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Research Article

Large-scale extinction of large carnivores (lion *Panthera leo*, cheetah *Acinonyx jubatus* and wild dog *Lycaon pictus*) in protected areas of West and Central Africa

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Abstract

A number of recent studies have suggested that large carnivores are rapidly disappearing in West Africa, including in protected areas (PAs). The extent of this extinction process, however, is poorly known. Here, we quantify the extinction of three large carnivore species (*Panthera leo* (lion), *Acinonyx jubatus* (cheetah) and *Lycaon pictus* (wild dog)) in 41 West and Central African PAs by comparing historical and current data of occurrence. We found that lions have gone (near-) extinct in 23 out of the 38 PAs (63%) where they historically occurred and that extinction is significantly more pronounced in West (15 extinctions out of 18 historical occurrence, 64%) than in Central Africa (8/20, 40%). Cheetahs have disappeared from 11 out of 15 PAs (73% of site extinction). Wild dogs persist in only one PA in West Africa and two in Central Africa out of a total of 31 historical occurrences (90% of site extinction). For all three species combined, the number of extinctions in PAs in West Africa (33 out of 39 historical occurrences, i.e. 85% of site extinction) is significantly higher than in Central African PAs (29/45, i.e. 64%). Carnivore populations persist outside PAs in that latter region. Our study shows that PAs with remaining lion populations are significantly larger than those with extinct populations. However, we found that the human population density around PAs is not a good predictor of lion extinction. We suggest that the presence of mobile pastoralists may better explain the extinction pattern of large predators, and we recommend developing indicators of the pastoralism pressure to test that hypothesis.

Keywords: extinction; carnivores; protected areas; Africa; pastoralism, human density.

Résumé

Des d'études récentes suggèrent que les grands carnivores sont en train de disparaître rapidement d'Afrique de l'Ouest, y compris dans les aires protégées (APs). L'ampleur de cette extinction reste cependant mal connue. Dans cette étude, nous avons quantifié l'extinction de trois grands carnivores (*Panthera leo* (lion), *Acinonyx jubatus* (guépard) and *Lycaon pictus* (lycaon)) dans 41 APs d'Afrique de l'Ouest et centrale en comparant des données d'occurrence historique et récente. Notre étude montre que les lions se sont éteints (ou sont proches de l'extinction) dans 23 des 38 APs (63%) d'où ils étaient présents historiquement et que cette extinction est davantage prononcée en Afrique de l'Ouest (15 extinctions sur 18 occurrences historiques, 64%) qu'en Afrique centrale (8/20, 40%). Les guépards ont disparu de 11 sur 15 AP (soit 73% d'extinctions). Il ne reste qu'une seule population de lycaons dans une AP en Afrique de l'Ouest et deux en Afrique centrale sur les 31 occurrences historiques (soit 90% d'extinction). Globalement, le nombre d'extinctions cumulées des trois espèces dans les APs est significativement plus élevé en Afrique de l'Ouest (33 extinctions sur 39 occurrences, soit 85% d'extinctions) qu'en Afrique centrale (29/45, soit 64% d'extinctions). Dans cette dernière région, des populations de carnivores persistent en dehors des APs. Notre étude montre que les APs abritant actuellement des populations de lions sont significativement plus grandes que celles d'où cette espèce s'est éteinte. La densité de population humaine autour des AP n'apparait pas comme étant un facteur explicatif de l'extinction des lions. Nous suggérons que la présence de pasteurs pourrait davantage expliquer l'extinction des prédateurs et nous recommandons de développer des indicateurs de la pression de pastoralisme pour tester cette hypothèse.

Mots clés : extinction; carnivores; aires protégées; Afrique; pastoralisme; densité humaine.

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Introduction

The conservation of large carnivores in protected areas (PAs) is challenging. Most PAs have small populations of large carnivores that are vulnerable to extinction through stochastic processes because of their naturally large home range and low densities, [1]. Additionally, in small to medium-sized PAs, an important part of the large carnivores range at the periphery or outside PAs where human–carnivore conflicts may arise from human attack or predation on livestock belonging to sedentary farmers. Human communities respond by killing carnivores, either in retaliation or as a preventive measure, leading to high carnivore mortality [2]. For wide-ranging carnivores, mortality outside PAs negatively affects the population dynamics inside PAs [3]. The capacity of African PAs to ensure the persistence of their large carnivore populations over the long term is a critical issue, because large carnivore species are among the most threatened taxa [4] and because the PAs have been the main tool used by African governments to conserve threatened species [5].

The persistence and extinction of carnivores in national PA networks has been poorly documented in West and Central Africa, because although PAs were established in these regions long ago in 1926 [6], few PAs have set up long-term biodiversity monitoring systems [e.g. 7]. Recently, Henschel et al. [8] assessed the status of lions (*Panthera leo*) in a selected number of large (> 500 km²) West African PAs. They sampled sites where lion populations were known to occur up to 10 years ago and updated the data on lion occurrence and population size. Although this study significantly improved knowledge of the current status of lions in West African PAs, it did not reveal the magnitude of the carnivore extinction process in PAs because the study ignored sites that had lost their lion population more than 10 years ago. It also is unknown to what extent the results of the study apply to other large carnivore species.

In the present study, we quantified the process of large carnivore extinction in 41 West and Central African PAs by comparing historical and current carnivore occurrence. We also tested whether the size of PAs and the human population density around the PAs are good predictors of carnivore extinction, as suggested by the literature [9 -11].

Methods

Large carnivores considered in this study were restricted to lions, cheetahs (*Acinonyx jubatus*) and wild dogs (*Lycaon pictus*). The leopard (*Panthera pardus*) was not included in the study because its cryptic behavior results in uncertain information on its historical and current occurrence in PAs. We defined

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six categories of occurrence status (Table 1). We selected a set of 41 PAs (or complexes of contiguous PAs) from 15 countries in West and Central Africa for which both historical and recent data on the occurrence of large carnivores could be found. The study focused on PAs dedicated to the conservation of biodiversity (categories I, II and IV according to IUCN categorization [12]). To determine the occurrence status of carnivores in the PAs, we used a two-step method. First, we compared the historical and current status of species within a PA by reviewing the literature on each PA from published and grey literature. Historical data is defined as occurrence data at the date of (or shortly after) the gazettement of the PA, and recent data as data no older than 5 years (≥ 2009). PAs established less than 5 years ago were therefore not included in the study. Literature reviewed included the technical gazettement notices of PAs with lists of occurring species, general mammal census surveys with methods allowing the detection of large carnivores, and specific carnivore census surveys. Data were only considered if i) information was available on how the data on the occurrence of species were collected, and ii) the method was adequate. Second, we interviewed experts (scientists, park staff) with excellent knowledge of the PAs to confirm the occurrence status generated by the first step and to obtain updated information on the status of large carnivores. In total, 14 experts were contacted. We estimated the (sedentary) human population density within a 50 km buffer around each PA based on human population data from the UNEP/GRID database (http://na.unep.net/siouxfalls/datasets/datalist.php) using PA outlines obtained from the World Database of Protected Areas (http://protectedplanet.net). All statistics were performed with XLSAT 2013.

Table 1. Definition of the occurrence status used in this study.

Status	Definition
Absent (A)	The species has not been reported to occur in the protected area since its gazettement
Present (P)	The species has been observed directly (visual) and/or indirectly (spoors, feces, vocalization) over the last 5 years
Near Extinct (NE)	The species is observed directly or indirectly infrequently suggesting a very low ($n < 10$), declining and not viable population
Extinct (E)	The species has not been observed directly or indirectly in the protected area over the last 15 years
Unknown (?)	No recent data (< 5 years) available
Possibly Near Extinct (NE?)	No recent data (< 5 years) available but general information on the poor management of the protected area and the depleted prey population suggest a Near Extinct status

Results

Overall, lions have gone extinct or near extinct in 23 out of the 38 PAs (61%) where they historically occurred (Table 2; Appendix 1 and 2). Only three West African PAs still contain lion populations (out of historical occurrences in 18 PAs), while lions are still present in 11 PAs in Central Africa (out of historical occurrences in 20 PAs).

Cheetahs were historically less widespread than lions, occurring in only 15 PAs of our sample (Table 2; Appendix 1 and 2). They still occur in only 4 PAs (two in West Africa and two in Central Africa) and are categorized as “Possibly near extinct” in two additional Central African PAs where recent data are not available.

The wild dog is the large carnivore species most affected by extinction: only one population remains in a West Africa PA and two in Central Africa (Table 2; Appendix 1 and 2) out of a total of 31 historical

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occurrences. In Central Africa, the status of this species is unknown in one PA located in Chad and categorized as "Possibly near extinct" in two PAs located in the north of the Central African Republic.

For all three species combined, the percentage of extinctions in PAs in West Africa (33 extinctions out of a total of 39 historical occurrences, i.e. 85%) is significantly higher than in Central African PAs (29 extinctions out of 45 occurrences, i.e. 64%) (*z* test, $p = 0.001$). This also holds true for lions (15 extinctions out of 18 historical occurrences, i.e. 83%, in West Africa versus 8 extinctions out of 20 historical occurrences, i.e. 40%) in Central Africa) (*z* test, $p = 0.02$).

PAs where lion populations currently persist are significantly larger than those where lions have been extirpated (Table 3). However, human population densities within a 50 km buffer from PAs do not differ significantly between PAs with or without lions (Table 3). We did not test PA size and human population density as drivers of extinction for cheetahs and wild dogs due to the small number of PAs containing these species.

Table 2. Statistics of historical and current occurrence and extinction of three large carnivores in 41 protected areas (PAs) in West and Central Africa.

	West Africa (n=20 PAs)			**Central Africa** (n=21 PAs)			**Both regions** (n=41 PAs)		
	Historical occurrence	**Current occurrence**	**% site Extinction** (a)	**Historical occurrence**	**Current occurrence**	**% site Extinction** (a)	**Historical occurrence**	**Current occurrence**	**% site extinction** (a)
Lion *(Panthera leo)*	18	3	83	20	11	40	38	14	61
Cheetah *(Acinonyx jubatus)*	6	2	67	9	2	78	15	4	73
Wild dog *(Lycaon pictus)*	15	1	93	16	2	81	31	3	90
All species	39	6	85	45	15	64	84	21	74

(a) : Include PAs where the species is categorized Extinct, Near Extinct and Possibly Near Extinct; Unknown category excluded (see Table 1 for definition).

Table 3. Mean ± SD (n) value of two protected area attributes by lion presence and extinction.

Protected area attribute	**Region**	**PAs with lions present**	**PAs where lions extinct/near extinct**	**Mann-Whitney U test (p value)** (a)
Size	West	9,922 ± 4,983 (3)	5,841 ± 5,804 (15)	Non sig. (0.09)
	Central	9,183 ± 8,756 (11)	3,574 ± 3,720 (8)	Non sig. (0.07)
	Both	9,342 ± 7,931 (14)	5,266 ± 5,295 (21)	Sig. (0.03)
Human Population Density (n.km $^{-2}$ within a 50 km)	West	20.33 ± 11.02 (3)	25.64 ± 18.77 (12)	Non sig. (0.37)
	Central	29.01 ± 54.69 (11)	18.77 ± 22.18 (8)	Non sig. (0.47)
	Central exc. VNP (b)	13.01 ± 14.04 (10)	18.77 ± 22.18 (8)	Non sig. (0.36)
	Both	27.15 ± 48.31 (14)	22.89 ± 19.93 (18)	Non sig. (0.24)
	Both exc. VNP (b)	14.70 ± 13.36 (13)	22.89 ± 19.93 (18)	Non sig. (0.13)

(a) : alpha = 5% ; unilateral test ; (b) excluding Virunga National Park (DRC) because of its unusual high human population density (see Appendix 2)

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Discussion

In West Africa, lions remain in only six PAs, including three where they are near extinct. With an estimated population of 300-400 lions [13, 14], the W-Arly-Pendjari (WAP) transfrontier PA complex (made up of three national parks and 12 hunting blocks) contains the largest West African lion population (Fig. 1a) and possibly the only viable one as the size of the other populations is less than 35 individuals [8]. Our study confirms that lions persist in the two Guinean PAs, categorized as "lion potentially present" by Henschel et al. [8]. However, based on information collected, it is highly likely that lions are represented in these PAs by the last remaining individuals of vanishing populations (Fig. 1b).



a **b**

Fig. 1. Lions from West Africa. 1a: With 300-400 individuals, lions from the W-Arly-Pendjari protected area complex represent the largest and possibly the single viable population in West Africa (PHOTO CREDIT P. Henschell/Panthera). 2b: Lions are the on verge of extinction in Guinea. This picture, taken in the 2000s near Siguirini (11°49'41''N, 10°02'41''O), Guinea, shows two lionesses shot in unknown circumstances. To our knowledge, it is the only available picture of Guinean lions (PHOTO CREDIT D. Brugière).

In Central Africa, lions persist in most PAs located to the north of the Congo basin's rainforest block. In Chad, the lion population of the Zakouma National Park (NP) is estimated to number 110-130 (sub-)adults and has been stable since the mid-2000s [15, 16]. The lion population in the northern savanna PA complex of Cameroon (Faro, Bénoué and Bouba Ndjida NPs plus 20 hunting zones) has been estimated at over 200 sub-adult individuals [17,18] and is currently under further study. The lion population of the Waza NP, Cameroon (Fig. 2a), is the most threatened in Central Africa: it is totally isolated and has been declining over the last 10 years from 40-60 individuals in 2002 to 10-20 individuals in 2008, mainly due to conflicts with resident cattle raisers and pastoralists [19]. The recent dramatic increase of pastoralists in the periphery of the park due to migration from north-eastern Nigeria (caused by the current state of insecurity in that region) seriously threatens the viability of the park's lion population.

Lions have been extirpated in the historical PAs of the savannah belt located to the south of the Congo basin's rainforest block, in Democratic Republic of Congo and Congo. The last occurrence of lions in Odzala NP, Congo, was in 1994 when two young males were shot after they killed two park workers [19; Fig. 2b]. Recently, a male lion was caught on camera trap in Plateaux Batéké National Park, Gabon [20]. It is unclear so far whether it is a leftover from an old population or a transient from the DRC where the closest population is several hundred kilometers away.

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a **b**

Fig.2. Lions from Central Africa. 2a: The lion population of Waza National park, northern Cameroon, is small (10-20 individuals), declining and totally isolated from other lion population. It is under immediate risk of extinction (PHOTO CREDIT M-C. Fleury-Brugière). 2b: Man-eater lions are rarely reported in West Central Africa. In 1994, two young males killed two villagers in Odzala National Park, northern Congo. They were subsequently shot by a professional hunter (PHOTO CREDIT E. Stockenstroom).

While the cheetah was common in the past in West and Central Africa (Fig. 3a), its future is uncertain. The WAP complex harbors the last West African savannah population (Fig. 3b) but the density is apparently low. In 2003, Claro et al. [21] estimated that 15–21 cheetahs occurred in the Nigeran part of the W park and the adjacent Tamou FR (3083 km², which is 11 % of the total WAP complex). During an intensive carnivore survey carried out in 2014 in the whole WAP complex (covering 1,492 km of transect), seven cheetah tracks were observed [14], an increase from the 2012 survey where only 2 sets of tracks were recorded over 1,110 km of transects. Anecdotal evidence suggests that the number of direct sightings per year is currently increasing (P. Henschel, pers. com.). Cheetahs occur in the desert of Niger, in the Air Tenéré National Reserve (NR) [22] and in the recently created Tin Toumma Termit NR [23]. In Central Africa, the sole confirmed cheetah population in PAs is that of the Zakouma NP and the contiguous Bahr Salamat FR. Home range studies using GPS collar technology have shown that, contrary to a previous hypothesis [24], not all cheetahs leave the park during the rainy season [16]. As a result, it is not known to what extent the park's cheetah population is isolated or connected with other populations. In northern Central African Republic, cheetahs used to occur in the two NPs and adjacent FRs, although they have always been more common in Manono-Gounda St Floris NP than in Bamingui-Bangoran NP [25]. The last confirmed sighting in the former park was in 2005 [P.A. Roulet, pers. comm.]. Due to recurrent civil unrest, the management of these two NPs ceased 10 years ago, leading to a rise in poaching pressure and massive invasion by livestock. This has resulted in a dramatic decline of ungulate populations, including local extinctions [26, 27]. The current occurrence of a viable cheetah population in both NPs is therefore uncertain.

Wild dogs are on the verge of total extinction in West Africa. The last confirmed occurrence is in the Niokolo-Koba NP, Senegal, where the population size was estimated at 38 individuals in 2011 [28], a significant decrease from previous estimates (400 individuals estimated in 1975 [29]; 50–100 individuals in 1995 [30]). The park's ungulate population has been experiencing a continuous decline for the last 20 years due to severe poaching [31], and the future of the park's large carnivores is uncertain. In Central Africa, the wild dog was extirpated from Cameroon in the early 2000s [32]. The only confirmed population in a PA to date is that of the Siniaka Minia FR, Chad, where a pack of 20 wild dogs with pups was spotted in July 2014 [L. Labuschagne, pers. comm.]. It probably also persists in the Zemongo Faunal Reserve, CAR, as there are recent confirmed records of wild dogs in the nearby Chinko Basin [33], an area not classified as PA. In central Africa, information received from hunter operators and other local informants suggests that significant populations of lions, and possibly cheetahs and

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wild dogs, persist outside PAs (P. Chardonnet, pers. com.), particularly in southern Chad and northern and eastern CAR (see 34 for lions).



a **b**

Fig.3. Cheetah from West Africa. 3a: At the beginning of the 20th century, the cheetah was common in the sahelo-saharian zone of West Africa and it was often tamed as pet by local people. Here a picture of a tamed male cheetah taken in 1938 in Nema (15°06'48''N, 07°32'44''O), Mali (PHOTO CREDIT O. de Puigaudeau). 3b: The cheetah of the W-Arly-Pendjari (WAP) protected area complex represents the last West African savannah population. (PHOTO CREDIT: C. Pavey).

A number of proximate drivers has been identified to explain local extinction of large mammals in PAs, namely habitat loss inside the PAs, land use changes outside the PA, overexploitation, diseases and natural causes [35]. For large carnivores, subsequent low prey density, persecution by people on the borders or inside PAs, and diseases are amongst the most frequently cited causes of extinction [36]. Our study shows that PAs with lion populations are significantly larger than those with extinct populations, mainly because animal populations in large PAs are less vulnerable to edge effects [3]. However, contrary to expectation, we found that the (sedentary) human population density around PAs is not a good predictor of lion extinction. This is consistent with the results of Henschel et al. [8] in West Africa, suggesting that other factors of lion extinction are operating in West and Central PAs. We hypothesize that the presence of pastoralists and the associated density of cattle around PAs may explain the extinction of large predators [see also 37]. In the sahelo-saharian bioclimatic region of Africa, cattle husbandry is mainly exercised through seasonally mobile pastoralism. To cope with declining rainfall in the sahelo-saharian zone, pastoralists have moved further southward in search of dry-season pasture over the last 30 years [38], leading to increasing grazing pressure on Sudanian PAs. Pastoralists and sedentary farmers increasingly use poison to kill potential livestock predators. Because of the temporal and spatial mobility of pastoralism, the pastoralism pressure is difficult to quantify in georeferenced data such as the (sedentary) human density data used in this study and is rarely (statistically) tested as a driver of large mammal population decline or extinction. We suggest that indicators of the pastoralism pressure, including the presence of pastoralists in transit or for a longer time, as well the use of poison, should be developed and tested to better understand the generalized pattern of large carnivore population decline in West and Central African PAs.

Implications for Conservation

From a large carnivore perspective, the only remaining functional conservation areas [39] seem to be the WAP complex in West Africa, the North Cameroon savanna complex, and the larger Zakouma ecosystem in Central Africa. The two latter areas are more vulnerable to large carnivore extinction

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because they harbor pastoralists throughout the dry seasons, while the WAP complex is mainly a transit area. Scarce conservation funding [40] should target these areas with priority.

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Appendix 1. Historical and current status of three large carnivore species in 20 selected protected areas in West Africa.

Protected area					Carnivores species						Reference
Country/Name[a]	**Year gazetted [b]**	**Size (km²) [c]**	**Human Population Density [d] (n.km^{-2})**		**Lion** *(Panthera leo)*		**Cheetah** *(Acinonyx jubatus)*		**Wild dog** *(Lycaon pictus)*		
					Historical Status [e]	**Current status [e]**	**Historical status**	**Current status**	**Historical status**	**Current status**	
Senegal											
Niokolo Koba NP	1926	9130	15.2		P	P	A	-	P	P	28,41,42
Guinea Conakry											
Haut Niger NP	1997	554	13.8		P	NE	A	-	A	-	43
Kankan FR	1926	5314	Na		P	NE	A	-	P	E	44
Mali											
Boucle du Baoulé PAC	1926	5071	18.3		P	E	P	E	P	E	1, 41,45
Ansongo-Ménaka FR	1950	17500	6.1		P	E	A	-	A	-	45,46
Gourma FR	1959	12500	11.2		P	E	A	-	A	-	45,46
Ivory Coast											
Comoé NP	1926	11494	11.7		P	NE	A	-	P	E	41,47
Burkina Faso											
Sahel FR	1970	16000	19.9		P	E	P	E	P	E	45,49
Deux Balés NP	1967	806	38.6		P	E	A	-	A	-	48,50
Po (K.Tambi) NP	1976	1550	60.6		P	E	A	-	P	E	48,51
Nazinga PA	1980	913	30.2		P	E	A	-	P	E	48,52
Burkina F-Bénin - Niger											
W-Arly-Pendjari Tf NP	1926	15254	32.9		P	P	P	P	P	E	13,14
Niger											
Air-Ténéré FR	1988	77360	0.01		A	-	P	P	A	-	20
Gadabedji FR	1955	760	6.4		A	-	P	E	P	E	53
Ghana											
Mole NP	1961	4577	14.74		P	E	A	-	P	E	47

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Bui NP	1971	1814	Na		P	E	A	-	P	E	8
Gbele FR	1971	565	Na		P	E	A	-	P	E	47
Nigeria											
Yankari NP	1957	2240	61.8		P	NE	P	E	P	E	8
Kainji Lake NP	1975	5382	12.7		P	P	A	-	P	NE	8
Gashaka Gumti NP	1972	6731	20.51		P	E	A	-	P	E	8
Number of PA in which the species historically occurred/is extinct or near extinct					18/15		6/4		15/14		
Number of remaining population in PA					3		2		1		

(a) NP: National park; FR : Faunal Reserve; PAC : protected areas complex; Tf: transfrontier; (b) Year gazetted as a protected area whatever the subsequent change of the legal status (e.g. change from Faunal Reserve to National Park; (c) current size whatever the change in size over time; (d) within a 50 km buffer; (e) A: Absent; - : no change, still absent; P: Present; E: Extinct; NE : Near Extinct; ? : Unknown; NE? : Possibly Near Extinct (see definition in Table 1);

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Appendix 2. Historical and current status of three large carnivore species in 21 selected protected areas in Central Africa.

	Protected area			Carnivore species						Reference
Country/name [a]	**Year gazetted** [b]	**Size (km^2)** [c]	**Human Population Density** [d] **($n.km^{-2}$)**	**Lion** *(Panthera leo)*		**Cheetah** *(Acinonyx jubatus)*		**Wild dog** *(Lycaon pictus)*		
				Historical Status [e]	**Current status** [e]	**Historical status**	**Current status**	**Historical status**	**Current status**	
Cameroon										
Kalamaloué NP	1972	45	69.7	P*	E	A	-	A	-	41,54
Waza NP	1934	1700	46.8	P	P	P	E	A	-	41,54,55
Bouba Ndjidah NP	1947	2200	16.4	P	P	P*	E	P	E	32,56
Bénoué NP	1932	1800	22.6	P	P	A	-	P	E	32,41
Faro NP	1947	3300	18.2	P	P	A	-	P	E	32,41
Chad										
Manda NP	1953	1140	28.5	P	E	A	-	P	NE	41,57
Zakouma NP	1958	3050	3.5	P	P**	P	P**	P	E	16,24
Bahr Salamat FR	1964	20950	8.6	P	P**	P	P**	P	?	16,24
Ouadi Rimé-O.Achim FR	1969	80000	2.5	P*	E	P	E	P	E	58
Siniaka Minia FR	1961	4643	3.6	P	?	A	-	P	P	24
Binder Léré FR	1974	1350	62.3	A	-	A	-	P	NE	59
Central Africa Republic										
Bamingui-Bangoran PAC	1933	19660	3.3	P	P	P	NE?	P	NE?	26,34,41
Manovo-Gounda St Floris PAC	1933	25500	3.3	P	P	P	NE?	P	NE?	26,34,41
Zémongo FR	1925	10100	0.3	P	P	A	-	P	P	34,60
Congo										
Odzala NP	1935	2848	2.6	P	E	A	-	A	-	41,47
Léfini-Lesio-Louna FR	1951	6740	9.8	P	E	A	-	A	-	41,61
Gabon										
Plateaux Batéké NP	2002	2050	Na	P*	NE	A	-	A	-	20

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Democratic Republic of Congo										
Garamba NP	1938	4920	6.7	P	P	A	-	P	E	62,63
Virunga NP	1925	7843	188.9	P	P	A	-	P	E	62,64
Upemba NP	1939	10000	13.6	P	E	P	E	P	E	62,65
Kudulengu NP	1939	2200	14.6	P	E	P	E	P	E	62,65
Number of PA in which the species historically occurred/is extinct or near extinct				20/8		9/7		16/13		
Number of remaining population in PA				11		2		2		

(a) NP: National park; FR : Faunal Reserve; PAC : protected areas complex; Tf : Transfrontier; (b) Year gazetted as a protected area whatever the subsequent change of the legal status (e.g. change from Faunal Reserve to National Park; (c) current size whatever the change in size over time; (d) within a 50 km buffer; (e) A: Absent; -: no change, still absent; P: Present; E: Extinct; NE : Near Extinct; ? : Unknown; NE? : Possibly Near Extinct (see definition in Table 1); *: vagrant individuals; ** The Zakouma NP is totally surrounded by the Bahr Salamat FR; lions and cheetahs occurring in these two PAs form a single population.

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