the past 10 years. "Site" in this text refers to any area in which surveys were conducted in the last 10 years, including amongst others protected areas and their buffer zones, a logging concession or a group of concessions. Population estimates presented in this report are drawn from peer-reviewed publications, published or unpublished reports, data from research and conservation organizations, or are expert estimates. Estimating population size is complex, because great apes are difficult to observe. All great apes build a new nest to sleep in every night, and these can be used as proxies for independent nest-building animals. A software package (Distance) incorporates animal sign production (in this case night nests) and decay rate to calculate the density of animal sign and of population (Thomas, et al., 2010). Because sample size can be small where ape density is low, the resulting estimates of abundance often show a great deal of variation in precision (see Kühl, et al., 2008). At some sites, genetic censusing is used (Arandjelovic, et al., 2010; Arandjelovic, et al., 2011; Gray, et al., 2013; Roy, et al., 2014). An overview of survey methods can be found in Kühl, et al. (2008).

2.2.1. Population size estimates per country

There is great disparity in population estimates from taxon to taxon depending on the survey method used and sampling effort. Chimpanzee, gorilla and bonobo population estimates per range state are presented in Table 2. The Democratic Republic of Congo (DR Congo) and the Republic of Congo (Congo) host the highest combined population sizes of great apes in Africa, followed by Cameroon, Guinea and Gabon. Countries with the lowest great ape population numbers include Burundi, Ghana, Rwanda, Mali and Senegal, which each hosts a few hundred great apes (Table 2).

Table 2: African great ape population estimates by country. *Except for mountain gorillas,estimates are based on the number of "nest builders", thus excluding infants. Estimates are derived from both surveys and modelling approaches. This is the best information available. However, survey effort is often highest in protected areas, while other areas remain unsampled, thus can lead to low country estimates.*

Country	Taxon	Abundance	Survey period	Source
Angola	western lowland gorilla	1,652 (1,174-13,311)	2005-2013	Strindberg, et al. (2018)*
	central chimpanzee	1,705 (1,027-4,801)	2005-2013	Strindberg, et al. (2018)
Burundi	eastern chimpanzee	204 (122-339)	2011-2013	Hakizimana & Huynen (2013)
Cameroon	Cross River gorilla	132-194	2014	Dunn, et al. (2014)
	western lowland gorilla	38,654 (34,331-112,881)	2005-2013	Strindberg, et al. (2018)*
	central chimpanzee	21,489 (18,575-40,408)	2005-2013	IUCN SSC A.P.E.S. database (2017); Strindberg, et al. (2018)
	Nigeria-Cameroon chimpanzee	3,000-7,060	2004-2006	Morgan, et al. (2011); Mitchell, et al.(2015); Oates, et al. (2016)
Central African Republic	western lowland gorilla	5529 (3,635-8,581)	2015	N'Goran, et al. (2016)
	central chimpanzee	2,843 (1,194–4,855)	2015	Strindberg, et al. (2018)
	eastern chimpanzee	910 (538-1,534)	2012-2016	Aebischer, et al. (2017)
Côte d'Ivoire	western chimpanzee	580 (332-940)	2007-2015	Tiédoué, et al. (2016); IUCN SSC A.P.E.S. database (2017)

[2]Ape Populations, Environments and Surveys database (http://apesportal.eva.mpg.de/).

Democratic Republic of Congo	Grauer's gorilla	3,800	2011-2015	Plumptre, et al. (2016a)
	mountain gorilla	200	2010	Gray, et al. (2013)
	central chimpanzee	Present (population size unknown)	N/A	Inogwabini, et al. (2007)
	eastern chimpanzee	173,000-248,000	2010	Plumptre, et al. (2010)
	bonobo	Minimum 15,000-20,000	2012	IUCN & ICCN (2012)
Equatorial Guinea	western lowland gorilla	1,872 (1,082-3,165)	2005-2013	Strindberg, et al. (2018)*
	central chimpanzee	4,290 (2,894-7,985)	2005-2013	
Gabon	western lowland gorilla	99,245 (67,117-178,390)	2005 - 2013	Strindberg, et al. (2018)*
	central chimpanzee	43,037 (36,869-60,476)		
Ghana	western chimpanzee	264	2009	Danquah, et al. (2012)
Guinea	western chimpanzee	21,210 (10,007-43,534)	2009-2014	WCF (2012; 2014) Kühl, et al. (2017)
Guinea Bissau	western chimpanzee	1,000-1,500	2016	Chimbo Foundation (2017) unpublished data
Liberia	western chimpanzee	7,008 (4,260-11,590)	2011-2012	Tweh, et al. (2015)
Mali	western chimpanzee	Present, (population size unknown)	2014	PANAF (2014) unpublished data
Nigeria	Cross River gorilla	85-115	2014	Dunn, et al. (2014)
	Nigeria-Cameroon chimpanzee	730-2,095	2005	Morgan, et al. (2011); Oates, et al. (2016) ; Nixon & Maisels, pers. comm.
Republic of Congo	western lowland gorilla	215,799 (180,814-263,913)	2005-2013	Strindberg, et al. (2018)*
	central chimpanzee	55,397 (42,433-64,824)	2005-2013	
Rwanda	mountain gorilla	230	2010	Gray, et al. (2013)
	eastern chimpanzee	430	2009-2014	IUCN SSC A.P.E.S. database (2017)
Sierra Leone	western chimpanzee	5,580 (3,052-10,446)	2009	Brncic, et al. (2010)
Senegal	western chimpanzee	500-600	2016-2017	Pruetz and Wessling unpublished data
South Sudan	eastern chimpanzee	Present	2011	Plumptre, et al.(2016b)
Tanzania	eastern chimpanzee	2,500	2010-2012	Plumptre, et al. (2016b)
Uganda	mountain gorilla	430 (398-487)	2010-2011	Gray, et al. (2013); Roy, et al. (2014)
	eastern chimpanzee	5,000	2006-2017	Plumptre, et al. (2016b)

**All estimates from Strindberg, et al.(2018) are for 2013; western lowland gorilla populations are still declining and will have lost a further 13% overall by 2018 from the 2013 estimate.*

2.2.2 Population size estimates per taxon

Western lowland gorillas and eastern chimpanzees are the most numerous great ape taxa, while the Cross River gorilla has the smallest population size, with fewer than 250 mature individuals remaining.

Table 3: African great ape population estimates by taxon in descending order of abundance. *Except for mountain gorillas, estimates are based on the number of "nest builders", thus excluding infants. Estimates are derived from both surveys and modelling approaches. The IUCN Red List classification of most great ape taxa is based on the rate of decline over three generations (one generation time equating to 20-25 years, depending on the taxon).*

Taxon	Abundance	IUCN Status*	Source
western lowland gorilla *Gorilla gorilla gorilla*	361,919 (302,973-460,093)	Critically Endangered	Strindberg, et al. (2018)*
eastern chimpanzee *Pan t. schweinfurthii*	181,000-256,000	Endangered	Plumptre, et al. (2010; 2016b)
central chimpanzee *Pan t. troglodytes*	128,760 (114,208-317,039)	Endangered	Strindberg, et al. (2018)
western chimpanzee *Pan t. verus*	18,000-65,000	Critically Endangered	Humle, et al. (2016); Kühl, et al. (2017)
bonobo *Pan paniscus*	15,000-20,000	Endangered	IUCN & ICCN (2012)
Nigeria-Cameroonchimpanzee *Pan t. ellioti*	4,400-9,345	Endangered	Morgan, et al. (2011); Oates, et al. (2016)
Grauer's gorilla *Gorilla b. graueri*	3,800 (1,280-9,050)	Critically Endangered	Plumptre, et al. (2015; 2016b)
mountain gorilla *Gorilla b. beringei*	880	Critically Endangered	Gray, et al. (2013); Roy, et al. (2014)
Cross River gorilla *Gorilla g. diehli*	<250	Critically Endangered	Dunn, et al. (2014); Bergl, et al. (2016)

** This was the estimate for the end of 2013. If the 2.7% decline has continued (highly likely), the population by the end of 2018 will be around 316,000.*

2.3. Temporal trends in African great ape populations

With the exception of the mountain gorillas, all African great ape taxa are facing an overall decline, some of them drastically. The extent of the decline, however, differs between taxa, with Grauer's gorillas suffering the highest estimated losses over a short period of time (Table 4)[3].

Grauer's gorilla, *Gorilla beringei graueri*
In 1995, the Grauer's gorilla population was estimated at 16,900 (Hall, et al., 1998). By 2015, however, estimates placed their population at only 3,800 individuls, with an annual rate of decline of 7.4%. This represents a decline estimated at between 84-93% across the subspecies' range. Comparing the 1994 data to that of 2011-2015, researchers found a 77% reduction in density data. The subspecies is classified as Critically Endangered. Source: Plumptre, et al. (2015; 2016a).

Mountain gorilla, *Gorilla beringei beringei*
Whilst the mountain gorilla is the only great ape taxon increasing in numbers, it remains Critically Endangered with an estimate of 880 individuals in the early 2010s. There are two small and isolated populations, the Virunga and the Bwindi populations, both of which have been the subject of intense conservation, research and census efforts over the last 40 years (e.g. Robbins, et al., 2011). Numbers in the Virungas had dwindled to an estimated 250 individuals by 1981, before the population then almost doubled between 1989 and 2010. Since 2003, the population has increased by 26% at an annual rate of 3.7% (Gray, et al., 2013)[4].

Cross River gorilla, *Gorilla gorilla diehli*
Cross River gorilla population changes are unknown. The subspecies is classified as Critically Endangered because of a small and highly fragmented population: each subpopulation is likely to number fewer than 50 mature individuals. Source: Bergl, et al. (2016).

[3] *Some of the text in sections 2.3 and 3.3 is taken from the IUCN Red List assessments, as indicated by "Source".*

[4] *Updated census results expected in 2018.*

Western lowland gorilla, *Gorilla gorilla gorilla*
The Critically Endangered western lowland gorilla population declined by 19.4% between 2005 and 2013, an annual loss of approximately 2.7% (Strindberg, et al., 2018). Although their geographic range is large, they are threatened by bushmeat poaching, disease (including Ebola), and habitat loss and degradation.

Central chimpanzee, *Pan troglodytes troglodytes*
This subspecies is classified as Endangered, having experienced a significant population reduction since the 1970s. The principal threats to this taxon, as for western lowland gorillas, are poaching for meat, disease, and habitat loss and degradation. An analysis of nest survey data collected between 2003 and 2013 across the entire range of the taxon did not detect a statistically significant decline (Strindberg, et al., 2018). Unlike gorillas, where the male will defend his family from a hunter and thus puts himself and the group in harms' way, chimpanzees slip away stealthily, and escape being killed. However, all the factors known to reduce chimpanzee populations (lack of forest guards, remoteness from roads, human population density, degree of forest intactness, etc.) were found to be significantly correlated with population density in the direction predicted (Strindberg, et al., 2018). All of these factors are increasing in either extent or intensity, or both, so we predict that, as the longitudinal dataset increases, a decline will be statistically easier to detect.

Eastern chimpanzee, *Pan troglodytes schweinfurthii*
The Albertine Rift escarpment in DR Congo is a stronghold for eastern chimpanzees, but recent surveys indicate 80-98% declines at some key sites in just 20 years, contributing to the major population declines seen in recent decades. It is estimated that the populations in eastern DR Congo declined (range of estimated decline 22-45%) between 1994 and 2015. Eastern chimpanzees are listed as Endangered. Source: Plumptre, et al. (2016b).

Nigeria-Cameroon chimpanzee, *Pan troglodytes ellioti*
This taxon has the lowest estimated population size of any chimpanzee subspecies. Its range is limited to clearly defined areas in southern Nigeria and central-southwest Cameroon. Its Endangered listing is based on an inferred population size reduction of between 50-80% over a three-generation period from the mid-1980s to 2060. Source: Oates, et al. (2016). Past presence of chimpanzees in Benin and Togo has been very poorly documented, but if chimpanzees were in those countries, it is most probable that they were this subspecies (Ginn, et al., 2013).

Western chimpanzee, *Pan troglodytes verus*
This subspecies, *Pan troglodytes verus*, has recently been upgraded to Critically Endangered as it is expected to experience a decline exceeding 80% over the next 69 years, i.e. three generations (Humle et al., 2016). It is found in West Africa from Senegal to Ghana but has almost certainly become extinct in Burkina Faso in the 20th century (Ginn, et al., 2013; Campbell & Houngbedji, 2015). With a likelihood of probably more than 18,850 individuals, Guinea now hosts the largest remaining western chimpanzee population. Liberia and Sierra Leone are also strongholds for this subspecies (Kühl, et al., 2017). Approximately 17,000 individuals (half of the total western chimpanzee population) live in the region of Fouta Djallon (Regnaut & Boesch, 2012). Between 1990 and 2015, the Côte d'Ivoire population declined by 80% (Kühl, et al., 2017); only a few hundred individuals remain in the Taï and Comoé National Parks (Campbell, et al., 2008). Between 2008 and 2011, the population in the Lagoas de Cufadas National Park (Guinea-Bissau) declined by more than 60% (Carvalho, et al., 2013).

Bonobo, *Pan paniscus*
Endemic to the DR Congo, the *Pan paniscus* population is estimated to have declined sharply in the last 15-20 years. This decline is projected to be over 50% over a 75-year period from 2003 to 2078. The species is listed as Endangered. Source: Fruth, et al. (2016).

Table 4: African great ape population trends by taxon in descending order of abundance. *Except for mountain gorillas, estimates are based on the number of "nest builders", thus excluding infants. Estimates are based on both surveys and modelled results.*

Taxon	Abundance	Trend	Annual rate of change	Total estimated change	Period assessed	Source of trend
western lowland gorilla	361,919 (302,973-460,093)*	Declining ↘	-2.7%	-19.4%	2005-2013	Strindberg, et al. (2018)
eastern chimpanzee	181,000-256,000	Declining ↘	-5.1%	-22-45%**	1994-2014	Plumptre, et al. (2015; 2016b)
central chimpanzee	128,760 (114,208-317,039)*	Declining ↘	>-4.95%	>-50%	2005-2013	Maisels, et al. (2016b)
western chimpanzee	18,000-65,000*	Declining ↘	-6.43%	-80%	1990-2015	Kühl, et al. (2017)
bonobo	15,000-20,000	Declining ↘	-5.95%***	-54.9%	2003-2015	Fruth, et al. (2016)
			-1%****	>-50%	2003-2078	
Nigeria-Cameroon chimpanzee	4,400-9,345	Declining ↘	-0.92%-2.14%	-50-80%	1985-2060	Oates, et al. (2016)
Grauer's gorilla	3,800 (1,280-9,050)	Declining ↘	-7.4%	-94.2%	1994-2015	Plumptre, et al. (2015; 2016a; 2016c)
mountain gorilla	880	Increasing ↗	+3.7%	+26%*****	2003-2010	Gray, et al. (2013); Roy, et al. (2014)
Cross River gorilla	<250	Declining ↘	N.A.	N.A.	N.A.	Dunn, et al. (2014)

* *Surveys conducted in 2003-2013 in western equatorial Africa were used to estimate total population size.*
** *The 22% to 45% decline has been estimated only for eastern DR Congo, not for the entire range.*
*** *The confidence interval for this analysis is too large, suggesting an uncertainty in the data.*
**** *Because of the uncertainty surrounding the 5.95% annual decline, Fruth, et al. (2016) considered that a minimal annual decline of 1% would still lead to >50% decline of the bonobo population by 2078.*
***** *Virunga population only. No estimate available for the Bwindi population due to changes in sampling method.*

2.4 Threats to African great apes

The most important threats to great apes in Africa are poaching for bushmeat, habitat loss and degradation, and disease. Live trade is also an issue in some places. The level of these threats varies greatly between range countries (Table 5) and between taxa (Table 6). Western lowland gorilla and central chimpanzee are treated together because their ranges overlap by 97% (Strindberg, et al., 2018).

Grauer's gorilla, *Gorilla beringei graueri*
Even though all killing, capture and consumption of great apes is illegal in the DR Congo, poaching presents the most serious and immediate threat to Grauer's gorillas. This concerns the entire range with a high demand for bushmeat created by the growing human population and widespread artisanal mining in remote areas (Kirkby, et al., 2015; Plumptre, et al., 2015; Plumptre, et al., 2016a). Miners working in Grauer's gorilla habitat admit to poaching gorillas, considering them as relatively easy to hunt with guns and providing large quantities of meat (Kirkby, et al., 2015, Spira, et al., 2017). Habitat loss and degradation, mainly driven by artisanal mining operations, farming (slash-and-burn agriculture) and livestock ranching to supply regional markets, also constitute a major threat. There is currently no commercial logging occurring in the Grauer's range, although artisanal logging is widespread. As parts of the DR Congo emerge from civil war new concessions for timber, minerals and possibly petroleum will pose conservation challenges for the future. Another major threat to Grauer's gorillas is civil unrest in eastern DR Congo, which massively exacerbated the decline of this subspecies since the mid-1990s. Long-term conflict and insecurity resulted in rebel and civilian occupation of the forests, including protected areas, and severely restricted the ability of conservation organizations to monitor

and protect gorillas, enforce hunting and protected area regulations and address intensifying threats. Only 26% of the predicted range of Grauer's gorillas overlaps with national parks and nature reserves. Source: Plumptre, et al. (2016c).

Mountain gorilla, *Gorilla beringei beringei*
Mountain gorillas live in the Bwindi Impenetrable National Park in Uganda and the Virunga massif, shared by the DR Congo, Rwanda and Uganda. Mountain gorilla habitat is well protected and conservation measures, including long-term activities such as intensive law enforcement, research, tourism and veterinary care have been proven to lower the impact of the main threats such as habitat loss, poaching and mortality due to disease (Robbins, et al., 2011). As a result of these conservation activities, population numbers have increased. However, challenges remain despite these positive results. The mountain gorilla population is growing, but the habitat is surrounded by farms, limiting options for expansion. Another issue is climate change, which is likely to result in changes in food availability and habitat quality for the mountain gorillas, as well as the surrounding local communities, which could increase the challenges to conservation efforts. Source: Plumptre, et al. (2016d).

Cross River gorilla, *Gorilla gorilla diehli*
Cross River gorillas occur in 13 small forest fragments totalling approximately 600 km^2 in a landscape of 13,000 km^2. These fragments are surrounded by densely populated human settlements. Many of the subspecies' subpopulations are outside of protected areas and are at most risk from hunting and habitat loss. Although gorillas are not specifically targeted by poachers, it is estimated that opportunistic poaching removes 1-3 individuals from the population annually (though this may be an underestimate; Dunn, et al., 2014). Gorillas are also occasionally killed or injured in snares. The habitat of the Cross River gorilla is under threat. Much of the suitable habitat in Cameroon has no protected status and there is rapid, ongoing conversion of forest to agriculture and grazing. There is also some habitat loss even inside the protected areas, and corridors between subpopulations are particularly vulnerable. For example, the Okwangwo Division of Nigeria's Cross River National Park and the adjacent Takamanda National Park in Cameroon contain enclaves of human settlements whose farmlands have spread beyond their legal boundaries. The small size of the Cross River population in general and its high level of fragmentation also make it more vulnerable to disease. The Ebola virus, which has caused significant mortality in *G. g. gorilla* populations, has not been reported in *G. g. diehli* populations. Nevertheless, their proximity to dense human populations and livestock heightens the risk of disease transmission (Dunn, et al., 2014). Source: Bergl, et al. (2016).

Western lowland gorilla, *Gorilla gorilla gorilla* and central chimpanzee, *Pan troglodytes troglodytes*
Poaching for bushmeat is the primary driver of decline in western lowland gorilla and central chimpanzee populations. Most of the terra firma forests outside the protected areas of their range are now logging concessions (Global Forest Watch, 2017). A network of new logging roads provides rapid access to poachers and traffickers into previously inaccessible forests. Consignments of bushmeat can be rapidly sent, according to estimations, hundreds of kilometres out of the forests (Maisels, et al., 2016a). Infectious disease, especially the Ebola virus, is the second major driver of their decline. Surveys carried out since the 1980s show that a series of large great ape die-offs have occurred in a large forest region that straddles the border between northeastern Gabon and northwestern Congo. Approximately 14% of the total range of these taxa is thought to have been affected by the Ebola virus. At present, habitat loss (as opposed to habitat degradation) in the region is low, but this will change in the near future: 42% of western lowland gorilla and central chimpanzee range is considered suitable for oil palm, the progressive development of which could become a major threat to these taxa (Wich, et al., 2014). Approximately 80% of these two great ape subspecies live outside formally protected areas (Strindberg, et al., 2018), making them and their habitat vulnerable to habitat loss and poaching. Sources: Maisels, et al. (2016a; 2016b).

Eastern chimpanzee, *Pan troglodytes schweinfurthii*
Poaching is the greatest threat to great apes in eastern DR Congo, where large populations of eastern chimpanzees occur. Eastern chimpanzees are poached for bushmeat, especially around artisanal mining and logging camps where bushmeat is often the main source of protein available. When adult chimpanzees are killed for bushmeat, their infants may end up in the ape trade as pets (Hicks, et al., 2010). Poaching is evidenced by ongoing confiscations, as well as the hundreds of eastern chimpanzees housed in sanctuaries in the DR Congo (Plumptre, et al., 2015). This has been driven by insecurity over the past 20 years in the eastern DR Congo, where armed groups are involved in artisanal mining. Another major threat is habitat destruction and degradation due to small-holder and shifting agriculture. Industrial agriculture (e.g. oil palm plantations) poses a potential future threat as eastern DR Congo stabilizes (Plumptre, et al., 2016b). Infectious diseases were identified as the major cause of death in chimpanzees at Gombe and Mahale in Tanzania (e.g. Goodall, 1986; Nishida, et al., 2003). The frequency of encounters between chimpanzees, humans and human waste is increasing as human populations expand, leading to higher risks of disease transmission to chimpanzees. Source: Plumptre, et al. (2016b).

Nigeria-Cameroon chimpanzee, *Pan troglodytes ellioti*

The two main threats to the survival of Nigeria-Cameroon chimpanzees are poaching and habitat loss (Morgan, et al., 2011). These threats are exacerbated by the expansion of human populations within *P. t. ellioti*'s range, as well as economic growth in Cameroon and Nigeria. Poaching represents the greatest threat to the survival of this taxon, both supplying bushmeat trade and, to a lesser extent, providing body parts for traditional medicine (Oates, et al., 2016). In 2002-2003, a six-month study in rural markets in southeastern Nigeria and southwestern Cameroon recorded 240 chimpanzee carcasses (Fa, et al., 2006). Furthermore, a five-week Wildlife Conservation Society survey of eight markets in the transboundary region of Cross River State in Nigeria recorded six chimpanzee carcasses in 2009 (Oates, et al., 2016). Suitable habitat in Nigeria and Cameroon continues to be lost, degraded and fragmented by agriculture, logging, grazing and fire. In western Nigeria in particular, several forest reserves have been converted to farmland and to commercial oil palm and rubber plantations, while large areas of forest surrounding key protected areas such as Okomu and Cross River National Parks have already been converted to oil palm plantations. In Cameroon, extensive new oil palm developments are underway in both Littoral and Southwest Regions and new logging concessions continue to be established. The combined impacts of habitat loss and poaching have gradually fragmented *P.t. ellioti* populations, so that many of those remaining are small and isolated: they are therefore at increased risk of extinction from disease and other unpredictable events. Source: Oates, et al. (2016).

Western chimpanzee, *Pan troglodytes verus*

Half of western chimpanzees reside in the region of Fouta Djallon (Regnaut & Boesch, 2012). This area is characterized by traditional small-scale farming practices, predominantly by Fulani people, who neither eat nor kill chimpanzees for traditional reasons (Ham, 1998). The Fouta Djallon also contains the world's largest bauxite deposits and it is likely that industrial mining will occur in much of the chimpanzee habitat within the next decade (Kormos, et al., 2014). If mining proceeds at the scale planned, it will most certainly cause further population decline and thus threaten this stronghold of the subspecies (Kühl, et al., 2017). Mines also need electricity for their operations, and there are plans for hydrodams throughout the Fouta Djallon region, which could accelerate habitat loss (Kormos, personal communication). Other causes of the western chimpanzee decline include poaching, capture, habitat loss and infectious diseases (Humle, et al., 2016); these threats and their underlying drivers have led to significant extirpation of chimpanzee populations, especially in Ghana and Côte d'Ivoire. Population declines in Côte d'Ivoire have been caused by large-scale deforestation inside and outside of protected areas and classified forests. Such deforestation is a result of the rapidly growing human population, massive immigration from the Sahel Belt and the industrial-scale agricultural production of coffee, cacao, rubber and palm oil (Campbell, et al., 2008; Kühl, et al., 2017). The remaining strongholds of the western chimpanzee include Guinea, Sierra Leone and Liberia. Most chimpanzees in Sierra Leone and Liberia, however, occur outside protected areas where subsistence agricultural has been a major driver of forest loss. Chimpanzees in Liberia are threatened by poaching for bushmeat inside and outside of protected areas (Greengrass, 2016), as well as the rapidly developing mining, forestry and industrial-agricultural sectors (Junker, et al., 2015; Tweh, et al., 2015). Over 80% of the chimpanzee range outside protected areas in Liberia and Sierra Leone is at risk of industrialised agriculture and oil palm development (Wich, et al., 2014) and associated infrastructures, such as roads and hydrodams.

Bonobo, *Pan paniscus*

The most significant threat to bonobos is poaching, followed by habitat loss through deforestation and fragmentation. Disease is likely to pose a threat in the future, with increased exposure to human populations. A number of indirect threats exist, including the proliferation of weapons in the region, weak law enforcement, weak stakeholder commitment to conservation, expansion of slash-and-burn agriculture and industrial scale commercial activities. Not only is there a massive demand for bushmeat stemming from the cities, but rebel factions and poorly paid government soldiers also add to that demand. Source: Fruth, et al. (2016).

Table 5: Summary of major threats affecting African great apes per range country. *Threats were derived from the A.P.E.S. database and references. Some direct threats have a larger impact on great ape populations than others, but there is no quantitative comparison; therefore the table does not rate the threats. The term "poaching" is used as a synonym for illegal killing, but can have different purposes, for example, bushmeat hunting or retaliation for crop foraging. If not specified otherwise, poaching refers to bushmeat hunting and includes great apes that are not directly targeted but victims of snares.*

Country	Main threats (direct)		Source
Angola (Cabinda)	**Habitat loss** from artisanal logging		Ron & Refisch (2013)
	Poaching		
Burundi	**Poaching**		Plumptre, et al. (2010); Hakizimana & Huynen (2013)
	Habitat lossand habitat fragmentation from conversion into agricultural land		
	Habitat loss	illegal logging activities for timber and firewood	Plumptre, et al. (2010)
		infrastructure development (e.g. roads, dams)	Plumptre, et al. (2016b)
	Disease		
Cameroon	**Poaching**		Morgan, et al. (2011); IUCN (2014)
	Habitat loss	conversion into agricultural land	Walsh, et al. (2003); Morgan, et al. (2011); IUCN (2014)
		logging activities for timber and firewood	IUCN (2014)
		resource extraction, mining activities	Bergl, et al. (2016); Maisels, et al. (2016a); Maisels, et al. (2016b); Oates, et al. (2016)
		infrastructure development (e.g. roads, dams)	Kormos, et al. (2014)
	Disease		Bergl, et al. (2016); Maisels, et al. (2016a); Maisels, et al. (2016b); Oates, et al. (2016)
Central African Republic	**Poaching**		Maisels, et al. (2016a); Maisels, et al. (2016b); Plumptre, et al. (2016b)
	Habitat loss	conversion into agricultural land	
		infrastructure construction (e.g. roads, dams)	
	Disease		
Côte d'Ivoire	**Poaching**		Campbell, et al. (2008); Kühl, et al. (2017)
	Habitat loss	conversion into agricultural land	
		infrastructure construction (e.g. roads, dams)	Humle, et al. (2016)
	Disease		Campbell, et al. (2008); Köndgen, et al. (2008)
Democratic Republic of Congo	**Poaching**		Plumptre, et al. (2015); Plumptre, et al. (2016d)
	Habitat loss	conversion into agricultural land	
		natural resource extraction (artisanal/industrial mining extraction, logging for timber…)	
	Disease		Plumptre, et al. (2015); Fruth, et al. (2016)
Equatorial Guinea	**Poaching**		Murai, et al. (2013)
	Habitat loss	conversion into agricultural land	

		infrastructure construction (e.g. roads, dams)	
	Disease		Humle, et al. (2016)
Gabon	**Poaching**		IUCN (2014)
	Disease (Ebola)		Walsh, et al. (2003); Bermejo, et al. (2006)
	Habitat loss	resource extraction (e.g. mining extraction, logging concessions)	Maisels, et al. (2016a; 2016b)
		infrastructure construction (e.g. roads, dams)	
Ghana	**Poaching**		Danquah, et al. (2012); Kühl, et al. (2017)
	Habitat loss	conversion into agricultural land	
		infrastructure construction (e.g. roads, dams)	Humle, et al. (2016)
	Disease		
Guinea	**Poaching**		Kühl, et al. (2017)
	Habitat loss	conversion into agricultural land	
		resource extraction (e.g. mining concessions)	Kormos, et al. (2014); Kühl, et al. (2017)
	Disease		Humle, et al. (2016) Matsuzawa, et al. (2011)
	Illegal trade		EAGLE network (2017)*
Guinea Bissau	**Habitat loss**	infrastructure construction (e.g. roads, dams)	Van der Meer (2014; 2016)
		conversion into agricultural land	Wenceslau (2014); Van der Meer (2016)
		resource extraction (mining site overlaps with chimpanzee territory)	Humle, et al. (2016)
	Poaching		Van der Meer (2016)
	Disease		
Liberia	**Habitat loss**	infrastructure construction (e.g roads, dams)	Greengrass (2016); Kühl, et al. (2017)
		conversion into agricultural land and forest concessions	Junker, et al. (2015)
		resource extraction (logging and mining activities)	
	Poaching		Tweh, et al. (2015)
Mali	**Disease**		Kühl, et al. (2017)
	Poaching		
	Habitat loss andfragmentation from agriculture		
	Habitat loss from resource extraction (open pit mining)		
Nigeria	**Habitat loss**	resource extraction (e.g. forest logging for timber)	Bergl, et al. (2016); Oates, et al. (2016)
		conversion into agricultural land	Imong, et al. (2014)
		infrastructure construction (e.g. roads, dams)	Morgan, et al. (2011); Dunn, et al. (2014)
	Poaching		

	Habitat loss and fragmentation from conversion into agricultural land		Bergl, et al. (2016); Oates, et al. (2016)
	Disease		
Republic of Congo	**Habitat loss**	infrastructure construction (e.g. roads, dams)	IUCN (2014)
		resource extraction (e.g. artisanal/industrial mining activities, artisanal/industrial logging)	
	Poaching		Walsh, et al. (2003); Bermejo, et al. (2006); IUCN (2014)
	Disease		IUCN (2014)
Rwanda	**Habitat loss and degradation**	infrastructure construction (e.g. roads)	Plumptre, et al. (2010); Robbins, et al. (2011); Gray, et al. (2013); Plumptre, et al. (2016d)
		resource extraction	
	Disease		
	Poaching		
Senegal	**Habitat loss**	resource extraction (e.g. open pit, small scale and large scale mining)	Ndiaye (2011)
		infrastructure construction (e.g. roads, dams)	Galat, et al. (2008); Boyer (2011); Ndiaye (2011)
	Poaching		
	Habitat loss, fragmentation and degradation from agriculture, bush fires fodder extraction and drought		Humle, et al. (2016)
	Disease		Boyer (2011); Ndiaye (2011)
Sierra Leone	**Habitat loss**	infrastructure construction (e.g. roads, dams)	Kühl, et al. (2017)
		resource extraction (e.g. mining)	Kormos, et al. (2014)
	Habitat loss and fragmentation from conversion into agricultural land		Humle, et al. (2016)
	Disease		Brncic, et al. (2010); Kühl, et al. (2017)
	Poaching		Kühl, et al. (2017)
Tanzania	**Habitat loss**	bush fires	JGI, et al. (2011)
		logging for timber and firewood	
		infrastructure development (e.g. roads, dams)	JGI, et al. (2011); Nakamura & Nishida (2012)
	Poaching		JGI, et al. (2011)
	Habitat loss and fragmentation from conversion into agricultural land		
	Disease		Plumptre, et al. (2016b)
Uganda	**Habitat loss**	infrastructure construction (e.g. roads and dams)	Robbins, et al. (2008); Plumptre, et al. (2016b)
		resource extraction	Plumptre, et al. (2010); Roy, et al. (2014); Gilardi, et al. (2015);Plumptre, et al. (2016d)
	Poaching in retaliation to of crop raiding (e.g. guns, snares, traps)		

	Disease	Robbins, et al. (2008); Plumptre, et al. (2016b)

[*]*The EAGLE network (2017) describes illegal trade in great apes in Guinea, but it is not clear whether the individuals traded are from Guinea or from any other range state. The EAGLE network (Eco-Activists for Governance and Law enforcement) is an NGO fighting corruption and illegal wildlife trade.*

Table 6: Major threats affecting African great apes at taxon level. *Some direct threats have a larger impact on great ape populations than others, but no quantitative comparisons are possible. The term "poaching" is used as a synonym for illegal killing, but can have different purposes, e.g. bushmeat hunting or retaliation for crop foraging. If not specified otherwise, poaching refers to bushmeat hunting and includes great apes that are not directly targeted but victims of snares.*

Taxon	**Main threats (direct)**	**Source**
Grauer's gorilla *Gorilla b. graueri*	**Poaching** (e.g. bushmeat, medicine, crop protection, illegal trade as a by-product of bushmeat hunting)	Plumptre, et al. (2015; 2016c)
	Habitat lossand degradation from shifting and commercial agriculture	
	Disease	
	Habitat loss from artisanal and industrial mining	
mountain gorilla *Gorilla b. beringei*	**Habitat loss**	Gray, et al. (2010); Robbins, et al. (2011); Roy, et al. (2014)
	Disease	
	Poaching incl. snares and retaliation for human-wildlife conflict	
Cross River gorilla *Gorilla g. diehli*	**Habitat loss**	Bergl, et al. (2016)
	Poaching	
western lowland gorilla *Gorilla gorilla gorilla*	**Poaching**	Maisels, et al. (2016a)
	Disease	
	Habitat loss and degradation	
western chimpanzee *Pan t. verus*	**Habitat loss and fragmentation** from slash-and-burn, commercial agriculture or extractive industries	Humle, et al.(2016); Kühl, et al. (2017)
	Poaching (e.g. bushmeat, medicine, crop protection)	
	Illegal trade in live animals	
	Disease	
Nigeria-Cameroonchimpanzee *Pan t. ellioti*	**Poaching**	Oates, et al. (2016)
	Habitat loss from conversion into agricultural land	
	Disease	
central chimpanzee *Pan t. troglodytes*	**Poaching**	Maisels, et al. (2016b)
	Disease	
	Habitat loss and degradation	
eastern chimpanzee *Pan t. schweinfurthii*	**Poaching** (e.g. bushmeat, snares, medicine, crop protection)	Plumptre, et al. (2015; 2016b)
	Habitat loss and degradationfrom conversion to commercial agriculture	
	Habitat loss from artisanal and industrial	

	scale mining	
	Disease	
bonobo *Pan paniscus*	**Poaching**	Fruth, et al. (2016)
	Habitat loss from agriculture and mining	
	Disease	Sakamaki, et al. (2009); IUCN & ICCN (2012)

3. Asian great apes

3.1 Current distribution of Asian great apes

Orangutans are the only great apes found in Asia and exist solely on the islands of Sumatra and Borneo (Figure 2), in Indonesia and Malaysia (Wich, et al., 2008). There are three species of orangutans: the Bornean orangutan (*Pongo pygmaeus*) and two on Sumatra: the Sumatran orangutan (*Pongo abelii*) and the recently described Tapanuli orangutan (*Pongo tapanuliensis*). Bornean orangutans are further divided into three subspecies: *Pongo pygmaeus pygmaeus*, *Pongo pygmaeus wurmbii* and *Pongo pygmaeus morio.*

Table 7: The Asian great apes

Genus	Species	Subspecies
Orangutan 3 species	**Bornean orangutan** *Pongo pygmaeus* 3 subspecies	**northwest Bornean orangutan** *Pongo pygmaeus pygmaeus*
		southwest Bornean orangutan *Pongo pygmaeus wurmbii*
		northeast Bornean orangutan *Pongo pygmaeus morio*
	Sumatran orangutan *Pongo abelii*	**No subspecies currently recognized**
	Tapanuli orangutan *Pongo tapanuliensis**	**No subspecies currently recognized**

**New species described by Nater, et al. (2017).*

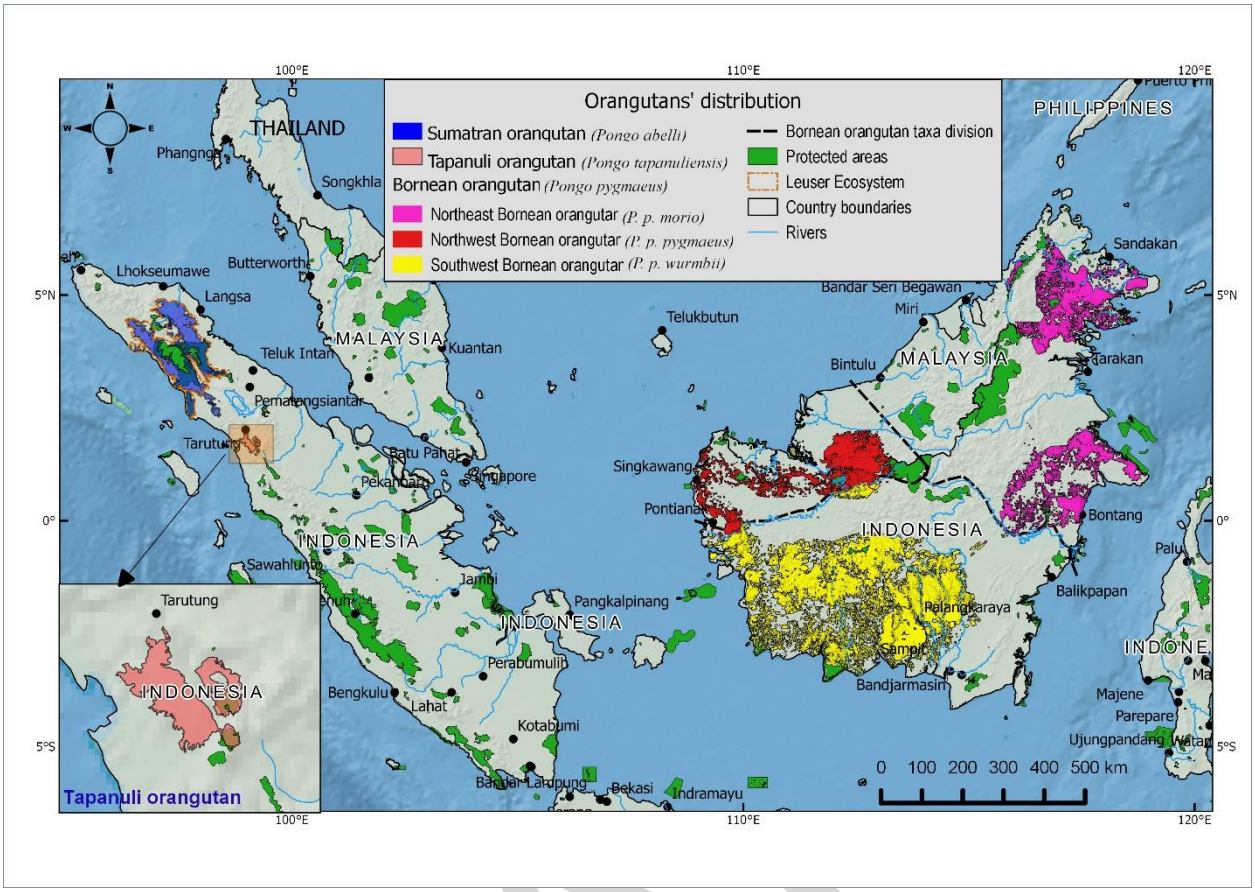

Figure 2: Geographic distribution of Asian great ape taxa (orangutans; IUCN SSC A.P.E.S. database, 2017), Max Planck Institute for Evolutionary Anthropology.

3.2 Asian great ape population sizes

3.2.1. Population size estimates per country

Table 8: All Asian great ape population estimates per country

Country	Taxon	Abundance*	IUCN status	Year of estimate	Source
Indonesia	**northwest Bornean orangutan** *P. pygmaeus pygmaeus*	5,200 (3,800-7,200)	Critically Endangered	2018	Calculated from Voigt, et al. (2018)
	southwest Bornean orangutan *P. pygmaeus wurmbii*	97,000 (73,800-135,000)	Critically Endangered	2018	Calculated from Voigt, et al. (2018)
	northeast Bornean orangutan *P. pygmaeus morio*	24,800 (18,100-35,600)	Critically Endangered	2018	Calculated from Voigt, et al. (2018)
	Sumatran orangutan*Pongo abelii*	13,900 (5,400-26,100)	Critically Endangered	2016	Wich, et al. (2016)
	Tapanuli orangutan*Pongo tapanuliensis*	800 (300-1,400)	Critically Endangered	2016	Wich, et al. (2016)

Malaysia	**southwest Bornean orangutan** *P. pygmaeus wurmbii*	1,100 (800-1,600)	Critically Endangered	2018	Calculated from Voigt, et al. (2018)
	northeast Bornean orangutan *P. pygmaeus morio*	11,000 (8,000-18,000)	Critically Endangered	2005	Ancrenaz, et al. (2005)

** Numbers rounded to the nearest 100. 95% confidence intervals.*

3.2.2 Population size estimates per taxon

Bornean orangutan, *Pongo pygmaeus*
Abundance estimates for *P.pygmaeus pygmaeus, P.pygmaeus wurmbii* and *P.pygmaeus morio*, all Critically Endangered, are presented in Table 8.

Sumatran orangutan, *Pongo abelii*
Previously estimated to be 6,600 (Wich, et al., 2008), the most recent abundance for the Sumatran orangutan is estimated at 13,900 individuals, in a total area of 16,775km² of forest (Wich, et al., 2016). This latest estimate does not reflect an increase in Sumatran orangutan numbers, but it is explained by much improved survey techniques and coverage, and hence more accurate data. Considering only populations that are potentially viable over the long term (i.e. > 250 individuals), there are just 13,587 individuals left. The vast majority (95%) occurs in the Leuser ecosystem, while other populations are found in the Sidiangkat, Pakpak and Batang Toru forests (Singleton, et al., 2017). The overall numbers continue to decline dramatically (Wich, et al., 2016). The species is classified as Critically Endangered.

Tapanuli orangutan, *Pongo tapanuliensis*
This new great ape species was first described in 2017 (Nater, et al., 2017). The Nater, et al. (2017) study showed that an isolated orangutan population found in the Batang Toru ecosystem of Sumatra, in the southernmost range of extant Sumatran orangutans, is distinct from other Sumatran and Bornean populations.With a total estimate of fewer than 800 individuals (Wich, et al., 2016), *Pongo tapanuliensis* is the great ape species with the lowest total number of individuals, and is Critically Endangered.

3.3. Temporal trends in Asian great ape populations

Bornean orangutan, *Pongo pygmaeus;* subspecies: *P. p. pygmaeus, P. p. wurmbii, P. p. morio*
Recent studies on the temporal trends of Bornean orangutans found declines of 25% over a ten-year period (~2000-2010; Santika, et al., 2017) and approximitaly 50% for the period of 1999-2015 (Voigt, et al., 2018). Based on predicted land-cover change alone, a further 43,000 Bornean orangutans could be lost by 2050 (Voigt, et al., 2018). Climate change and land-cover prediction models further show that under a business as usual scenario, by 2080 68-81% of the Bornean orangutan habitat will be lost (Wich, et al., 2015).

Sumatran orangutan, *Pongo abelii*
The decline of Sumatran orangutans to its current abundance of 13,900 in 2016 (Wich, et al., 2016) has not been systematically quantified. However, forest loss data indicates that the decline must have been large. Between 1985 and 2007, the Sumatran orangutan lost 60% of its key forest areas (>500m). Future predictions of forest loss indicate that a further 4,000 Sumatran orangutans could be lost by 2030 (Wich, et al., 2016).

Tapanuli orangutan, *Pongo tapanuliensis*
A quantitative population viability analysis estimated that, in 1985, there would have been ~1,489 individuals of the Tapanuli orangutan, and that these would decline to only 257 individuals over a 75-year period by 2060 (Nowak, et al., 2017). If the key threats are not effectively reduced, an 83% decline over the course of three generations is predicted. Source: Nowak, et al. (2017).

Table 9: Asian great ape population decline by taxon

Species	Subspecies	Abundance	Trend	Annual rate of change	Total estimated change	Period	Source of trend
Bornean orangutan	**northwest Bornean orangutan** *P.p.pygmaeus*	6,300 (4,700-8,600)	Declining ↘	-4.71%	-53%	1999-2015	Calculated from Voigt, et al. (2018)
	southwest Bornean orangutan *P.p.wurmbii*	97,000 (73,800-135,000)	Declining ↘	-4.71%	-53%	1999-2015	Calculated from Voigt, et al. (2018)
	northeast Bornean orangutan *P.pygmaeus morio*	30,900 (22,800-44,200)	Declining ↘	-4.45%	-52%	1999-2015	Calculated from Voigt, et al. (2018)
Sumatran orangutan	**Sumatran orangutan***Pongo abelii**	13,900 (5,400-26,100)	Declining ↘	-2.37%	-30%*	2015-2030	Wich, et al. (2016)
Tapanuli orangutan	**Tapanuli orangutan***Pongo tapanuliensis*	800 (300-1,400)	Declining ↘	-2.36% (for 1985-2060)	-83%	1985-2060	Nowak, et al. (2017)

**See temporal trends text for the Sumatran orangutan trend based on forest loss. Confidence intervals rounded to the nearest 100. Under the current land-use scenario, as many as 4500 individuals (30% of the current estimate) could disappear by 2030. There are many other scenarios mentioned in Wich, et al. (2016).*

3.4 Threats to Asian great apes

Bornean orangutan, *Pongo pygmaeus;* subspecies: *P. p. pygmaeus, P. p. wurmbii, P. p. morio*
Widespread forest clearance for industrial plantations, cultivation for food, mining infrastructure and rural development, combined with illegal logging, fire and poaching, are the main threats to this taxon and have dramatically reduced the number of Bornean orangutans (Wich, et al., 2008; Wich, et al., 2012b; Santika, et al., 2017; Voigt, et al., 2018). Data from the Global Forest Resources Assessment shows a 2.4% forest loss between 2000 and 2015 and a 0.7% between 2010 and 2015 (FAO, 2015). This translates to an annual rate of deforestation estimated at more than 3,000 km² per year between 2000 and 2010 (Gaveau, et al., 2014). If this deforestation rate continues, it is predicted that 32,000 km² of forest could be lost by 2020, 129,000 km² by 2050 and 226,000 km² by 2080 (Wich, et al., 2015). Most of this deforestation occurs in peatlands that generally harbor large orangutan populations, suggesting a heightened threat to Bornean orangutans. In 2010, 80% of the range in Kalimantan was located outside protected areas, consisting of commercial forest reserves exploited for timber and forest areas earmarked for conversion to agriculture. The situation is different in Malaysia, where more than 80% of the current population are found in fully-protected forests. Besides forest loss, poaching is another major cause of Bornean orangutan decline. It is estimated that several thousand individuals are killed every year, principally for meat consumption or during human-orangutan conflict (Meijaard, et al., 2011; Davis, et al., 2013; Voigt, et al., 2018). This means that habitat protection alone will not ensure the survival of orangutans and that effective reduction of orangutan killings is urgently needed (Ancrenaz, et al., 2016). Other threats are fires that contribute to habitat loss and fragmentation, lack of environmental awareness and climate change (Ancrenaz, et al., 2016; Santika, et al., 2017; Voigt, et al., 2018).

Sumatran orangutan, *Pongo abelii*
Habitat loss and fragmentation seriously threaten the survival of the Sumatran orangutan (Wich, et al., 2011; Wich, et al., 2016). Forests continue to be cleared at scale (hundreds of square kilometres) for oil palm plantations. On a smaller scale, logging for timber (both legal and illegal) remains a threat. In addition, the creation of new roads fragment populations and provide access to illegal settlements and further encroachment for agriculture and plantations (also frequently illegal) and to wildlife poachers (Singleton, et al., 2017). Sumatran orangutans are frequently killed deliberately during human-wildlife conflict, and surviving infants end up in illegal pet trade (Singleton, et al., 2017).A significant spatial threat to the Sumatran orangutan comes from the 2013 Aceh province spatial land-use plan allowing large areas of the Leuser ecosystem, which hosts 90% of

Sumatran orangutans, to be designated for oil palm plantations as well as timber and mining concessions (Wich, et al., 2016). With the same Leuser ecosystem designated in 1997/8 as a National Strategic Area for its environmental function under Aceh's special autonomy law, and it being the main stronghold of the Sumatran orangutan, revisiting the spatial land-use plan as a priority would have meaningful benefits for future orangutan populations.

Tapanuli orangutan, *Pongo tapanuliensis*

The Tapanuli orangutan is under considerable threat from high levels of habitat loss and fragmentation, as well as from poaching, killing during crop conflict and the illegal trade in young orangutans, fueled by a population influx from the west of Sumatra. A substantial section of its range is threatened by habitat conversion for small-scale agriculture, mining exploration and exploitation, a large-scale hydroelectric scheme and geothermal development (Nowak, et al., 2017). Due to their slow reproduction rate, with a generation time of about 25 years (Wich, et al., 2004; Wich, et al., 2009), orangutans on Sumatra are unable to cope with significant and continued individual losses. The small population size and geographic isolation of *Pongo tapanuliensis* may lead to inbreeding depression (Hedrick & Kalinowski, 2000) and threaten population persistence (Allendorf, et al., 2013).

Table 10: Summary of threats facing Asian great ape per taxon

Species	Main threats	Source
Bornean orangutan	**Habitat loss, fragmentation and degradation** from agriculture and extractive industries and fire	Ancrenaz, et al. (2016)
	Poaching	
	Climate change	Struebig, et al. (2015)
Sumatran orangutan	**Habitat loss and fragmentation** from agriculture, logging, infrastructure (roads) and extractive industries*	Wich, et al. (2012a; 2016); Singleton, et al. (2017)
	Poaching incl. retaliation for human-wildlife conflict	Wich, et al. (2012a); Singleton, et al. (2017)
Tapanuli orangutan	**Habitat loss and fragmentation** from agriculture and extractive industries	Nowak, et al. (2017)
	Poaching	Wich, et al. (2012a)
	Habitat loss from construction of large-scale infrastructure (e.g. hydroelectric dam, mining)	Nowak, et al.(2017)

**Cases of illegal trade as a by-product of habitat loss have been reported (Singleton, et al., 2017), but in these cases trade is not a direct threat; the direct threat is habitat loss.*

4. Descripion of threats

The most important direct threats to great apes are habitat loss, degradation and fragmentation, infectious disease and poaching for bushmeat or deliberate killing due to conflicts over resources, usually cultivated foods. The relative importance of these threats varies by taxon and location. Areas with high human population densities tend to have the most degraded habitats and the lowest ape densities. Poaching for bushmeat includes great ape meat, although apes are not generally specifically targeted. The killing of the mother may enable opportunistic capture of infants, which are then sold (Plumptre, et al., 2015; Plumptre, et al., 2016a; Plumptre, et al., 2016b; Plumptre, et al., 2016c; Singleton, et al., 2017). Many range states are among the poorest countries in the world, with growing populations and development aspirations, including Guinea, Liberia, DR Congo, Rwanda and Uganda. Sub-Saharan African human population growth rates are among the highest in the world, at about 2.7% overall (World Bank, 2018). This places ever-increasing pressure on land, natural resources and wildlife. Consequently, a thorough understanding of local circumstances is required to address the main threats to great apes, as they cannot be considered in isolation from each other.

Habitat loss, degradation and fragmentation

Great apes depend on forest ecosystems, but these are increasingly threatened by industrial and small-scale agriculture, resource extraction such as logging and mining, as well as infrastructure development (e.g. Ancrenaz, et al., 2015). Mirroring the major role that palm oil has played in the loss of great ape habitats in

Asia, the progressive development of plantations is a future threat to the African great apes (Humle & Matsuzawa, 2004; Wich, et al., 2014). Once a forest habitat is lost, it is very difficult to rehabilitate and repopulate it. Laurance, et al. (2015) describes the environmental costs of 33 planned or under-construction development corridors in Sub-Saharan Africa. It is important to note that some great ape taxa can survive in reduced-impact logging areas as long as hunting is strictly controlled (gorillas and chimpanzees: Morgan, et al., 2017; orangutans: Ancrenaz, et al., 2010). However, survival in low impact logging areas is only possible when the logging is carefully controlled, does not lead to subsequent uncontrolled logging and further habitat deterioration and when poaching is not a threat (Morgan & Sanz, 2007; Ancrenaz, et al., 2010). Any progressive loss of forest resources (as opposed to rapid loss or habitat conversion) also necessitates high levels of tolerance from people in surrounding areas if great apes are to persist, especially if great apes turn to foraging on crops to supplement their diet, which is the case for orangutans in Asia and many chimpanzee populations in West and East Africa (Hockings & Humle, 2009; Campbell-Smith, et al., 2012; Bryson-Morrison, et al., 2016).

Disease

Great apes and humans are very closely related and we are susceptible to the same deadly diseases (Gilardi, et al., 2015). Such diseases include Ebola, anthrax, Marburg virus and respiratory diseases, with the risk of transmission growing as human populations expand into great ape territories (Leendertz, et al., 2006). Pathogen transfer goes both ways and the consumption of bushmeat can contribute to infections in humans (Leendertz, et al., 2017). The spread of disease in great apes is facilitated by habitat fragmentation, close proximity between ape populations and human settlements and high frequency of human-great ape interactions (Gilardi, et al., 2015).

Poaching

CITES, INTERPOL and World Customs Organization (WCO) databases (SC65, Doc. 37) only record international trade, thereby under-reporting domestic trade. This highlights the need for domestic monitoring.

A) Domestic trade

The term "poaching" is used as a synonym for illegal killing, but can have different purposes, e.g. bushmeat hunting or retaliation for crop foraging. If not specified otherwise, poaching henceforth refers to hunting of great apes for meat, whether deliberately, opportunistically or accidentally (such as becoming trapped in a snare set for smaller animals). Although snares are not set to specifically target great apes, they become caught in them and may lose a limb or die from their injuries (see Gilardi, et al., (2015)). Poaching is a key threat to all great ape taxa (Tables 6, 10). Almost all wildlife species (mammals, birds, reptiles, amphibians and even insects) are eaten throughout West and Central Africa, and a huge bushmeat trade network has developed where very large numbers of animals are hunted in remote forest areas and brought to industrial camps (logging, mining), towns and cities for profit, often over very long distances (Nasi, et al., 2008; Fa & Brown, 2009; Wilkie, et al., 2011; Wilkie, et al., 2016; Ziegler, 2016). For example, animals are hunted in central DR Congo, where the Salonga National Park is located; the meat is smoked and then transported on foot and by bicycle, hundreds of kilometres south to the mining towns in Katanga, where the purchasing power of consumers is far higher than in the source villages (Colom, 2006; Steel, et al., 2008; Abernethy, et al., 2010). There is also evidence of deliberate hunting of Cross River gorillas for bushmeat in Cameroon (Dunn, et al., 2014). Such poaching is often restricted to specific communities. Other communities, particularly in Africa, consider great apes to be their close relatives and hence the killing of them is a taboo (e.g. in West Africa (Kormos, et al., 2003); or along the Congolese coast (Doswett, 1991)). However, in Central Africa, these taboos against eating western lowland gorillas and central chimpanzees only exist in approximately 1% and 5% of their ranges, respectively (Strindberg, et al., 2018).

Great ape populations in all West and Central African countries are highly threatened by the bushmeat trade (Refisch & Koné, 2005; Plumptre, et al., 2010; IUCN, 2014; Plumptre, et al., 2015; Fruth, et al., 2016; Maisels, et al., 2016c). African apes are also killed for traditional medicine or witchcraft. Sá, et al. (2012) suggests that poaching of chimpanzee to obtain skins for use as medicine threatens populations in Guinea-Bissau.

Bornean orangutans are killed in large numbers for bushmeat, or when they are perceived as a threat to human safety or agricultural crops (Meijaard, et al., 2011; Davis, et al., 2013). Sumatran and Tapanuli orangutans are similarly at risk from bushmeat poaching and killing as a result of habitat destruction or human-wildlife conflict (Nowak, et al., 2017; Singleton, et al., 2017).

Hunting orangutans for food occurs extensively in Borneo (Davis, et al., 2013), and to a lesser extent in the range of the Tapanuli orangutan on Sumatra (Wich, et al., 2012b). It is not known how much trade in orangutan meat occurs, but orangutans have been killed to sell the meat to local communities (Davis, et al., 2013). New roads to remote forest areas facilitate the expansion of the bushmeat trade. For example, the road from Brazzaville to Ouesso in Congo opens access to remote landscapes and enables transport of bushmeat. Illegal and unsustainable poaching has brought many species to the brink of extinction, causing the "empty forest" syndrome (Redford, 1992; Wilkie, et al., 2011).

Although funding has gone into providing alternative protein, the impact of such investments has been marginal and, indeed, rarely quantified. Wicander & Coad (2015) investigated 64 projects in Central Africa that aimed to encourage the production of alternative sources of protein, and in some cases, to increase revenue of the target populations. Unfortunately, very few of these projects monitored the impact of their efforts, so no conclusion could be reached as to whether they succeeded in their aims. Because there were, in most cases, either no regulations for compliance, or no sanctions for noncompliance, or both, many participants were likely to develop new protein sources as an additional activity, rather than an alternative activity. In other words, new activities were added to hunting and bushmeat trade rather than replacing them. In some cases, commercial hunters from outside the communities posed a far higher threat to wildlife or ecosystems than did the target community, rendering project activities ineffective in the face of external pressure. It is essential to build in and budget for monitoring of project impacts, or it will be impossible to gauge success and failure, or to learn how to improve approaches.

B) International trade

Poaching for bushmeat poses particular challenges to enforcement, with species-specific identification of bushmeat being a key to addressing this threat. Numerous publications have investigated bushmeat issues in Africa and Asia (for examples see: Nasi, et al., 2008;Fa & Brown, 2009; Meijaard, et al., 2011; Wilkie, et al., 2011; Wilkie, et al., 2016; Foerster, et al., 2012; Coad, et al., 2013; Ziegler, 2016). However, the proportion of bushmeat that crosses international borders - which is specifically relevant to CITES - is particularly difficult to estimate. The vast majority of transborder trade in great ape meat is not transcontinental but rather simply across neighbouring country boundaries, where detection is weak. All smuggled goods, including ape meat, can easily be transported in small boats across rivers, which form highly porous international boundaries. Across terrestrial borders, trafficked goods often travel undiscovered in bush taxis, minibuses, motorcycles or even on foot through unpatrolled forests. The vast majority of gorillas, for example, live in Gabon and Congo and their meat is trafficked mostly within those two countries and across the borders to the cities of neighbouring countries. Thus, Kinshasa in DR Congo, Yaoundé and Douala in Cameroon, and Bata in Equatorial Guinea are major destinations for all types of bushmeat, including great ape meat, which is trafficked from the more wildlife-rich parts of the region. Intercontinental trade does occur, but is completely dwarfed by the subregional illegal trade. Only two studies based at airports in Europe have been carried out. These indicated there is an active international bushmeat trade from West and Central Africa to Paris, which could be used as transit points to other European countries (Chaber, et al., 2010; Wood, et al., 2014). However, more research is required to determine how much great ape meat is involved in this trade (Chaber, et al., 2010).

Illegal live trade

The illegal trade in live great apes has been recognized as a threat to their survival since the 1980s, and the CITES Secretariat has noted that illegal live trade is one of several key factors that negatively impacts the health and integrity of wild populations of great apes in Africa and Asia (SC66 Doc48.2). The current scale of this trade is unknown. Indications of ongoing trade include records from the United Nations Office on Drugs and Crime (UNODC) of 208 live apes seized since 2000 (UNODC, 2016). In 2017 alone, 20 great ape traffickers were arrested, and 12 live chimpanzees were seized in three African great ape range states, Cameroon, Gabon and Guinea (EAGLE Network, 2017).In all cases of illegal live ape trade, adults must be killed to obtain infants (see for example Plumptre, et al., 2015; Humle, et al., 2016; Singleton, et al., 2017). Evidence indicates that illegal trade in great apes is a secondary effect of habitat loss and poaching or conflict-related killing. Great apes are captured and traded opportunistically, as opposed to poachers entering the forest to deliberately capture infants (Davis, et al., 2013; Plumptre, et al., 2015; Humle, et al., 2016; Singleton, et al., 2017).

Known instances of apes targeted for capture and subsequent trade include Guinea, where highly organised syndicates have used fraudulent CITES papers to trade chimpanzees with China (CITES mission to Guinea in 2011).

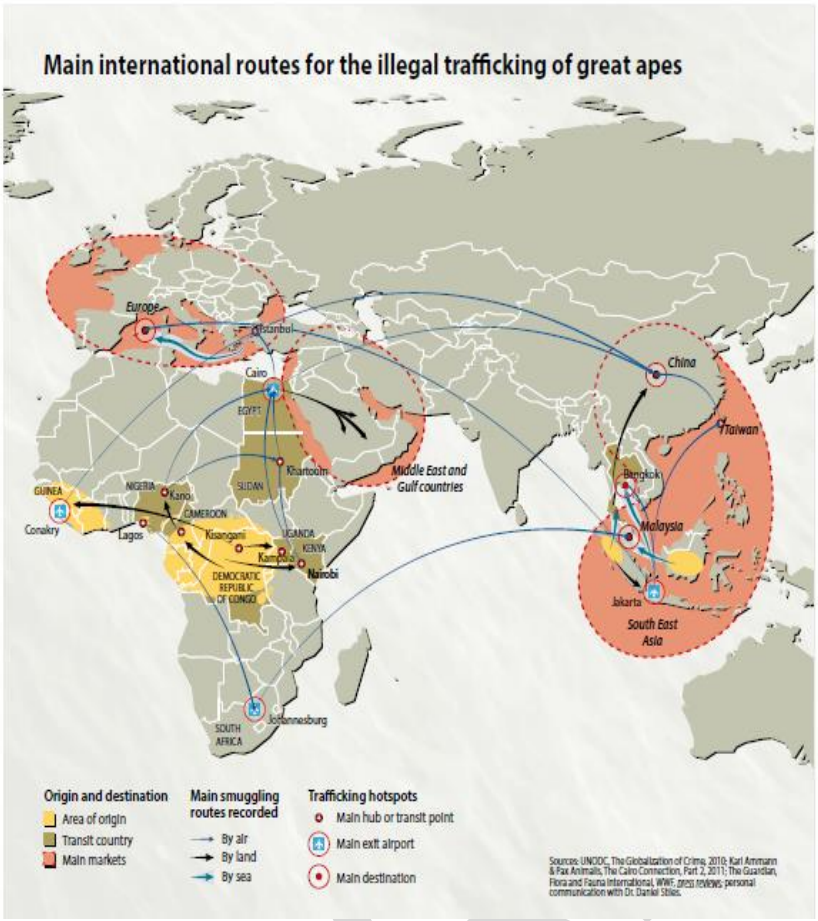

Figure 3: Main international routes for the illegal trade of live great apes (Stiles, et al., 2013).

Combined impacts of economic development
Many great ape range states are rich in natural resources, for example Guinea, the DR Congo and Indonesia. The expanding extractives sector is one of the key drivers collectively accelerating the threats faced by great apes. This poses new challenges for great ape conservation, due to the difficulties in reconciling conservation priorities with urgently needed economic development. Alongside the direct impact of habitat loss caused by mines, roads, logging concessions and other infrastructure, new development attracts huge numbers of people from far away in search of new opportunities (Rainer, et al., 2014). This often leads to uncontrolled development including artisanal mining, farming and poaching for bushmeat. For example, Poulsen & Clark (2010) described poaching for bushmeat in general inside logging concessions and Spira, et al. (2017) discussed the increase of poaching of gorillas and chimpanzees around mines.

5. National reports to CITES

CITES mandated a template for national reports on illegal trade (https://cites.org/eng/resources/reports/Annual_Illegal_trade_report) which are an additional source of information. These national illegal trade reports were screened, but only a limited number of records with evidence on great apes (see below) were found. Data extracted from the national reports were from 72 parties but across different years.

Submissions of illegal trade national reports considered:
2015: Australia, Lithuania, Turkey.
2016: Austria, Canada, China, Czech Republic, EU[5], France, Georgia, Greece, Italy, Japan, Kuwait, Latvia, Lithuania, Malaysia, Malta, Mexico, Monaco, Mongolia, Namibia, Nepal, Netherlands, New Zealand, Nigeria, Norway, Pakistan, Peru, Poland, Qatar, Singapore, South Africa, Spain, Sweden, Switzerland, Thailand,

[4] *European Union contained information from Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Latvia, Lithuania, Luxembourg, Netherlands, Malta, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.*

Tunisia, Turkey, United Arab Emirates, United Kingdom, United States, Uzbekistan, Venezuela, Viet Nam. **2017:** Kuwait, Mongolia, Pakistan.

In 2016, France reported detection of *Gorilla ssp* skulls, but it turned out that it was a mis-declaration. The same year the USA reported one *Gorilla gorilla* scientific specimen and two skulls of *Pongo pygmaeus*.

6. International legislation specific to great ape range states

The Agreement on the Conservation of Gorillas and Their Habitats, also known as the Gorilla Agreement, is a Multilateral Environmental Agreement covering all ten gorilla range states. Many gorilla populations are transboundary, and therefore much of the success of conservation efforts depends on transboundary collaboration. The Gorilla Agreement was developed under the auspices of CMS and has been in force since the first Meeting of Parties in Rome, Italy, in November 2008.

The Gorilla Agreement provides governments, IGOs, NGOs, scientists, local people and the international community at large with a legally-binding framework to maintain and rehabilitate gorilla populations and their habitats. The Agreement is administered by the CMS Secretariat on an interim basis. The Secretariat works closely with the UNEP Great Apes Survival Partnership (GRASP) and benefits from partnerships with other organizations, including CITES and the Primate Specialist Group of the IUCN Species Survival Commission (SSC).

Central African Republic, Congo, DR Congo, Gabon, Nigeria, Rwanda and Uganda are parties to the agreement. Equatorial Guinea has signed but not ratified, and Angola and Cameroon have not signed yet (Gorilla Agreement, 2008: www.cms.int/en/legalinstrument/gorilla-agreement).

At the 12th CMS Conference of the Parties, in 2017, chimpanzees were listed as migratory species under CMS.

7. Challenges and solutions

Almost all great ape populations are in decline in both Africa and Asia, sometimes so drastically that the population viability is in doubt. Following similar developments in Southeast Asia, the African landscape will soon experience a dramatic change through large-scale investments in extractive industries, transport infrastructure and commercial agriculture (Edwards, et al., 2014; Wich, et al., 2014; Laurance, et al., 2015; Rainer, et al., 2015; Sloan, et al., 2016). While these industries can help lift people out of poverty, operations must be sensitive to the local biodiversity values and ecosystem services on which local communities and wildlife heavily rely. Hence, inclusive and integrated land-use planning processes and implementation of biodiversity-friendly business practices are required if such economic activities are to be accommodated sustainably in great ape habitats. The most sensitive and rich ecosystems in great ape habitats should be protected, ideally through designation as off-limits to habitat modification. In this respect, a number of initiatives seek to minimize the negative impact of industrial activities (logging, industrial scale agriculture and extractives) on biodiversity. These efforts include the Forestry Stewardship Council (FSC) for sustainable logging, the Roundtable for Sustainable Palm Oil (RSPO), the Business and Biodiversity Offsets Programme (BBOP) and associated standards (BBOP Standard), the International Finance Cooperation (IFC) Performance Standard 6, the Equator Principles, the Global Oil and Gas Industry Association for Environmental and Social issues (IPIECA), the International Council on Mining and Metals (ICMM) and other initiatives. The description of each initiative and its potential benefit for the conservation of great apes and their habitats goes beyond the purpose of this report.

As many great ape habitats extend beyond political state borders, land-use planning and protected areas management require cross-border cooperation. However, transboundary conservation efforts can easily become complex. To be successful, they require high-level political commitment, sustained financial and technical support, cross-sectorial collaboration, strong institutional coordination and inclusion of all impacted stakeholders in the decision-making process. Examples of particularly encouraging initiatives include transboundary collaboration between DR Congo, Rwanda and Uganda in the Greater Virunga Landscape (Refisch & Jenson, 2016); the Sangha Trinational which includes Congo, the Central African Republic and Cameroon; the Transboundary Peace Park for Sierra Leone and Liberia which unites the Gola Forest Reserve in Sierra Leone and the Lofa and Foya Forest Reserves in Liberia; the Mayombe Transboundary Initiative encompassing Luki Reserve in DR Congo, Dimonika Reserve in Congo and Maiombe National Park in Cabinda (Ron & Refisch, 2013), Angola; and the Heart of Borneo Initiative uniting the interior regions of Indonesian and Malaysian Borneo and Brunei Darussalam. The Gorilla Agreement, as mentioned above, is also an important international legal instrument.

Law enforcement is currently insufficient to halt the illegal trade in live great apes or great ape body parts. Arrests and convictions for holding or selling great apes (or bushmeat of any kind, including ape meat) remain

rare. *Stolen Apes* reported just 27 arrests for great ape trade between 2005 and 2011 - one quarter of which were never prosecuted (Stiles, et al., 2013). Peer-reviewed studies found weak enforcement and lenient sentencing insufficient to deter further crime, and only one prosecution in two provinces of West Kalimantan, Indonesia for orangutan trading between 2006-2016 (Freund, et al., 2016; Nijman, 2017). Freund, et al. (2016) found that of 145 orangutan cases reported and 133 rescues/confiscations during the study period, none resulted in prosecution or charges. Nijman (2017) found that across Indonesia, between 1993 and 2016, at least 440 formal confiscations and surrenders of orangutans to law enforcement agencies resulted in only seven successful convictions. Reported convictions have been criticized for light sentences, which may not deter further crime. For example, four oil palm workers were sentenced to 8-10 months in prison for killing two orangutans and four persons were sentenced to eight months in prison for killing 20 orangutans (Jakarta Post, 2012). Corruption can render wildlife law enforcement ineffectual, as deterrence become difficult to achieve (Bennett, 2015). Many of the world's great ape range states score poorly on the Corruption Perceptions Index (Transparency International, 2018). In many cases, convicted and incarcerated criminals have been able to bribe their way to liberty (Martini, 2013; WWF & TRAFFIC, 2015; Wyatt & Ngoc Cao, 2015). Without convictions and effective deterrence, it will not be possible to reduce the illegal poaching that threatens all great ape taxa. In this context, understanding the whole chain of actors involved in the bushmeat trade is necessary in order to address the threat. Caspary, et al. (2001) described the entire bushmeat network around the Tai National Park in Côte d'Ivoire, including urban bushmeat markets and restaurants.

Improvements in law enforcements efforts are underway in several countries. The EAGLE network, which started in Cameroon, has now been replicated in Benin, Congo, Gabon, Guinea, Côte d'Ivoire, Madagacar, Senegal, Togo and Uganda, with increasingly visible success (EAGLE Network, 2018). Partnerships between EAGLE members and national governments result in environmental crimes being detected, followed up and brought to justice; the emphasis is usually on ivory as well as on great ape meat and live trade. For example, efforts by the EAGLE network member LAGA in Cameroon, in collaboration with the government, resulted in a record number of eight court judgments against 13 wildlife traffickers in Cameroon in 2017, with two traffickers receiving maximum penalties of three years imprisonment (EAGLE Network, 2017). In Indonesia in 2016, three orangutan smugglers were sentenced to up to 2.5 years in prison (Tempo, 2016), and in 2017, an orangutan killer was given a sentence of two years and nine months in prison (Robin des Bois, 2016; the organisation produces a quarterly newsletter of wildlife illegal trade records across the world). More work is needed to build on these efforts and establish deterrence against further illegal capture, killing, holding or sale of great apes across all range states.

In the context of the CITES mandate, more research is required to understand the scale of illegal cross-border trade in live great apes and their body parts. As detailed above, bushmeat crosses borders with little or no control. It is often difficult to identify body parts to species level (meat can be smoked and/or cut into sections) or by country of origin.

Both illegal meat and live trade are facilitated by corruption, lack of law enforcement, and in some range states, inpunity. High profit margins and low risks to wildlife criminals have meant that people engaged in other types of crime (drugs trafficking, for example) have added wildlife crime to their activities. Furthermore, e-commerce has given suppliers and smugglers unprecedented access to new markets (Estrada, et al., 2017). The development of social media outlets as venues for wildlife trade is responsible for an explosion of illegal trade in numerous species that are now sold illicitly through the Internet (CITES CoP17 Doc. 29; Harrison, et al., 2016). CITES Decisions 17.92-17.96 direct parties, the CITES Secretariat and the CITES Standing Committee to review and develop measures to combat this wildlife cybercrime (CITES CoP17 Decisions, 2016). The online trade is indirectly supported by the countless photos on social media of people holding wild animals taken in various situations (be they captive, in zoos, orphanages and elsewhere, semi-captive or in the wild). These pictures can influence the perceptions people have of those species' status and promote the idea of possessing them as pets (Ross, et al., 2008; Nekaris, et al., 2013; Leighty, et al., 2015). Great apes are highly symbolic in the global illegal wildlife trade. The media is increasingly covering this topic and regular reports give cause for continued concern (e.g. Shukman,2017). However, until recently, there has been a significant lack of verified quantitative and qualitative data on the trade in great apes, including the circumstances surrounding a confiscation, making it hard to define longer-term strategies to combat this high-profile issue. To address this gap, GRASP, together with its technical partner, the UNEP-World Conservation Monitoring Centre (UNEP-WCMC), has developed the first phase of the Apes Seizure Database (https://database.un-grasp.org/). This database includes data on live ape trade and the illegal trade in great ape parts and carcasses. The application was launched at the 17th CITES Conference of the Parties, in October 2016, in Johannesburg, and is currently undergoing a data validation process. It is anticipated that the database will provide analytics on illegal trade for a Status Report to the CITES CoP18 in 2019.

The further development of the Apes Seizure Database can work hand-in-hand with the application of new advances in genetic recognition technology. According to CITES regulations, when possible, live victims of

illegal wildlife trade should be repatriated to their countries of origin. However, when a great ape is confiscated, it carries with it little identification other than its DNA. Substantial genetic data collected to date on many wild great ape populations create a good starting point for a genetic recognition resource (Goldberg, 1997). Additional reference samples will be required, with particular attention paid to populations less well-documented by existing research projects. In cases of illegally trafficked great apes or great ape meat, DNA can be analysed to inform decisions on repatriation of live individuals to country of origin, to identify the source population, and thus better direct future law enforcement efforts. Progress has been made in the development of mobile DNA sequencers (e.g. MiniIon from Oxford Nanopore Technologies). Providing units to law enforcement and customs officers, as well as the necessary training would enable genetic sampling on the spot and improve the identification of bushmeat of the origin of live animals.

Given the wide range of different threats and their complex interlinkages, it is reasonable to assume that addressing any one of the threats alone will not be enough to achieve conservation goals. Great ape habitats continue to be degraded, because national developmental spatial planning has not taken conservation into account, because of lack of any national spatial land-use planning or law enforcement, or a combination of these factors. Human populations continue to grow (especially in Sub-Saharan Africa, doubling every thirty years; in Indonesia it will take about 70 years (World Bank, 2018)), putting ever-increasing pressure on land and natural resources. Great ape meat (and live apes) will continue to appear in the illegal wildlife trade. A holistic approach is required to tackle these challenges effectively, with strong political commitment and coordination between the various actors involved in law enforcement and conservation, including across borders. Responses to address the drivers of the local bushmeat trade and of international illegal live ape by criminal cartels are required.

One approach to addressing the complex interlinkages, which remains a challenge, is the coordination among different law enforcement stakeholders at national and regional level. The International Consortium on Combatting Wildlife Crime (ICCWC) is one example where main law enforcement actors try to coordinate and pool efforts. Within this Consortium, CITES, UNODC, INTERPOL and WCO partner to strengthen criminal justice systems and provide coordinated support at national, regional and international level to combat wildlife and forest crime (https://cites.org/eng/prog/iccwc.php).

8. Recommendations

This report recommends the following actions directed to CITES parties:

1. Increase of law enforcement and promotion of training of local practitioners and rangers in law enforcement, prosecution and modern forensic methods;

2. Review of relevant legislations and sanctions per ICCWC Wildlife and Forest Crime Analytic Toolkit and USAID's Measuring Efforts to Combat Wildlife Crime: A Toolkit for Improving Action and Accountability sanctions,to ensure adequate protection of great apes and improved legal framework;

3. Technical and financial assistance to range states, to further strengthen their criminal justice responses to wildlife crime, including tracing and recovering the proceeds of crime (UNODC);

4. Capacity building of customs agents to profile suspect shipments and identify the species, as most enforcement activities to combat illegal trade take place at ports of entry, but also to monitor domestic trade;

5. Oblige, by national law, all private actors in the extractive, logging, energy and agricultural sectors to comply with national and international laws, and with industry best practices in minimising impact on great ape populations and habitat. For forestry, this is the Forestry Stewardship Council (FSC), for industry in general, this includes the Business and Biodiversity Offsets Program (BBOP) and BBOP Standard, International Finance Corporation (IFC) Performance Standard 6, Equator Principles, IPIECA (global oil and gas industry association for environmental and social issues), and the International Council on Mining and Metals (ICMM). Of particular benefit would be the inclusion of great apes as a Species at Risk (SAR) for FSC;

6. Great ape conservation partners to contribute to, further develop and use the GRASP Apes Seizure Database. These partners include the national law enforcement agencies and wildlife departments likely to hold data on seizures of trafficked bushmeat and live animals, relevant conservation NGOs involved in supporting law enforcement and compliance, researchers and wildlife sanctuaries;

7. Encourage sharing of illegal trade data with GRASP for inclusion in the GRASP Apes Seizure Database for the illegal trade in great apes and great ape parts, with relevant data related to live apes under source code "I" (confiscated);

8. Development of DNA sequence database to locate the origin of confiscated apes;

9. Contribute to the IUCN SSC A.P.E.S database;

10. Use of tools developed by the International Consortium in Combating Wildlife Crime, such as the ICCWC Indicator Framework for Wildlife and Forest Crime or the Wildlife and Forest Crime Analytic Toolkit, for countries to be able to measure and monitoring the effectiveness of their law enforcement responses to wildlife crime;

11. Ratification and full implementation of the UN Convention against Transnational Organized Crime;

12. Ratification and full implementation of the UN Convention against Corruption;

13. Improvement of reporting and data on illegal domestic trade;

14. Encourage more investigation into cross border trade in bushmeat.

The following actions are recommended to be directed to the CITES Secretariat:

15. Examination of the CITES permits issued for great ape species, particularly with attention to discrepancies in reported importing/exporting figures, and all permits for trade of potentially wild caught great apes (source code "W", "U" or "I"). Given the rarity of these taxa and the large numbers of captive-bred great apes currently held in zoos and other ex-situ collections, wild-caught great apes are not acceptable fortrade among zoos, safari parks or other educational or scientific institutions except under extraordinary circumstances.

9. Main sources of information

Information on great ape population estimates and change over time has been derived from the IUCN SSC A.P.E.S. database. However, data from the more recent publications has not been entered yet. In these cases, we used information from the IUCN Red List to ensure that the information presented in this report is as up-to-date as possible.

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References

- Abernethy, K., Coad, L., Ilambu, O., Makiloutila, F., Easton J. and Akiak, J. (2010). Wildlife hunting, consumption and trade in the Oshwe sector of the Salonga-Lukenie-Sankuru Landscape. *DRC,WWF*, 122.

- Aebischer, T., Siguindo, G., Rochat, E., Arandjelovic, M., Heilman, A., Hickisch, R., Vigilant, L., Joost, S. and Wegmann, D. (2017). 'First quantitative survey delineates the distribution of chimpanzees in the Eastern Central African Republic'. *Biological Conservation*, 213: 84-94.

- Allendorf, F.W., Luikart, G. and Aitken, S.N., (2013). *Conservation and the genetics of populations*. 2nd ed. Hoboken: Wiley-Blackwell.

- Ancrenaz, M., Gimenez, O., Ambu, L., Ancrenaz, K., Andau, P., Goossens, B., Payne, J., Tuuga, A. and Lackman-Ancrenaz, I. (2005). 'Aerial surveys give new estimates for orangutans in Sabah, Malaysia'. *PLoS Biology*, 3: 30–37.

- Ancrenaz, M., Ambu, L., Sunjoto, I., Ahmad, E., Manokaran, K., Meijaaed, E. and Lackman, I. (2010). 'Recent surveys in the forests of Ulu Segama Malua, Sabah, Malaysia, show that orangutans (*P.p. morio*) can be maintained in slightly logged forests'. *PLoS One* 5(7): e11510.

- Ancrenaz, M., Cheyne, S.M., Humle, T. and Robbins, M.M. (2015). 'Impacts of industrial agriculture on ape ecology'. In: H. Rainer (ed) *State of the Apes: Industrial Agriculture and Ape Conservation.* Cambridge, UK: Cambridge University Press.

- Ancrenaz, M., Gumal, M., Marshall, A.J., Meijaard, E., Wich, S.A. and Husson, S. (2016). *Pongo pygmaeus*. *The IUCN Red List of Threatened Species 2016*: e.T17975A17966347. http://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T17975A17966347.en. Downloaded on 05 September 2017.

- Arandjelovic, M., Head, J., Boesch, C., Kuehl, H.S., Robbins, M.M. and Maisels, F. Vigilant. (2010). 'Effective non-invasive genetic monitoring of multiple wild western gorilla groups'. *Biological Conservation*, 1443: 1780-1791.

- Arandjelovic, M., Head, J., Rabanal, L.I., Schubert, G., Mettke, E., Boesch, C., Robbins, M.M. and Vigilant, L. (2011). 'Non-invasive genetic monitoring of wild central chimpanzees'. *PLoS One*, 6: e14761.

- Bennett, E.L. (2015). 'Legal ivory trade in a corrupt world and its impact on African elephant populations'. *Conservation Biology*, 29(1): 54-60.

- Bergl, R.A., Dunn, A., Fowler, A., Imong, I., Ndeloh, D., Nicholas, A. and Oates, J.F. (2016). *Gorilla gorilla ssp. diehli*. *The IUCN Red List of Threatened Species 2016*: e.T39998A102326240. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T39998A17989492.en. Downloaded on 12 September 2017.

- Bermejo, M., Rodriguez-Teijeiro, J.D., Illera, G., Barroso, A., Vila, C. and Walsh, D.P. (2006). 'Ebola outbreak killed 5000 gorillas'. *Science*, 314(5805): 1564-1564.

- Boyer, K. (2011). 'Chimpanzee conservation in light of impending iron ore mining project in S.E Senegal'. Graduate Masters thesis. Iowa State University.

- Brncic, T.M., Amarasekaran, B. and McKenna, A. (2010). Final report of the Sierra Leone national chimpanzee census project. Freetown, Sierra Leone: Tacugama Chimpanzee Sanctuary.

- Bryson-Morrison, N., Matsuzawa, T. and Humle, T. (2016). 'Chimpanzees in an anthropogenic landscape: examining food resources across habitat types at Bossou, Guinea, West Africa'. *International Journal of Primatology*, 78(12): 1237-1249.

- Campbell, G., Kuehl, H., Kouamé, P. N. G., and Boesch, C. (2008). 'Alarming decline of West African chimpanzees in Côte d'Ivoire'. *Current Biology*, 18(19): R903–R904.

- Campbell, G. and Houngbedji, M. (2015). Conservation status of the West African chimpanzee (*Pan troglodytes verus*) in Togo and Benin. *Unpublished report to Primate Action Fund*.

- Campbell-Smith, G., Sembiring, R., and Linkie, M. (2012). 'Evaluating the effectiveness of human–orangutan conflict mitigation strategies in Sumatra'. *Journal of Applied Ecology*, 49(2): 367-375.

- Carvalho, J.S., Marques, T.A. and Vicente, L. (2013). 'Population status of *Pan troglodytes verus* in Lagoas de Cufada Natural Park, Guinea-Bissa'u. *PLoS One* 8(8): e71527.

- Caspary, H.U., Kone, I., Prouot, C. and De Pauw, M. (2001). La chasse et la fliliere viande de brousse dans l'espace Tai, Cote d'Ivoire. Tropenbos-Côte d'Ivoire Série 2, *ISBN:*90-5113-048-1.

- Chaber, A. L., Allebone-Webb, S., Lignereux, Y., Cunningham, A.A. and Rowcliffe, J.M. (2010). 'The scale of illegal meat importation from Africa to Europe via Paris'. *Conservation Letters,* 3(5): 317-321.

- CITES CoP17 Decisions (2016). [Online], https://cites.org/eng/dec/valid17/81840. Consulted on 22 March 2018.

- CITES (2017). Annexes. [Online], https://cites.org/eng/app/appendices.php.

- Coad, L., Schleicher, J., Milner-Gulland, E.J., Marthews, T.R., Starkey, M., Manica, A., Balmford, A., Mbombe, W., Diop Binen, T.R. and Abernethy, K.A. (2013). 'Social and ecological change over a decade in a village hunting system, Central Gabon'. *Conservation Biology*, 27(2): 270-280.

- Colom, A. (2006). The socioeconomic aspects of natural resource use and management by local communities in the Salonga-Lukenie-Sankuru landscape: guidelines for conservation and livelihood improvement. WWF – Democratic Republic of Congo, pp: 250.

- Danquah, E., Oppong, S.K., Akom, E. and Sam, M. (2012). 'Preliminary survey of chimpanzees and threatened monkeys in the Bia-Goaso forest block in southwestern Ghana'. *African Primates*, 7: 163–174.

- Davis, J.T., Mengersen, K., Abram, N.K., Ancrenaz, M., Wells, J.A. and Meijaard, E. (2013). 'It's not just conflict that motivates killing of orangutans'. *PLoS One* 8(10): e75373.

- Dowsett, R.J. and Dowsett-Lemaire, F. ed. (1991). *Flore et Faune du bassin du Kouliou (Congo) et leur exploitation.*Liège, Belgium: Tauraco Press.

- Dunn, A., Bergl, R., Byler, D., Eben-Ebai, S., Etiendem, D.N., Fotso, R., Ikfuingei, R., Imong, I., Jameson, C., Macfie, L., Morgan, B., Nchanji, A., Nicholas, A., Nkembi, L., Omeni, F., Oates, J., Pokempner, A., Sawyer, S. and Williamson, E.A. (2014). *Revised regional action plan for the conservation of the Cross River gorilla (Gorilla gorilla diehli): 2014–2019*. IUCN/SSC Primate Specialist Group and Wildlife Conservation Society, New York.

- EAGLE Network (2017). 'The EAGLE Network Annual Report 2017'. [Online], http://www.eagle-enforcement.org/data/files/eagle-network-annual-report-2017.pdf.

- EAGLE Network (2018). 'Our Members'. [Online], www.eagle-enforcement.org/members/.

- Edwards, D.P., Sloan, S., Weng, L., Dirks, P., Sayer, J. and Laurance, W.F. (2014). 'Mining and the African environment'. *Conservation Letters,* 7(3): 302-311.

- Estrada, A., Garber, P.A., Rylands, A.B., Roos, C., Fernandez-Duque, E., Di Fiore, A., Nekaris, K.A.I., Nijman, V., Heymann, E.W., Lambert, J.E., Rovero, F., Barelli, C., Setchell, J.M.,Gillespie, T.R., Mittermeier, R.A., Arregoitia, L.V., De Guinea, M., Gouveia, S., Dobrovolski, R., Shanee, S., Shanee, N., Boyle, S.A., Fuentes, A., MacKinnon, K.C., Amato, K.R., Meyer, A.L., Wich, S.,Sussman, R.W., Pan, R., Kone, I. and Li, B. (2017). 'Impending extinction crisis of the world's primates: Why primates matter'. *Science Advances,* 3: e1600946.

- Fa, J.E., Seymour, S., Dupain, J., Amin, R., Albrechtsen, L. and Macdonald, D. (2006). 'Getting to grips with the magnitude of exploitation: bushmeat in the Cross-Sanaga rivers region, Nigeria and Cameroon'. *Biological Conservation,* 129(4): 497–510.

- Fa, J. and Brown, D. (2009). 'Impacts of hunting on mammals in African tropical moist forests: A review and synthesis'. *Mammal Review*, 39(4): 231-264.

- FAO (2015). WFP (2015). The State of Food Insecurity in the World 2015. Meeting the 2015 international hunger targets: taking stock of uneven progress. Food and Agriculture Organization Publications, Rome.

- Foerster, S., Wilkie, D., Morelli, G.A., Demmer, J., Starkey, M., Telfer, P., Steil, M. and Lewbel, A. (2012). ,Correlates of bushmeat hunting among remote rural households in Gabon, Central Africa'. *Conservation Biology*, 26(2): 335-344.

- Freund, C., Rahman, E. and Knott, C. (2016). 'Ten years of orangutan related wildlife crime investigation in West Kalimantan, Indonesia'. *American Journal of Primatology*, 79(11).

- Fruth, B., Hickey, J.R., André, C., Furuichi, T., Hart, J., Hart, T., Kuehl, H., Maisels, F., Nackoney, J., Reinartz, G., Sop, T., Thompson, J. and Williamson, E.A. (2016). *Pan paniscus. The IUCN Red List of Threatened Species 2016:* e.T15932A102331567. http://dx.doi.org/10.2305.

- Galat, G., Galat-Luong, A. and Nizinski, G. (2008). Our cousins chimpanzees and baboons face global warming by digging wells to filtrate drinking water. In: *13thIWRA World Water Congress, IUCN.*

- Gaveau, D.L., Sloan, S., Molidena, E., Yaen, H., Sheil, D., Abram, N.K., Ancrenaz, M., Nasi, R., Quinones, M., Wielaard. N. and Meijaard, E. (2014). 'Four decades of forest persistence, clearance and logging on Borneo'. *PLoS One*, 9(7): e101654.

- Gilardi, K. V., Gillespie, T. R., Leendertz, F. H., Macfie, E. J., Travis, D. A., Whittier, C. A. and Williamson, E. A. (2015). Best practice guidelines for health monitoring and disease control in great ape populations. *Occasional Papers of the IUCN Species Survival Commission*, 56.

- Ginn, L.P., Robison, J., Redmond, I. and Nekaris, K.A.I. (2013). 'Strong evidence that the West African chimpanzee is extirpated from Burkina Faso'. *Oryx*, 47(3): 325-326.

- Global Forest Watch (2017). [Online], <www.globalforestwatch.org/map/6/0.74/15.68/ALL/grayscale/none/581>. Consulted on 22 March 2018.

- Goldberg, T.L. (1997). 'Inferring the geographic origins of 'refugee' chimpanzees in Uganda from mitochondrial DNA sequences'. *Conservation Biology*, 11(6): 1441-1446.

- Goodall, J, (1986). *The Chimpanzees of Gombe: Patterns of behaviour*. (Eds T. Matsuzawa, T. Humle and Y. Sugiyama). Cambridge, Massachusetts: Belknap Press.

- Gorilla Agreement (2008). [Online], www.cms.int/en/legalinstrument/gorilla-agreement. Consulted on 22 March 2018.

- Gray, M., McNeilage, A., Fawcett, K.T., Robbins, M.M., Ssebide, B., Mbula, D. and Uwingeli, P. (2010). 'Censusing the mountain gorillas in the Virunga Volcanoes: complete sweep method versus monitoring'. *African Journal of Ecology*, 48(3): 588–599.

- Gray, M., Roy, J., Vigilant, L., Fawcett, K., Basabose, A., Cranfield, M., Uwingeli, P., Mburanumwe, I., Kagoda, E. and Robbins, M.M. (2013). 'Genetic census reveals increased but uneven growth of a critically endangered mountain gorilla population'. *Biological Conservation*, 158: 230–238.

- Greengrass, E. (2016). 'Commercial hunting to supply urban markets threatens mammalian biodiversity in Sapo National Park, Liberia'. *Oryx*, 50(3): 397–404.

- Hakizimana, D. and Huynen, M.C. (2013). 'Chimpanzee (*Pan troglodytes schweinfurthii*) population density and abundance in Kibira National Park, Burundi'. *Pan Africa News*, 20(2): 16–19.

- Hall, J.S., White, L.J., Inogwabini, B.I., Omari, I., Morland, H.S.,Williamson, E.A., Saltonstall, K., Walsh, P., Sikubwabo, C., Bonny, D., Kaleme, P.K., Vedder, A. and Freeman, K. (1998). 'Survey of Grauer's gorillas (*Gorilla gorilla graueri*) and eastern chimpanzees (*Pan troglodytes schweinfurthii*) in the Kahuzi-Biega National Park lowland sector and adjacent forest in eastern Democratic Republic of Congo'. *International Journal of Primatology*, 19(2): 207–235.

- Ham, R. (1998). Nationwide chimpanzee census and large mammal survey: Republic of Guinea. Unpublished report to the European Union, Conakry, Guinea.

- Harrison, J., Roberts, D. and Hernandez-Castro, J. (2016). 'Assessing the extent and nature of wildlife trade on the dark web'. *Conservation Biology*, 30(4): 900-904.

- Hedrick, P. W. and Kalinowski, S. T. (2000). 'Inbreeding depression in conservation biology'. *Annual review of ecology and systematics*, 31(1): 139-162.

- Hicks, C., Darby, L., Hart, J., Swinkels, J., January, N. and Menken, S. (2010). Trade in orphans and bushmeat threatens one of the Democratic Republic of the 'Congo's most important populations of eastern chimpanzees (*Pan troglodytes schweinfurthii*)'. *African Primates*, 7: 1–18.

- Hockings, K. and Humle, T. (2009). *Best Practice Guidelines for the Prevention and Mitigation of Conflict Between Humans and Great Apes*. Gland, Switzerland: IUCN SSC Primate Specialist Group. 40 pp. [Online], https://portals.iucn.org/library/node/9324.

- Humle, T. and Matsuzawa, T. (2004). 'Oil palm use by adjacent communities of chimpanzees at Bossou and Namba Mountains, West Africa'. *International Journal of Primatology*, 25(3): 551-581.

- Humle, T., Boesch, C., Campbell, G., Junker, J., Koops, K., Kuehl, H and Sop, T. (2016), *Pan troglodytesssp verus*. *The IUCN Red List of Threatened Species 2016*: e.T15935A102327574.http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T15935A17989872.en.

- ICCWC (International Consortium on Combating Wildlife Crime) (2012). *Wildlife and Forest Crime Analytic Toolkit (Revised edition).* New York: United Nations. [Online], http://www.unodc.org/documents/Wildlife/Toolkit_e.pdf. Downloaded on May 6, 2018.

- Imong, I., Robbins, M.M., Mundry, R., Bergl, R.A. and Kuhl, H.S. (2014). 'Informing conservation management about structural versus functional connectivity: a case study of Cross River gorillas'. *American Journal of Primatology*, 76(10): 978–988.

- Inogwabini, B.I., Matungila, B., Mbende, L., Abokome, M. and Wa Tshimanga, T. (2007). 'Great apes in the Lake Tumba landscape, Democratic Republic of Congo: newly described populations'. *Oryx*, 41(4): 532-538.

- IUCN (2014). *Regional Action Plan for the Conservation of Western Lowland Gorillas and Central Chimpanzees 2015–2025.* Gland, Switzerland: IUCN SSC Primate Specialist Group.

- IUCN (2017). *The IUCN Red List of Threatened Species. Version 2017-3*. [Online], www.iucnredlist.org.

- IUCN and ICCN. (2012). Bonobo (*Pan paniscus*): *Conservation Strategy 2012–2022*.Gland, Switzerland: IUCN SSC Primate Specialist Group & Institut Congolais pour la Conservation de la Nature.

- IUCN SSC A.P.E.S. database (2017). [Online], http://apesportal.eva.mpg.de/database/archive.

- Jakarta Post (2012). 'Orangutan Killers Sent to Prison in Kalimantan Case'. [Online], (23 May 2012). http://jakartaglobe.id/archive/orangutan-killers-sent-to-prison-in-kalimantan-case/. Consulted on 22 March 2018.

- JGI, TNC, CBSG, FZS, WCS, WD-MNRT, TAWIRI and USFWS. (2011). Tanzania chimpanzee conservation action planning workshop report. Jane Goodall Institute, Arlington, USA.

- Junker, J., Boesch, C., Freeman, T., Mundry, R., Stephens, C. and Kühl, H. S. (2015). 'Integrating wildlife conservation with conflicting economic land-use goals in a West African biodiversity hotspot'. *Basic and Applied Ecology*, 16(8): 690–702.

- Kirkby, A., Spira, C., Bahati, B., Twendilonge, A., Kujirakwinja, D., Plumptre, A.J., Wielland, M. and Nishuli, R. (2015). Investigating artisanal mining and bushmeat around protected areas: Kahuzi-Biega National Park and Itombwe Reserve. Report to USAID and Arcus Foundation. Wildlife Conservation Society, New York.

- Köndgen, S., Kühl, H., N'Goran, P. K., Walsh, P. D., Schenk, S., Ernst, N., Biek, R., Formenty, P., Mätz-Rensing, K., Schweiger, B., Junglen, S., Ellerbrok, H., Nitsche, A., Briese, T., Lipkin, W.I., Pauli, G., Boesch, C. and Leendertz, F. (2008). 'Pandemic human viruses cause decline of endangered great apes'. *Current Biology*, 18(4): 260–264.

- Kormos, R., Boesch, C., Bakarr, M.I. and Butynski, T.M. (2003). *West African chimpanzees: status survey and conservation action plan*. Gland, Switzerland and Cambridge, UK: IUCN SSC Primate Specialist Group.

- Kormos, R., Kormos, C.F., Humle, T., Lanjouw, A., Rainer, H., Victurine, R., Mittermeier, R.A., Diallo, M.S., Rylands, A.B. and Williamson, E.A. (2014). 'Great apes and biodiversity offset projects in Africa: The case for national offset strategies'. *PLoS One*, 9(11): e111671.

- Kühl, H., Maisels, F., Ancrenaz, M. and Williamson, E.A. (2008). *Best Practices Guidelines for Surveys and Monitoring of Great Ape Populations*. Gland, Switzerland: ICUN SSC Primate Specialist Group.

- Kühl, H., Sop, T., Williamson, E.A., Mundry, R., Brugière, D., Campbell, G., Cohen, H., Danquah, E., Ginn, L., Herbinger, I., Jones, S., Junker, J., Kormos, R., Kouakou, C., N'Goran, P., Normand, E., Shutt-Phillips, K., Tickle, A., Vendras, E., Welsh, A., Wessling, E. and Boesch, C. (2017). 'The critically endangered western chimpanzee declines by 80%'. *American Journal of Primatology*, 79(9): e22681.

- Laurance, W., Sloan, S., Weng, L. and Sayer, J.A. (2015). 'Estimating the environmental costs of Africa's massive "development corridors"'. *Current Biology*, 25(24): 3202-3208.

- Leendertz, F., Pauli, G., Maetz-Rensing, K., Boardman, W., Nunn, C., Ellerbrok, H., Jensen, S., Junglen, S. and Christophe, B. (2006). Pathogens as drivers of population declines: 'The importance of systematic monitoring in great apes and other threatened mammals'. *Biological Conservation*, 131(2): 325-337.

- Leendertz, S.A.J., Wich, S.A., Ancrenaz, M., Bergl, R.A., Gonder, M.K., Humle, T. and Leendertz, F. H. (2017). 'Ebola in great apes – current knowledge, possibilities for vaccination, and implications for conservation and human health'. *Mammal Review*,47(2): 98–111.

- Leighty, K., Valuska, A., Grand, A., Bettinger, T., Mellen, J., Ross, S., Boyle, P. and Ogden, J. (2015). 'Impact of visual context on public perceptions of non-human primate performers'. *PLoS One*, 10(2): e0118487.

- Maisels, F., Strindberg, S., Breuer, T., Greer, D., Jeffery, K. and Stokes, E. (2016a). *Gorilla gorilla ssp. gorilla*. *The IUCN Red List of Threatened Species 2016*: e.T9406A17989591. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T9406A17989591.en

- Maisels, F., Strindberg, S., Greer, D., Jeffery, K., Morgan, D.L. and Sanz, C. (2016b). *Pan troglodytes ssp. troglodytes*. *The IUCN Red List of Threatened Species 2016*: e.T15936A17990042. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T15935A17989872.en

- Maisels, F., Bergl, R.A. and Williamson, E.A. (2016c). *Gorilla gorilla*. *The IUCN Red List of Threatened Species 2016*: e.T9404A102330408. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T9404A17963949.en

- Martini, M. (2013). Wildlife crime and corruption: In which way does corruption exacerbate the problem of poaching and illegal wildlife trade in Southern Africa and how can anti-corruption contribute to the fight against it? U4 Expert Answer (15 February 2013), Number 367. U4 Anti-Corruption Resource Centre. www.transparency.org/files/content/corruptionqas/367_Wildlife_Crimes_and_Corruption.pdf.

- Matsuzawa, T., Humle, T. and Sugiyama, Y.(Eds.). (2011). *The Chimpanzees of Bossou and Nimba*. Japan: Springer.

- Meijaard, E., Buchori, D., Hadiprakarsa, Y., Utami-Atmoko, S.S., Nurcahyo, A., Tjiu, A., Prasetyo, D., Nardiyono, Christie, L., Ancrenaz, M., Abadi, F., Antoni, N.G., Armayadi, D., Dinato, A., Ella, Gumelar, P., Indrawan, T.P., Kussaritano, Munajat, C., Priyono, W.P., Purwanto, Y., Puspitasari, D., Putra, M.S.W., Rahmat, A., Ramadani, H., Sammy, J., Siswanto, D., Syamsuri, M., Andayani, N., Wu, H., Wells, J.A. and Mengersen, K. (2011). 'Quantifying killing of orangutans and human-orangutan conflict in Kalimantan, Indonesia'. *PLoS One*, 6(11): e27491.

- Mitchell M.W., Locatelli S., Ghobrial L., Pokempner, A.A., Sesink Clee, P.R., Abwe, E.E., Nicholas, A., Nkembi, L., Anthony, N.M., Morgan, B.J., Fotso, R., Peeters, M., Hahn, B.H. and Gonder, M.K. (2015). 'The population genetics of wild chimpanzees in Cameroon and Nigeria suggests a positive role for selection in the evolution of chimpanzee subspecies'. *BMC Evolutionary Biology*, 15: 3.

- Morgan, D. and Sanz, C. (2007). *Best Practice Guidelines for Reducing the Impact of Commercial Logging on Great Apes in Western Equatorial Africa*.Gland, Switzerland: IUCN SSC Primate Specialist Group (PSG), 32 pp.

- Morgan, B., Adeleke, A., Bassey, T., Bergl, R., Dunn, A., Fotso, R., Gadsby, E., Gonder, K., Greengrass, E.,Koulagna, D.K., Mbah, G., Nicholas, A., Oates, J., Omeni, F., Saidu, Y., Sommer, V., Sunderland-Groves, J.,Tiebou, J. and Williamson, E.A. (2011). Regional action plan for the conservation of the Nigeria-Cameroon chimpanzee (*Pan troglodytes ellioti*). San Diego, USA: IUCN/SSC Primate Specialist Group and Zoological Society of SanDiego.

- Morgan, D., Mundry, R., Sanz, C., Ayina, C.E., Strundberg, S., Lonsdorf, E. and Kühl, H.S. (2017). 'African apes coexisting with logging: Comparing chimpanzee (*Pan troglodytes troglodytes*) and gorilla (*Gorilla gorilla gorilla*) resource needs and responses to forestry activity'. *Biological Conservation*, 218: 277-286.

- Murai, M., Ruffler, H., Berlemont, A., Campbell, G., Esono, F., Agbor, A., Mbomio, D., Ebana, A., Nze, A. and Kühl, H. (2013). 'Priority areas for large mammal conservation in Equatorial Guinea'. *PLoS One*, 8(9): e75024.

- Nakamura, M. and Nishida, T. (2012). 'Long-term field studies of chimpanzees at Mahale Mountains NP, Tanzania'. In: Kappeler, P.M. and Watts, D. (Eds). *Long term field study of primates* (pp 339-356). Berlin Heidelberg: Springer-Verlag.

- Nasi, R., Brown, D., Wilkie, D., Bennett, E.L., Tutin, C., van Tol, G. and Christophersen, T. (2008). Conservation and use of wildlife-based resources: the bushmeat crisis. Technical Series no. 33: 50pp. Secretariat of the Convention on Biological Diversity, Montreal, and Centre for International Forestry Research (CIFOR), Bogor.

- Nater, A., Mattle-Greminger, M.P., Nurcahyo, A., Nowak, M.G., de Manuel, M., Desai, T., Grovers, C., Pybus, M., Sonay, T.B., Roos, C., Lameira, A.R., Wich, S.A., Askew, J., Davila-Ross, M., Fredriksson, G., de Valles, G., Casais, F., Prado-Martinez, J., Goossens, B., Verschoor, E.J, Warren, K.S., Singleton, I., Marques, D.A., Pamungkas, J., Perwitasari-Farajallah, D., Rianti, P., Tuuga, A., Gut, I.G., Gut, M., Orozco-terWengel, P., van Schaik, C.P., Bertranpetit, J., Anistimova, M., Scally, A., Marques-Bonet, T., Meijaard, E. and Krutzen, M. (2017). 'Morphometric, behavioural and genomic evidence for a new orangutan species'. *Current Biology*, 27(22) : 3487-3498.

- Ndiaye, S. (2011). Conservation du Chimpanzé au Sénégal. Etat des Connaissances et Réactualisation du Plan d'Actions. Report for USAID/Wula Nafaa.

- Nekaris, K., Campbell, N., Coggins, T., Rode, E., Nijman, V. and Roberts, D. (2013). 'Tickled to death: analysing public perceptions of 'cute' videos of threatened species (slow lorises – *Nycticebusspp*.) on web 2.0 sites'. *PLoS One*, 8(7): e69215.

- Nijman, V. (2017). 'Orangutan trade, confiscations, and lack of prosecutions in Indonesia'. *American Journal of Primatology*, 79(11).

- Nishida, T., Corp, N., Hamai, M., Hasegawa, T., Hiraiwa-Hasegawa, M., Hosaka, K., Hunt, K., Itoh, N., Kawanaka, K., Matsumoto-Oda, A., Mitani, J., Nakamura, M., Norikoshi, K., Sakamaki, T., Turner, L., Uehara, S. and Zamma, K. (2003). 'Demography, female life history, and reproductive profiles among the chimpanzees of Mahale'. *American Journal of Primatology*, 59(3): 99-121.

- N'Goran, K.P., Ndomba, D.L. and Beukou, G.B. (2016). Rapport de l'inventaire des grands et moyens mamifères dans le segment RCA du paysage trinational de la Sangha. Bureau Régional du WWF pour l'Afrique. Unpublished Report.

- Nowak, M.G., Rianti, P., Wich, S.A., Meijaard, E. and Fredriksson, G. (2017). *Pongo tapanuliensis. The IUCN Red List of Threatened Species 2017:* e.T120588639A120588662. http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T120588639A120588662.en. Downloaded on 24 March 2018.

- Oates, J.F., Doumbe, O., Dunn, A., Gonder, M.K., Ikemeh, R., Imong, I., Morgan, B.J., Ogunjemite, B. and Sommer, V. (2016). *Pan troglodytes ssp. ellioti*. *The IUCN Red List of Threatened Species 2016*:

e.T40014A17990330. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T40014A17990330.en. Downloaded on 06 September 2017.

- Plumptre, A.J., Rose, R., Nangendo, G., Williamson, E.A., Didier, K., Hart, J., Mulindahabi, F., Hicks, C., Griffin, B., Ogawa, H., Nixon, S., Pintea, L., Vosper, A., McClennan, M., Amsini, F., McNeilage, A., Makana, J.R., Kanamori, M., Hernandez, A., Piel, A., Stewart, F., Moore, J., Zamma, K., Nakamura, M., Kamenya, S., Idani, G., Sakamaki, T., Yoshikawa, M., Greer, D., Tranquilli, S., Beyers, R., Furuichi, T., Hashimoto, C. and Bennett, E. (2010). *Eastern Chimpanzee (Pan troglodytes schweinfurthii): Status Survey and Conservation Action Plan 2010-2020.* Gland, Switzerland: IUCN/SSC Primate Specialist Group.

- Plumptre, A.J., Nixon, S., Critchlow, R., Vieilledent, G., Nishuli, R., Kirkby, A., Williamson, E.A., Hall, J.S. and Kujirakwinja, D. (2015). *Status of Grauer's gorilla and chimpanzee in eastern Democratic Republic of Congo: Historical and current distribution and abundance*. Wildlife Conservation Society, Fauna & Flora International and Institut Congolais pour la Conservation de la Nature, New York.

- Plumptre, A.J., Nixon, S., Kujirakwinja, D.K., Vieilledent, G., Critchlow, R., Williamson, E.A., Nishuli, R., Kirkby, A.E. and Hall, J.S. (2016a). 'Catastrophic decline of world's largest primate: 80% loss of Grauer's gorilla (*Gorilla beringei graueri*) population justifies Critically Endangered status'. *PLoS One*, 11(10): e0162697.

- Plumptre, A., Hart, J.A., Hicks, T.C., Nixon, S., Piel, A.K. and Pintea, L. (2016b). *Pan troglodytes ssp. schweinfurthii. The IUCN Red List of Threatened Species 2016*: e.T15937A17990187. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T15937A17990187.en.

- Plumptre, A., Nixon, S., Caillaud, D., Hall, J.S., Hart, J.A., Nishuli, R. and Williamson, E.A. (2016c). *Gorilla beringeissp. graueri. The IUCN Red List of Threatened Species 2016*: e.T39995A102328430. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T39995A17989838.en.

- Plumptre, A., Robbins, M. and Williamson, E.A. (2016). *Gorilla beringei. The IUCN Red List of Threatened Species 2016*: e.T39994A102325702. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T39994A17964126.en.

- Poulsen, J.R., and Clark, C.J. (2010). 3.1 Congo Basin timber certification and biodiversity conservation. *Biodiversity conservation in certified forests*, *55*.

- Rainer, H., White, A. and Lanjouw, A. (2014). *State of the Apes: Extractive Industries and Ape Conservation*. Cambridge, UK: Cambridge University Press.

- Rainer, H., White, A. and Lanjouw, A. (2015). *State of the Apes: Industrial Agriculture and Ape Conservation*. Cambridge, UK: Cambridge University Press.

- Redford, K. (1992). 'The empty forest'. *BioScience*, 42(6): 412-422.

- Refisch, J. and Koné, I. (2005). 'Impact of commercial hunting on monkey populations in the Tai region, Cote d'Ivoire'. *Biotropica*, 37(1): 136-144.

- Refisch, J. and Jenson, J. (2016). 'Transboundary collaboration in the Greater Virunga landscape: From gorilla conservation to conflict-sensitive transbondary landscape management'. In: Bruch, C., Muffett, C. and Nichols, S. (Eds.). *Governance, natural resources and post-conflict peacebuilding*. Oxfod, UK: Earthscan from Routledge.

- Regnaut, S., and Boesch, C. (2012). Offset strategy for the Guinean Aluminia project. Conakry, Republic of Guinea: Wild Chimpanzee Foundation.

- Robbins, M., Gray, M., Kümpel, N., Lanjouw, A., Maisels, F., Mugisha, A., Spelman, L. and Williamson, L. (2008). *Gorilla beringei ssp. beringei. The IUCN Red List of Threatened Species 2008:* e.T39999A10292321. http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T39999A10292321.en.

- Robbins, M.M., Gray, M., Fawcett, K.A., Nutter, F.B., Uwingeli, P., Mburanumwe, I., Kagoda, E., Basabose, A., Stoinski, T.S., Cranfield, M.R., Byamukama, J., Spelman, L.H. and Robbins, A.M. (2011). 'Extreme conservation leads to recovery of the Virunga Mountain gorillas'. *PLoS One*, 6(6): e19788.

- Robin des Bois. (2016). 'Three Sentenced to Prison over Orangutan Illegal Trade.' [Online], (23rd March, 2016), https://en.tempo.co/read/news/2016/03/23/206756195/Three-Sentenced-to-Prison-over-Orangutan-Illegal-Trade.

- Ron, T. and Refisch, J. (2013): Towards a transboundary protected area complex in the Mayombe forest ecosystems: Strategic Plan. UNEP, GRASP and IUCN.

- Ross, S. R., Lukas, K. E., Lonsdorf, E. V., Stoinski, T. S., Hare, B., Shumaker, R. and Goodall, J. (2008). 'Inappropriate use and portrayal of chimpanzees'. *Science*, 319(5869): 1487.

- Roy, J., Vigilant, L., Gray, M., Wright, E., Kato, R., Kabano, P., Basabose, A., Tibenda, E., Kühl, H. and Robbins, M. (2014). 'Challenges in the use of genetic mark-recapture to estimate the population size of Bwindi mountain gorillas (*Gorilla beringei beringei*)'. *Biological Conservation*, 180: 249-261.

- Sá, R., Ferreira da Silva, M.J., Sousa, F.M. and Minhós, T. (2012). 'The trade and ethnobiological use of chimpanzee body parts in Guinea-Bissau: Implications for Conservation'. *TRAFFIC Bulletin*, 24(1): 31-34.

- Sakamaki, T., Mulavwa, M. and Furuichi, T. (2009). 'Flu-like epidemics in wild bonobos (*Pan paniscus*) at Wamba, the Luo Scientific Reserve, Democratic Republic of Congo'. *Pan Africa News*, 16: 1-4.

- Santika, T., Ancrenaz, M., Wilson, K., Spehar, S., Abram, N., Banes, G., Campbell-Smith, G., Curran, L., d'Arcy, L., Delgado, R., Erman, A., Goossens, B., Hartanto, H., Houghton, M., Husson, S., Kühl, H., Lackman, I., Leiman, A., Llano Sanchez, K., Makinuddin, N., Marshall, A., Meididit, A., Mengersen, K., Musnanda, Nardiyono, Nurcahyo, A., Odom, K., Panda, A., Prasetyo, D., Purnomo, Rafiastanto, A., Raharjo, S., Ratnasari, D., Russon, A., Santana, A., Santoso, E., Sapari, I., Sihite, J., Suyoko, A., Tjiu, A., Utami-Atmoko, S., van Schaik, C., Voigt, M., Wells, J., Wich, S., Willems, E. and Meijaard, E. (2017). 'First integrative trend analysis for a great ape species in Borneo'. *Scientific Reports*, 7(1): 4839.

- Shukman, D. (2017). 'The secret trade in baby chimps: Full report'. *BBC News*. [Online], (31st Jan 2017). www.bbc.com/news/science-environment-38804688. Consulted on 22 March 2018.

- Singleton, I., Wich, S.A., Nowak, M., Usher, G. and Utami-Atmoko, S.S. (2017). *Pongo abelii*. *The IUCN Red List of Threatened Species 2017:* e.T121097935A115575085. http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T121097935A115575085.en. Downloaded on 24 March 2018.

- Sloan, S., Bertzky, B. and Laurance, W.F. (2016). 'African development corridors intersect key protected areas'. *African Journal of Ecology*, 55(4): 731-737.

- Spira, C., Kirkby, A., Kujirakwinja, D. and Plumptre, A. (2017). 'The socio-economics of artisanal mining and bushmeat hunting around protected areas: Kahuzi-Biega Natoinal Park and Ithombwe Nature reserve, eastern Democratic Republic of Congo'. *Oryx*, 1-9.

- Steel, L., Colom, A., Maisels, F. and Shapiro, A. (2008). The scale and dynamics of wildlife trade origionating in the south of Salonga-Lukenie-Sankuru landscape. WWF-WCS.

- Stiles, D., Redmond, I., Cress, D., Nellemann, C. and Formo, R. K. (2013). 'Stolen Apes* The Illicit Trade in Chimpanzees, Gorillas, Bonobos, and Orangutans'. In: Haenn, N., Wilk, R. and Harnish, A. (Eds.) *The Environment in Anthropology: A Reader in Ecology, Culture, and Sustainable Living*. New York: New York University Press. pp: 359.

- Strindberg, S., Maisels, F., Williamson, E.A., Blake, S., Stokes, E.J., Aba'a, R., Abitsi, G., Agbor, A., Ambahe, R.D., Bakabana, P.C., Bechem, M., Berlemont, A., de Semboli, B.B., Boundja, P.R., Bout, N., Breuer, T., Campbell, G., de Wachter, P., Akou, M.E., Mba, F.E., Feistner, A.T.C., Fosso, B., Fotso, R., Greer, D., Inkamba-Nkulu, C., Iyenguet, C.F., Jeffery, K.J., Kokangoye, M., Kühl, H.S., Latour, S., Madzoke, B., Makoumbou, C., Malanda, G.A.F., Malonga, R., Mbolo, V., Morgan, D.B., Motsaba, P., Moukala, G., Mowawa, B.S., Murai, M., Ndzai, C., Nishihara, T., Nzooh, Z., Pintea, L., Pokempner, A., Rainey, H.J., Rayden, T., Ruffler, H., Sanz, C.M., Todd, A., Vanleeuwe, H., Vosper, A., Warren, Y. and Wilkie, D.S. (2018). 'Guns, germs, and trees determine density and distribution of gorillas and chimpanzees in Western Equatorial Africa'. *Science Advances*, 4(4).

- Struebig, M.J., Fischer, M., Gaveau, D.L.A., Meijaard, E., Wich, S.A., Gonner, C., Sykes, R., Wilting, A. and Kramer-Schadt, S. (2015). ‚Anticipated climate and land-cover changes reveal refuge areas for Borneo's orangutans'. *Global Change Biology*, 21(8): 2891–2904.

- Tempo (2016). 'Three Sentenced to Prison over Orangutan Illegal Trade.' [Online]. (23rd March 2016). https://en.tempo.co/read/news/2016/03/23/206756195/Three-Sentenced-to-Prison-over-Orangutan-Illegal-Trade.

- Thomas, L., Buckland, S.T., Rexstad, E.A., Laake, J.L., Strindberg, S., Hedley, S.L., Bishop, J.R.B., Marques, T.A. and Burnham, K.P. (2010). ‚Distance software: design and analysis of distance sampling surveys for estimating population size'. *Journal of Applied Ecology*, 47: 5-14.

- Tiédoué, M. R., Normand, E., Diarrassouba, A., Tondossama, A. and Boesch. C. (2016). Etat de conservation du Parc National de Taï: Rapport de suivi-écologique - phase 11. Rapport de l'Office Ivoirien des Parcs et Réserves/Direction de Zone Sud-ouest, Soubré, Côte d'Ivoire, 31pp.

- Transparency International. (2018). 'Corruption Perceptions Index 2017'. [Online], www.transparency.org/news/feature/corruption.

- Tweh, C. G., Lormie, M. M., Kouakou, C. Y., Hillers, A., Kühl, H. S. and Junker, J. (2015). 'Conservation status of chimpanzees *Pan troglodytes verus* and other large mammals in Liberia: A nationwide survey'. *Oryx*, 49(4): 710–718.

- United Nations Office on Drugs and Crime, World Drug Report (2016). United Nations publication, Sales No. E.16.XI.7

- USAID (2015). Measuring efforts to combat wildlife crime: A toolkit for improving action and accountability. United States Agency for International Development.

- Van der Meer, I.P. (2014). Inventory of the vegetation structure and food availability for the Western chimpanzee (*Pan troglodytes verus*) in the Boé region, Guinea-Bissau. Internship report. Ecology Group of Wageningen University and Chimbo Foundation.

- Van der Meer, D. (2016). Can the Random Encounter Model be a useful tool in estimating chimpanzee density? Internship report. VHL University of Applied Sciences and Chimbo Foundation.

- Voigt, M., Wich, S., Ancrenaz, M., Meijaard, E., Abram, N., Banes, G., Campbell-Smith, G., d'Arcy, L.J., Delgado, R.A., Erman, A., Gaveau, D., Goossens, B., Heinicke, S., Houghton, M., Husson, S.J., Leiman, A., Sanchez, K.L., Makenudddin, N., Marshall, A., Meididit, A., Miettinen, J., Mundry, R., Musnanda, Nardiyono, Nurcahyo, A., Russon, A., Santika, T., Sihite, J., Spehar, S., Struebig, M., Sulbaran-Romero, E., Tjiu, A., Wells, J., Wilson, K. and Kuhl, H. (2018). 'Global demand for natural resources elimated more than 100,000 Bornean orangutans'. *Current Biology*, 28(5): 761-769.

- Walsh, P., Abernethy, K., Bermejo, M., Beyers, R., De Wachter, P., Akou, M., Huijbregts, B., Mambounga, D., Toham, A., Kilbourn, A., Lahm, S., Latour, S., Maisels, F., Mbina, C., Mihindou, Y., Ndong Obiang, S., Effa, E., Starkey, M., Telfer, P., Thibault, M., Tutin, C., White, L. and Wilkie, D. (2003). 'Catastrophic ape decline in western equatorial Africa'. *Nature*, 422(6932): 611-614.

- WCF (2012). Etat de la faune et des menaces dans les aires protégées terrestres et principales zones de forte biodiversité de République de Guinée. Unpublished report, Wild Chimpanzee Foundation, Conakry, Guinea.

- WCF (2014). Study of a key area for the preservation of chimpanzee in West Africa: Preliminary inventory along the Bafing River, Republic of Guinea. Unpublished Report.

- Wenceslau, J.F.C. (2014). 'Bauxite mining and chimpanzees population distribution, a case study in the Boé sector, Guinea-Bissau'. Master Thesis. VHL University of Applied Sciences and Chimbo Foundation.

- Wicander, S., and Coad, L. (2015). *Learning our lessons: A review of alternative livelihood projects in Central Africa*. ECI, University of Oxford, Oxford, UK and IUCN, Gland, Switzerland.

- Wich, S. A., Utami-Atmoko, S. S., Setia, T. M., Rijksen, H. D., Schürmann, C., van Hooff, J. A. R. A. M. and van Schaik, C. P. (2004). 'Life history of wild Sumatran orangutans (*Pongo abelii*)'. *Journal of human evolution*, 47(6): 385-398.

- Wich, S.A., Meijaard, E., Marshall, A.J., Husson, S., Ancrenaz, M., Lacy, R.C., van Schaik, C.P., Sugardjito, J., Simorangkir, T., Traylor-Holzer, K., Doughty, M., Supriatna, J., Dennis, R., Gumal, M., Knott, C.D. and Singleton, I. (2008). 'Distribution and conservation status of the orangutan (*Pongo* spp.) on Borneo and Sumatra: how many remain?'. *Oryx*, 42(3): 329-339.

- Wich, S. A., Swartz, K. B., Hardus, M. E., Lameira, A. R., Stromberg, E., and Shumaker, R. W. (2009). 'A case of spontaneous acquisition of a human sound by an orangutan'. *Primates*, *50*(1): 56-64.

- Wich, S., Riswan, Jenson, J., Refisch, J., and Nellemann, C. (2011). *Orangutans and the economics of sustainable forest management in Sumatra*. UNEP/GRASP/PanEco/YEL/ICRAF/Grid Arendal. ISBN 978-82-7701-095-3.

- Wich, S., Fredriksson, G.M., Usher, G., Peters, H.H., Priatna, D., Basalamah, F., Susanto, W., and Kühl. H. (2012a). 'Hunting of Sumatran orangutans and its importance in determining distribution and density'. *Biological Conservation*, 146(1): 163-169.

- Wich S.A., Gaveau, D., Abram, N., Ancrenaz, M., Baccini, A., Brend, S., Curran, L., Delgado, R.A., Erman, A., Fredriksson, G.M., Goossens, B., Husson, S.J., Lackman, I., Marshall, A.J., Naomi, A., Molidena, E., Nardiyono, Nurcahyo, A., Odom, K., Panda, A., Purnomo, Rafiastanto, A., Ratnasari, D., Santana, A.H., Sapari, I., van Schaik, C.P., Sihite, J., Spehar, S., Santoso, E., Suyoko, A., Tiju, A., Usher, G., Atmoko, S.S.U., Willems, E.P. and Meijaard, E. (2012b). 'Understanding the impacts of land-use policies on a threatened species: is there a future for the Bornean orangutan?'. *PLoS One*, 7(11): e49142.

- Wich, S. A., Garcia-Ulloa, J., Kühl, H. S., Humle, T., Lee, J. S. and Koh, L. P. (2014). ‚Will oil palm's homecoming spell doom for Africa's great apes?'. *Current Biology*, 24(14): 1659–1663.

- Wich, S.A., Struebig, M., Refisch, J. Wilting, A., Kramer-Schadt, S. and Meijaard, E. (2015). The future of the Bornean orangutan: Impacts of change in land cover and climate. Nairobi, Kenya: UNEP/GRASP.

- Wich, S., Singleton, I., Nowak, M., Utami Atmoko, S., Nisam, G., Arif, S., Putra, R., Ardi, R., Fredriksson, G., Usher, G., Gaveau, D. and Kühl, H. (2016). 'Land-cover changes predict steep declines for the Sumatran orangutan (*Pongo abelii*)'. *Science Advances*, 2(3): e1500789-e1500789.

- Wilkie, D.S., Bennett, E.L., Peres, C.A. and Cunningham, A.A. (2011). 'The empty forest revisited'. *Annals of the New York Academy of Sciences*, 1223: 120-128.

- Wilkie, D.S., Wieland, M., Boulet, H., Le Bel, S., van Vliet, N., Cornelis, D., BriacWarnon, V., Nasi, R. and Fa, J.E. (2016). 'Eating and conserving bushmeat in Africa'. *African Journal of Ecology*, 54(4): 402-414.

- Wood, K.L., Tenger, B., Morf, N.V. and Kratzer, A. (2014). Report to CITES: Cites-listed species at risk from illegal trafficking in bushmeat; Results of a 2012 study in Switzerland's International Airports. pp. 129. Tengwood Organization & Zürich Institute of Forensic Medicine, University of Zürich, Forensic Genetics, Switzerland.

- World Bank (2018). World Development Indicators. [Online], http://data.worldbank.org/data-catalog/world-development-indicators.

- WWF and TRAFFIC (2015). Strategies for fighting corruption in wildlife conservation: A primer. WWF and TRAFFIC Wildlife Crime Initiative. pp. 23. [Online], http://d2ouvy59p0dg6k.cloudfront.net/downloads/wci_strategies_for_fighting_corruption_wildlife_conservation.pdf.

- Wyatt, T. and Ngoc Cao, A. (2015). Corruption and wildlife trafficking. U4 Anti-Corruption Resource Centre. U4 Issue May 2015, No 11. pp. 54. [Online], http://issuu.com/cmi-norway/docs/150603144854-73fa106fbd71418f9a0afa481e93443f/1?e=0.

- Ziegler, S., Fa, J.E., Wohlfart, C., Streit, B., Jacob, S. and Wegmann, M. (2016). 'Mapping bushmeat hunting pressure in Central Africa'. *Biotropica*, 48(3): 405–412.