Convention on the Conservation of Migratory Species of Wild Animals

CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES OF WILD FAUNA AND FLORA

1st Meeting of Range States for the Joint CMS – CITES African Carnivore Initiative (ACI1)

Bonn, Germany, 5 – 8 November 2018

CMS-CITES/ACI1/Inf.11

GUIDELINES FOR THE CONSERVATION OF LIONS IN AFRICA

(*As at 31 October 2018/Prepared by the Secretary*)

Summary:

This document contains in its Annex the *Guidelines for The Conservation of Lions in Africa* (draft version 1.0) developed by the IUCN SSC Cat Specialist Group on behalf of the CITES and CMS Secretariats.

These Guidelines represent a collection of concepts, best practice experiences and recommendations, compiled by the IUCN SSC Cat Specialist Group on behalf of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Convention on the Conservation of Migratory Species of Wild Animals (CMS).

These Guidelines contribute to the implementation of CITES Decision 17.241 on African lion (*Panthera leo*) and CMS Decision 12.67 on Conservation and Management of the African Lion (*Panthera leo*).

The document shall guide discussions at the 1st Meeting of Range States for the Joint CMS-CITES African Carnivore Initiative and inform future work on lions to be conducted under the auspices of CITES and CMS and the role of the African Carnivore Initiative in lion conservation in Africa.

Guidelines for the Conservation of Lions in Africa

DRAFT Version 1.0 – October 2018

A collection of concepts, best practice experiences and recommendations, compiled by the IUCN SSC Cat Specialist Group on behalf of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Convention on the Conservation of Migratory Species of Wild Animals (CMS)

CITES & CMS Logos?

IUCN SSC Species Survival Commission

IUCN SPECIES SURVIVAL COMMISSION CAT SPECIALIST GROUP

Guidelines for the Conservation of Lions in Africa

A collection of concepts, best practice experiences and recommendations, compiled by the IUCN SSC Cat Specialist Group on behalf of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Convention on the Conservation of Migratory Species of Wild Animals (CMS)

DRAFT of Version 1.0 – October 2018

This draft version is submitted to the CITES and CMS Parties from Africa for review to be discussed at the CITES CMS African Carnivores Initiative meeting on 5–8 November 2018 in Bonn, Germany. It will be finalised in December 2018 to be submitted for the CITES CoP18.

All contributors to this draft version, representatives of the lion Range States from Africa and other participants at the ACI meeting are kindly invited to submit suggestion for changes or for complements to the Co-chairs of the IUCN SSC Cat Specialist Group until the 1 December 2018.

Frontispiece © Patrick Meier: Male lion in Kwando Lagoon, Botswana, March 2013.

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Christine Breitenmoser-Würsten and Urs Breitenmoser, co-chairs, IUCN SSC Cat Specialist Group

Acronyms

ACI	Joint CMS-CITES African Carnivores Initiative
ALWG	African Lion Working Group
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on the Conservation of Migratory Species of Wild Animals
CoP	Conference of the Parties
DRC	Democratic Republic of the Congo
GCLA	Guidelines for the Conservation of Lions in Africa
GO	Governmental Organisation
GR	Game Reserve
GRAA	Game Rangers' Association of Africa
IGO	Intergovernmental Organisation
IUCN	International Union for Conservation of Nature
KAZA	Kavango Zambezi Transfrontier Conservation Area
NAP	National (Conservation) Action Plan
NGO	Non-Governmental Organisation
NP	National Park
PA	Protected Area
PAC	Problem Animal Control
RCS	Regional Conservation Strategy
ROCAL	Réseau Ouest et Centre Africain pour la Conservation du Lion
SADC	Southern African Development Community
SCS	Species Conservation Strategy
SDG	Sustainable Development Goals
SMART	Specific, Measurable, Attainable, Relevant, and Time-bound
SSC	Species Survival Commission (of IUCN)
TBCA	Transboundary Conservation Area
TFCA	Transfrontier Conservation Area
UN	United Nations
WAP	W-Arly Pendjari
ZOPP	Ziel-Orientierte Projekt-Planung

Country Codes (in accordance with ISO 3166-1 alpha 3)

ISO 3166-1 alpha 3	English short name	French short name
AGO	Angola	Angola (l')
BDI	Burundi	Burundi (le)
BEN	Benin	Bénin (le)
BFA	Burkina Faso	Burkina Faso (le)
BWA	Botswana	Botswana (le)
CAF	Central African Republic	République centrafricaine (la)
CIV	Côte d'Ivoire	Côte d'Ivoire (la)
CMR	Cameroon	Cameroun (le)
COD	Congo (the Democratic Republic of the)	Congo (la République démocratique du)
COG	Congo (the)	Congo (le)
DJI	Djibouti	Djibouti
DZA	Algeria	Algérie (l')
EGY	Egypt	Égypte (l')
ERI	Eritrea	Érythrée (l')
ETH	Ethiopia	Éthiopie (l')
GAB	Gabon	Gabon (le)
GHA	Ghana	Ghana (le)
GIN	Guinea	Guinée (la)
GMB	Gambia (the)	Gambie (la)
GNB	Guinea-Bissau	Guinée-Bissau (la)
GNQ	Equatorial Guinea	Guinée équatoriale (la)
KEN	Kenya	Kenya (le)
LBR	Liberia	Libéria (le)
LBY	Libya	Libye (la)
LSO	Lesotho	Lesotho (le)
MAR	Morocco	Maroc (le)
MLI	Mali	Mali (le)
MOZ	Mozambique	Mozambique (le)
MRT	Mauritania	Mauritanie (la)
MWI	Malawi	Malawi (le)
NAM	Namibia	Namibie (la)
NER	Niger	Niger (le)
NGA	Nigeria	Nigéria (le)
RWA	Rwanda	Rwanda (le)
SDN	Sudan (the)	Soudan (le)
SEN	Senegal	Sénégal (le)
SLE	Sierra Leone	Sierra Leone (la)
SOM	Somalia	Somalie (la)
SSD	South Sudan	Soudan du Sud (le)
SWZ	Eswatini (Swaziland)	Eswatini (l') (Swaziland)
TCD	Chad	Tchad (le)
TGO	Togo	Togo (le)
TUN	Tunisia	Tunisie (la)
TZA	Tanzania, United Republic of	Tanzanie, République-Unie de
UGA	Uganda	Ouganda (l')
ZAF	South Africa	Afrique du Sud (l')
ZMB	Zambia	Zambie (la)
ZWE	Zimbabwe	Zimbabwe (le)

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** Convention on the Conservation of Migratory Species of Wild Animals.

1 Introduction

Urs Breitenmoser and Christine Breitenmoser-Würsten

The Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Secretariat of the Convention on the Conservation of Migratory Species of Wild Animals (CMS) have commissioned the Cat Specialist Group (CatSG) of the Species Survival Commission (SSC) of the International Union for the Conservation of Nature (IUCN) to coordinate the development of *Guidelines for the Conservation of the Lion in Africa*. The GCLA or *Guidelines* contribute to implementing CITES Conference of the Parties Decision 17.241 and CMS Conference of the Parties Decision 12.67 on the conservation of *Panthera leo*. Conserving evocative species such as the lion and Africa's extraordinary wildlife and their habitats is in line with the United Nations' Sustainable Development Goal 15, Life on Land – *Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss*. Goal 15 Targets 15.5, 15.7, 15.9 are directly linked to lion conservation, whereas for achieving other targets, the iconic lion can serve as a flagship species.

The GCLA provide best practice guidance for the survey, conservation and management of lion populations in Africa in order to facilitate the implementation of the *Conservation Strategy for the Lion in West and Central Africa* (IUCN SSC Cat Specialist Group 2006a) and the *Conservation Strategy for the Lion in Eastern and Southern Africa* (IUCN SSC Cat Specialist Group 2006b) and National or Regional Action Plans developed based on the two Strategies. Moreover, the *Guidelines* should facilitate, under the auspice of CITES and CMS, the cooperation between lion Range States sharing transboundary populations.

The lion *Panthera leo* is listed in Appendix II under both CITES and CMS, respectively. The status and conservation of the lion in Africa is a regular topic at CITES conferences. A proposal to transfer the lion to Appendix I at CoP13 in October 2004 highlighted the need for a pan-African consensus on lion conservation. IUCN was asked to facilitate a series of workshops to develop regional conservation plans for the lion. The outcomes from these workshops were the above-mentioned 2006 Strategies. In a review of the performance of the 2006 Strategies commissioned by CMS based on the Resolution 11.32 from the CoP11 in November 2014, Bauer et al. (2015a) concluded that after ten years, the Goal and the Objectives of the Strategies were still valid, that however the level of implementation varied strongly across Africa. The review also emphasised that the dichotomy of the conservation status of the lion in Africa had further accentuated: While the situation of the species had stabilised or even improved in southern Africa, the lion was considered Critically Endangered in West Africa and Endangered in East and Central Africa (see also Bauer et al. 2015b).

The review served as an input document to the African lion Range States meeting on 30–31 May 2016, hosted by the Secretariats of CMS and CITES in Entebbe, Uganda. The participants at the meeting (Fig. 1.1) welcomed the review by Bauer et al. (2015a) and agreed to the conclusion, that the Objectives of the 2006 Strategies are still valid (Chapter 3.1) that however the implementation of the conservation actions should be strengthened (Communiqué - African Lion Range State Meeting).

At the same meeting, a new proposal for up-listing the lion to Appendix I under CITES was discussed. This proposal, mainly driven by the dire situation of the lion in West and Central Africa, was criticised by several Range States representatives with the argument that up-listing would not be justified for

the southern parts of the continent. The meeting communiqué emphasised that a 60% decline in lion populations in Western, Central and Eastern Africa had been observed over the past 21 years, while the populations of southern Africa increased by 12% in the same period. There was a consensus among the participants that (legal) trade – the raison d'être of CITES – was not the main problem of the lion, but that lion conservation should be strengthened through improved transboundary cooperation among Range States sharing regional populations. Such international cooperation could better be facilitated under CMS than under CITES.

Fig. 1.1. Participants of the African Lion Range State Meeting.

The proposal to transfer all African lion populations from CITES Appendix II to Appendix I was modified to an annotation to the existing Appendix II listing at the CoP17 in Johannesburg, South Africa, in October 2016. On the other hand, at CMS CoP12 in Manila, Philippines, the proposal to include *Panthera leo* in Appendix II of the convention was accepted, paving the way for a joint initiative on protecting Africa's great carnivores. At CoP12 in Manila, a joint CITES/CMS work programme 2015–2020 was concluded, which called, among others, for "joint activities addressing shared species and issues of common interest". The cooperation led to the establishment of the joint CMS-CITES African Carnivores Initiative (UNEP/CMS/COP12/Doc.24.3.1.1). The African Carnivores Initiative will become a focal point for the implementation of resolutions and decisions on lions, leopards, cheetahs and wild dogs under CMS and CITES.

The two UN wildlife conventions are joining forces on a new initiative to halt the serious decline of Africa's great carnivores: "The African Carnivores Initiative follows on from the CMS-CITES Joint Work Programme 2015-2020, which has been agreed by both Conventions. It is intended to become a shared platform for the implementation of resolutions and decisions on lions, leopards, cheetahs and

wild dogs under both CMS and CITES. The two conventions intend pooling their resources and expertise in a drive to deliver concrete action and policy guidance in tandem with other organizations such as the International Union for Conservation of Nature (IUCN)" (Press release from 18 October 2017).

The *Guidelines for the Conservation of Lions in Africa* are one product of this joint effort. They address several of the topics mentioned in the CITES CoP17 Decision 17.241 and CMS CoP12 Decision 12.67, concerning the review of the conservation status of lion populations, the spatial concept, strategic planning and transboundary cooperation in lion conservation in Africa, consistent monitoring and data analyses, conservation of habitats and prey, involvement of local people and possible incentives for lion and wildlife conservation. The GCLA are based on readily available information, best-practice experience and case studies. They are developed by members of the IUCN SSC Cat Specialist Group in consultation with the African lion Range States. The GCLA are a compendium of ideas, practical concepts and tools developed to date. They are meant to be a living document updated on a regular basis as new instruments are being developed or new insight becomes available.

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2 Status and assessment of the lion in sub-Saharan Africa

Hans Bauer, Samantha Page-Nicholson, Amy Hinks and Amy Dickman

2.1 Distribution and abundance of lion in Africa and its assessment in the IUCN Red List

The lion, most social member of the family of Felidae, is one of the flagship species of Africa; a powerful and omnipresent symbol. The lion has been listed as Vulnerable on the IUCN Red List of Threatened Species (hereafter: Red List) since it was first assessed in 1996. The most recent Red List assessment (Bauer et al. 2015a) inferred a decline of 43% over three lion generations and showed a dichotomy across the continent; sharp declines in West, Central and East Africa, but stable populations in some southern African countries. Declines were inferred from time-series data in known populations and were not calculated based on a total estimate of lion numbers. A different criterion was used for the regional assessment in West Africa; with an estimate of <250 mature lions the regional population was assessed as Critically Endangered (Henschel et al. 2015). The 2015 Red List lion distribution map is shown in Fig. 2. 1.

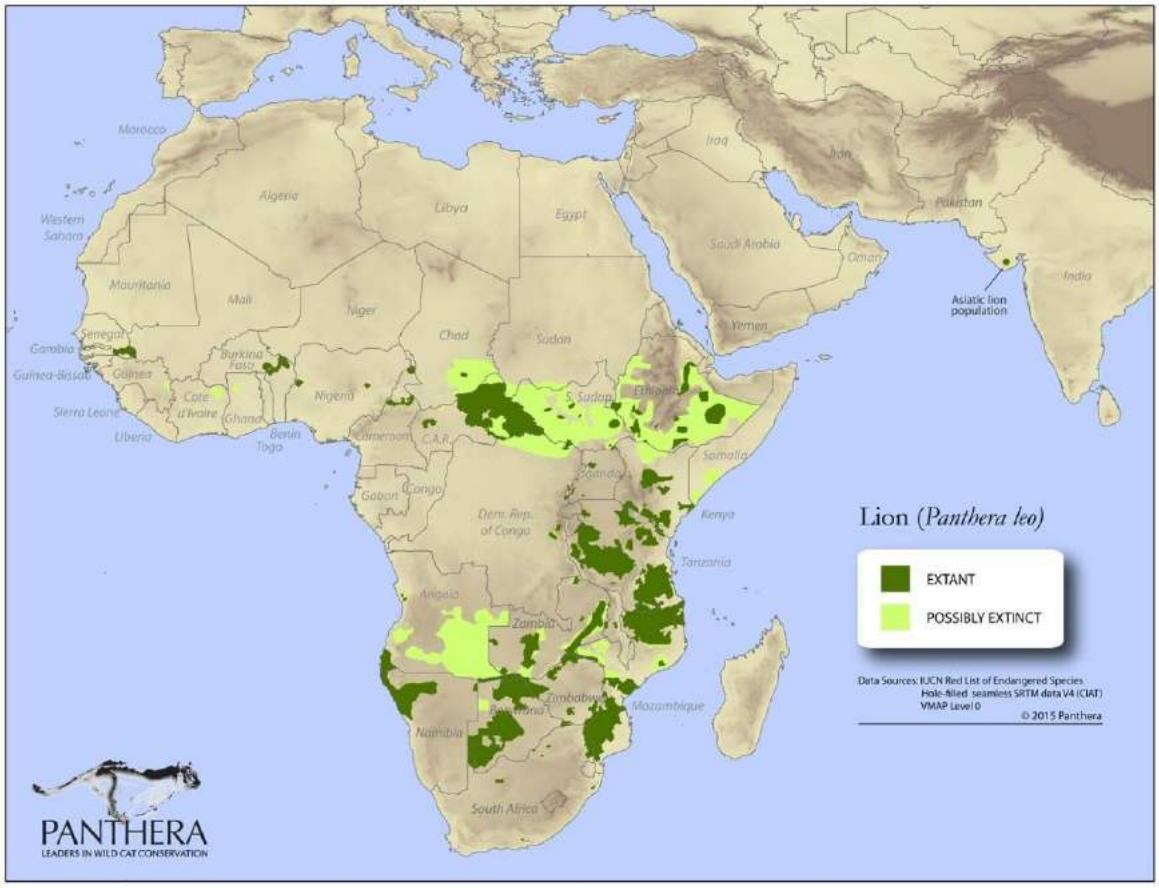

Fig. 2.1. Lion distribution map (source: 2015 Red List).

It is notoriously difficult to count lions, and lion numbers are inherently imprecise (i.e. with large confidence intervals) or of unknown accuracy (i.e. deviation from true population size). Figures from before 2002 are very speculative, the earliest estimates based on actual data were published by Chardonnet (2002) and Bauer & Van Der Merwe (2004). Chardonnet (2002) had larger geographical coverage and included some extrapolation or speculation about data deficient areas, giving an estimate of 39,373 lions. Bauer & Van Der Merwe (2004) did not aim to provide a comprehensive estimate but presented known numbers from areas for which information was available: 23,000 lions. In 2005, IUCN and WCS convened workshops with a large group of people, leading to a total estimate of 33,292 lions with 10% in West and Central Africa and 90% in Eastern and Southern Africa (IUCN 2006a, IUCN 2006b, IUCN, 2007). Riggio et al. (2013) used some of those data and provided an updated figure of 32,000 lions.

Considering the difficulty in interpreting lion numbers and the availability of an alternative, the 2015 Red List did not use total lion numbers (Criterion D in the Red List) for the assessment. Instead, it inferred a decline (Criterion A) of 43% based on time trend analysis of census data for 47 relatively well monitored lion populations. These populations comprised a substantial portion of the total species population and therefore the species as a whole was assessed as Vulnerable. The overall classification however masks a dichotomy: Sample lion populations increased by 12% in four southern African countries (Botswana, Namibia, South Africa and Zimbabwe) and in India, while an observed decline of 60% in sample populations was inferred for the remainder of its African range.

While the 2015 Red list assessment was less sensitive to lack of data across much of lion range, it did have its limitations. Most importantly, the assessment was based on the power of aggregation of data across the continent and the sub-regions; the data cannot be used to make assessments at national or even lower spatial scales. This limitation does not concern the regional assessment of Critically Endangered for West Africa, which was based on a different type of data analysis.

2.2 Inventory of lion populations

There is no continent-wide lion survey programme, but lion surveys are constantly providing new information for specific areas. In Table 2.1, we provide the estimates that are currently known to us, and Figure 2.2 shows these populations on a map. Note that CAR and South sudan both have extremely large polygons, whereas very little recent information is available to corroborate lion presence there. The reverse is true for Ethiopia and northern Kenya where lions are suspected to occur widely but patchily and at very low densities; this is not captured on the map but ongoing survey work there is expected to give more clarity in the near future. This is not a comprehensive status review; these figures are provided to set a common baseline of information. We refer to Chapter 9.1 for the initiative to create a more comprehensive and structured African Lion Database.

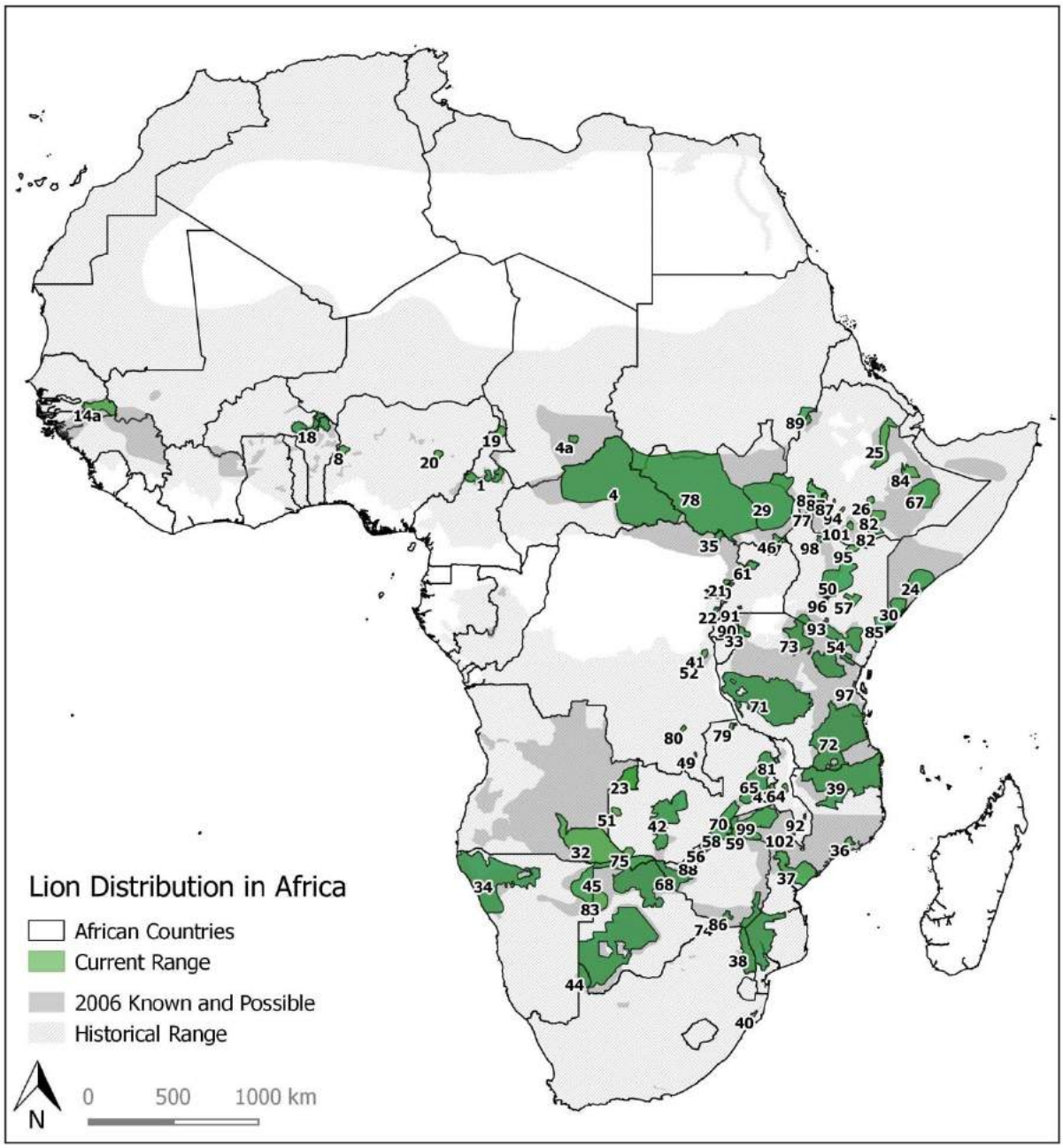

Fig. 2.2. Lion distribution map, using recent data as listed in Table 2.1. Numbers refer to the numbers in Table 2.1.

In 2006, 78 'Lion Conservation Units' contained an estimated total of 33,292 lions; those same areas now contain an estimated 24,510 lions; a decline of 26%. Some lion populations were not listed in 2006, but were incorporated in our present Table 2.1, summing up to a total of 25,852 lions in 102 populations, plus a metapopulation of 628 lions in small fenced reserves in South Africa (mentioned separately here because of the very different context). Expert panel data can be misleading, and we urge caution in the interpretation of subsets of the data presented here, especially when it comes to lion numbers. However, the overall decline of 26% over 12 years calculated from our expert data is consistent with a decline of 43% over 21 years measured with a different data set consisting of re-peat surveys in the Red List assessment.

Table 2.1. Lion Conservation Units as defined by IUCN (2006a, b), with population sizes estimated in 2005 and in 2018. # = Number in map of Fig. 1. Country = UN 3-letter codes.

#	LCU_name	Country	Area [km²]	2005	2018	source / rationale
	West and Central Africa					
1	Benoue complex	CMR	28,332	250	250	Bauer et al. 2015d
2	Boucle Baoule	MLI	4,532	40	0	Red List
3	Bui-White Volta Ecosystem	GHA	3,786	15	0	Red List
4	Chad-RCA	TCD/RCA	394,070	1,400	650	between 0 and 1000 -> 500
4a	Zakouma, previously incl. in 4	TCD		100	140	African Parks
5	Comoe-Leraba	CIV	19,367	30	0	Red List
6	Digya	GHA	2,458	30	0	Red List
7	Gbele Ecosystem	GHA	1,209	30	0	Red List
8	Kainji Lake	NGA	4,185	50	20	A.Dunn, pers.comm.
9	Kamuku/Kwiambana	NGA	2,307	30	0	Red List
10	Lame-Burra/Falgore GRS	NGA	3,468	30	0	Red List
11	Mole	GHA	5,505	0	0	Red List
12	Mont Kouffe/Wari Maro Forest	BEN	2,750	30	0	Red List
13	Nazinga-Sissili Ecosystem	BFA	2,116	30	0	Red List
14	Niokolo-Guinee	GIN/SEN	162,648	750	0	Red List
14a	Niokolo-Faleme (previously included above)	SEN		60	20	G. Malle, pers. comm.
15	Odzala	COG	1,716	2	0	Red List
16	Old Oyo	NGA	1,534	5	0	Red List
17	Oti-Mandouri	TGO	592	0	0	Red List
18	WAP	BEN/BFA/NER	28,558	300	418	Bouché et al. 2016
19	Waza	CMR	3,779	60	17	Tumenta 2010
20	Yankari	NGA	2,488	50	10	A.Dunn, pers.comm.
	East and southern Africa					
21	Albertine North	COD/UGA	1,298	30	30	no new data
22	Albertine South	COD/UGA	1,529	175	180	Dickman et al. subm.
23	Alto Zambeze	AGO	18,214	80	80	Vaz Pinto: no new info
24	Arboweerow-Alafuuto	SOM	21,396	175	175	no new data
25	Awash-Afar	ETH	13,621	30	75	Yirga et al. subm.
26	Bale-Harena	ETH	880	30	30	Yirga et al. subm.
27	Bicuar	AGO	9,914	30	0	Overton et al. 2017
28	Bocoio-Camucuio	AGO	24,800	50	0	V. Pinto, pers.comm.
29	Boma-Gambella	SDN/EZH	94,273	375	375	Yirga et al. subm.
30	Bush-Bush	SOM	10,694	750	100	O. Gedow, pers.comm.
31	Cameia-Lucusse	AGO	30,550	100	50	Vaz Pinto: no new info
32	Cuando Cubango - Luengue-Luiana Mavinga	AGO	144,443	1,100	20	Funston et al., 2017
33	Dar-Biharamulo	TZA/RWA	142,820	900	98	Dickman et al. subm.
34	Etosha-Kunene (+Ongava)	NAM	48,889	375	605	Dickman et al. subm.
35	Garamba-Bili Uere Complex	COD	114,434	175	150	Dickman et al. subm.
36	Gile	MOZ	2,637	30	25	Dickman et al. subm.
37	Gorongosa/Marromeu	MOZ	39,590	175	89	Dickman et al. subm.
38	Greater Limpopo (incl Kruger, Gonarezhou)	RSA/ZWE/MOZ	60,957	2,000	1,892	Dickman et al. subm.

#	LCU_name	Country	Area [km²]	2005	2018	source / rationale
39	Greater Niassa	MOZ/TZA	77,329	1,025	1,071	incl Niassa
40	Hluhluwe-Umfolozi	RSA	989	80	130	website
41	Itombwe Massif savanna	COD	1,875	30	25	Dickman et al. subm.
42	Kafue	ZMB	2,891	375	386	Dickman et al. subm.
43	Kasungu	MWI		10	6	Dickman et al. subm.
44	Kgalagadi	BWA	149,121	750	1,151	Dickman et al. subm.
45	Khaudum-Caprivi	NAM	23,522	150	150	Dickman et al. subm.
46	Kidepo Valley (SU)	SDN	6,236	30	30	no new data
47	Kidepo Valley (UG)	UGA	247	25	132	Dickman et al. subm.
48	Kissama-Mumbondo	AGO	2,783	10	0	Lindsey et al. 2017
49	Kundelungu	DOD	366	30	30	no new data
50	Laikipia-Samburu	KEN	18,910	350	300	Dickman et al. subm.
51	Liuwa Plains	ZMB	15,166	30	5	Dickman et al. subm.
52	Luama Hunting Reserve	COD	2,940	30	25	Dickman et al. subm.
53	Luchazes	AGO	125,623	550	0	V. Pinto, pers. comm.
54	Maasai Steppe (incl Amboseli, Tsavo, Mikumi, Mkomazi, Manyara etc.)	TZA/KEN	125,050	1,500	1,386	Dickman et al. subm.
55	Mangochi	MWI	396	5	0	Riggio et al. 2013
56	Matusadona	ZWE	1,328	75	31	Dickman et al. subm.
57	Meru	KEN	2,123	175	40	Dickman et al. subm.
58	Mid-Zambezi	ZWE/ ZMB/MOZ	18,012	375	200	Dickman et al. subm.
59	Mozambique S of Labannakassa	MOZ/ ZWE	11,420	75	75	no new data
60	Mupa-Cubati	AGO	22,612	75	0	Overton et al. 2017
61	Murchison Falls	UGA	1,249	120	132	Dickman et al. subm.
62	Murchison Falls South	UGA				Incl. in Murchison Falls
63	Niassa Reserve	MOZ	37,145			Incl. in Greater Niassa
64	Nkotakota	MWI	1,664	5	5	African Parks took over
65	North Luangwa	ZMB	16,179			Incl. in S. Luangwa
66	Nyika	ZMB/MWI	3,035	30	0	Riggio et al. 2013
67	Ogaden	ETH	31,215	75	150	Yirga et al. subm.
68	Okavango Hwange	BWA/ZWE	92,323	2,450	2,419	Dickman et al. subm.
69	Omay	ZWE	1,876	30	15	Kokes pers. comm.
70	Petauke Corridor	ZMB	4,249	30	173	Dickman et al. subm.
71	Ruaha-Rungwa-Katavi	TZA	160,963	4,500	2,352	Dickman et al. subm.
72	Selous	TZA/MOZ	167,322	5,500	4,325	Dickman et al. subm.
73	Serengeti Mara	TZA/KEN	51,561	3,500	2,956	Dickman et al. subm.
74	Shashe-Limpopo	ZWE/RSA/BWA	6,383	75	42	Dickman et al. subm.
75	Sioma Ngwezi	ZMB	198	30	25	Dickman et al. subm.
76	South Luangwa, North Luangwa	ZMB	20,135	550	569	Dickman et al. subm.
77	South Omo	ETH	16,849	175	150	Yirga et al. subm.
78	Southwestern South Sudan	SSD	316,620	375	375	no new data
79	Sumbu (Nsumbu)	ZMB	39,964	30	25	Dickman et al. subm.
80	Upemba	COD	1,252	30	30	no new data
81	Vwaza	MWI		10	5	Dickman et al. subm.
82	Welmel-Genale / Geraile	ETH	5,015	75	75	Yirga et al. subm.

#	LCU_name	Country	Area [km²]	2005	2018	source / rationale
83	Xaxa	BWA	12,628	75	15	Winterbach, pers. comm.
84	Babile	ETH	9,668		20	Yirga et al. subm.
85	Boni-Dodori	KEN	12,705		200	Dickman et al. subm
86	Bubye Valley	ZWE	2,717		332	Dickman et al. subm.
87	Chebera Churchura - Kafa - Maze	ETH			75	Yirga et al. subm.
88	Chizarira-Chirisa	ZWE			16	Dickman et al. subm.
89	Dinder-Alatash	SDN/ETH	15,000		200	Bauer et al. 2016
90	Kagera	RWA	1,200		22	African Parks
91	Lake Mburo	UGA	373		5	Dickman et al. subm.
92	Liwonde and other African Parks reintroductions	MWI			5	African Parks
93	Nairobi	KEN	733		17	Red List
94	Nechisar	ETH	1,029		15	Yirga et al. subm.
95	Northern Kenya NGA	KEN	3,473		50	Dickman et al. subm.
96	Ol Pejeta	KEN			85	Red List
97	Saadani	TZA	1,065		25	Dickman et al. subm.
98	Sibeloi	KEN	1,465		50	Dickman et al. subm.
99	Tchuma Tchato	MOZ			185	Dickman et al. subm.
100	Toro-Semiliki	UGA			5	Dickman et al. subm.
101	Yabelo	ETH			30	Yirga et al. subm.
102	Majete	MWI			5	Afrikan Parks
103	44 small fenced reserves	RSA			628	S. Miller, pers. comm
	Total (+fenced)			33,292	26,480	#1-102
	Total (-fenced)			33,292	25,852	#1-101
	LCU only			33,292	24,510	#1-83

We stress that it would be incorrect to say that “there are 25 thousand lions”. Many of the estimates we present have very large confidence intervals, and for many the precision is not even known. Some of them are based on old information and remain on the table in the absence of newer information. We maintain the statement from the Red List: “with all these considerations, we have greater confidence in an estimate of closer to 20,000 Lions in Africa than in a number over 30,000”. Any statement claiming to be more precise than that may be inaccurate.

The lion populations listed in Table 2.1 cover a total surface area of approximately 2.5 million km^2, only 12.5% of historical range. In Table 2.2, we present available information on range reduction over time. We also tried to analyse the amount of lion range under formal protection by overlaying lion populations with the World Database of Protected Areas (WCMC-WDPA). The analysis showed that 62% of current lion range is in formally protected areas, but during the analysis we noticed that the WDPA has so many shortcomings that we would caution against using this figure (e.g. adding an updated PA layer just for Angola increases PA coverage to 66%).

Table 2.2. Lion range (in km² and as a percentage of historical range) across Africa in different reference years.

Lion Range	Historical range	IUCN 2006a,b	Riggio et al. 2013	Present study (2018)
West & Central Africa	7,206,817	1,047,231 (15%)	n/a	379,852 (2.9%)
East & Southern Africa	13,010,000	3,564,000 (23%)	n/a	2,148,494 (16.5%)
Africa	20,216,817	4,611,231 (22%)	3,390,821 (17%)	2,528,346 (12.5%)

2.3 Threats

The reduction in lion range and numbers has a number of root causes, including issues of human population growth and poverty. An expanding poor human population leads to increasing expansion of human settlement into lion habitat, bringing with it the livestock and agricultural practices necessary to sustain people in both rural and urban areas, but also an increasing demand for bush meat. For lions, this results in habitat loss, population fragmentation, and reduction in the wild prey base. As human-lion contacts increase, so do human-lion conflicts, resulting in reductions in lion numbers through persecution (poisoning, trapping and shooting) and lack of support for lion conservation among local communities. In the Sahel especially, habitat loss is compounded by consecutive droughts over the last decades and the process of desertification. Another root cause of lion declines is armed conflict. Beyond its greater costs to people and their society and economy, in relation to lions and wildlife, war prevents tourism and facilitates wildlife poaching and illegal trade, which is in turn exacerbated by the spread of firearms and anarchy.

Some root causes for lion declines are external to Africa. African wildlife-based economies rely on Western tourists (both photographic and hunting safari) to generate valuable foreign currency. This is vulnerable to external developments such as terrorism resulting in a general decline in international tourism. In addition, Western governments and conservation groups provide significant funding for conservation in Africa, and African governments can be subject to donor demands, and the politics of conservation in Western countries.

The IUCN Lion Strategies, as reviewed in Bauer et al. (2015b), grouped threats by their proximate causes:

a) Inappropriate lion population management. This threat includes ineffective protection of protected areas, unsustainable hunting practices in some wildlife management areas, lack of knowledge and monitoring of lion populations, etc.
b) Habitat degradation and reduction of prey base. This threat includes fragmentation, habitat loss, integration of wildlife in land use, unsustainable local hunting for 'bushmeat', encroachment of agriculture and livestock, etc.
c) Human-lion conflict. This threat includes the notorious problem of man killing in certain areas, depredation of livestock by lions, indiscriminate killing of lions (poisoning, snaring, retaliatory or pre-emptive killing), ineffective Problem Animal Control, etc.
d) Adverse socio-economic factors. This threat includes the negative perception of lions among local people, the lack of incentives to tolerate lions, the inequitable sharing of lion related benefits, lack of local participation in planning and decision-making, etc.

e) Unfavorable policies and political factors. This threat includes the policy aspects of integration of wildlife in land use, political controversy over trophy hunting, low priority on the political agenda, management of transfrontier populations, compliance with regulations, etc.
f) Institutional weakness. This threat includes the limited capacity of various levels of government and other stakeholders to manage lion populations effectively, inadequate institutional frameworks for integrated wildlife management (e.g. consultation between agriculture and wildlife sectors), etc.
g) Killing of lions for their body parts, motivated by 1) illegal trade for local traditional medicine, and 2) trade in lion bone to Asia and Asian diaspora (incl. in Africa)

The proximate causes above lead to several direct threats to lions. In the 2015 Red List Bauer et al. 2015c identified the following threats:

a) Human Lion Conflict (indiscriminate lion killing in retaliation or prevention for livestock depredation);
b) Prey depletion (many causes, including bushmeat poaching and changing land use);
c) Habitat loss (includes agricultural encroachment, resource extraction and infrastructure development; compounded by habitat fragmentation);
d) Killing of lions for their body parts, motivated by (1) illegal trade in parts and derivatives for local traditional medicine, and (2) trade in lion bone to Asia and Asian diaspora;
e) Other (poor protected area management, unsustainable offtake, disease, etc.).

2.4 The situation of the lion in West and Central Africa

The lion population in West and Central Africa, extending into the Horn of Africa, is of particular concern. Together with the only lion population in India this makes up the distribution area of a separate subspecies *Panthera leo leo* as opposed to *Panthera leo melanochaita*, the subspecies in East and southern Africa (Bertola et al. 2016, Kitchener et al. 2016). Declines in lion range and numbers were signalled as early as 2001 (Bauer et al. 2003) and have been monitored ever since (Bauer & Nowell 2004, Henschel et al. 2014). Bauer et al (2015c) documented the largest declines in this region over the last two decades. These declines continue in some areas, particularly in the largest contiguous area stretching across CAR and South Sudan, two countries with severe civil unrest. However, other areas now face a more promising future. Management of Zakouma NP in Chad, Pendjari NP in Benin and Chinko NP in CAR has been delegated to African Parks Network, with good results so far. Panthera is providing technical assistance to Senegal for the restoration of lions in Niokolo Koba NP, and WCS is supporting management in the Benoue area in Cameroon and in Yankari NP in Nigeria. A previously undocumented population on the border of Sudan and Ethiopia (Dinder NP - Alatash NP) turns out to possibly be the third largest relatively stable population after WAP and Benoue. While there is no guarantee for management success, or indeed lion persistence, in any of these areas, these vestiges offer hope for the survival of the subspecies.

2.5 Discussion and conclusions

The striking contrast between countries in southern Africa and the rest of the continent is congruent with differences in human population density, which has been shown to be an important explanatory variable for lion population status (Packer et al. 2013). Another important determinant is prey abundance; lion trends are closely mirrored by time series data on their main prey species; while herbivore population sizes increased by 24% in southern Africa, herbivore numbers declined by 52% in East Africa and by 85% in West-Central Africa between 1970 and 2005 (Craigie et al. 2010). A third important determinant is management budgets and capacity to protect parks. Lion populations appear to be stable where management is properly funded. However, many lion populations occur in areas where management budgets are low, leading to local decline and even extirpation, most notably in West Africa.

Within a few strongholds, lions are not threatened with imminent extinction; some populations, especially in southern Africa, are likely to persist for decades. Small fenced reserves in South Africa are also effective, but these include many small populations that require metapopulation management, euthanasia and contraception, and only make limited contributions to ecosystem functionality and conservation outcomes. However, rapid declines in numbers and range indicate that lions will disappear from most of Africa. Lions will increasingly be framed as conservation dependent and no longer thought of exclusively as the epitome of wilderness (Bauer et al. 2015c).

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3 Existing lion conservation plans

Urs Breitenmoser

Since the development of the lion conservation strategies for three regions in Africa (Chapter 3.1), a number of regional or national action plans have been issued to guide the conservation of lions. Many of these plans have been developed according to the IUCN standards for strategic planning in species conservation (Chapter 4.2). In this chapter, we compile information on presently available lion conservation plans. We distinguish a 'strategy' as an over-arching, analytic concept considering a large portion of the lion range from an 'action plan', which is a more concrete, action-oriented document that should consider the principle, i.e. the respective strategy, and facilitate the implementation of conservation action in a given area, often a country.

3.1 The 2006 lion conservation strategies and the 2015 review

Based on a decision at CITES CoP 13 in 2004, the CITES Secretariat mandated the IUCN SSC Cat Specialist Group to facilitate the development of lion conservation strategies for sub-Saharan Africa. These strategies were developed in two workshops, the first one on 2–7 October 2005 in Douala, Cameroun, for western and central Africa, the second one for eastern and southern Africa on 8–13 January 2006 in Johannesburg, South Africa. The outputs from these workshops were two documents (Fig. 3.1.1), the "Conservation Strategy for the Lion in West and Central Africa" (IUCN SSC Cat Specialist Group 2006a) and the "Conservation Strategy for the Lion in East and Southern Africa" (IUCN SSC Cat Specialist Group 2006b). The workshop in Douala split in two working groups, so that the document indeed contains two strategies, one for Western Africa and one for Central Africa. The Strategies identified a number of Objectives per region and defined for each Objective some Results (or Targets) to be achieved by implementing specific Activities (see Chapter 4.2 for more information on the structure of strategies and action plans).

The Vison of the 2006 Strategies was, as synthesised by Bauer et al. (2015):

> **A future in which Africa manages its natural resources sustainably for the mutual benefit of lions and people.**

And the Goal accordingly:

> **To ensure the conservation of lions across Africa, recognizing their potential to provide substantial social, cultural, ecological and economic benefits.**

In 2015, The CMS Secretariat commissioned an evaluation of the implementation of the Strategies. The review of Bauer et al. (2015) served as an input document to the joint CITES-CMS meeting of African lion Range States on 30–31 May 2016 in Entebbe, Uganda. For the review, the CMS Secretariat sent a questionnaire to 44 signatory Parties in Africa, of which ten replied (Bauer et al. 2015a). The countries that had replied considered the Strategies important or very important documents. Six of them had translated the respective Strategy into a National Action Plan (Chapter 3.2).

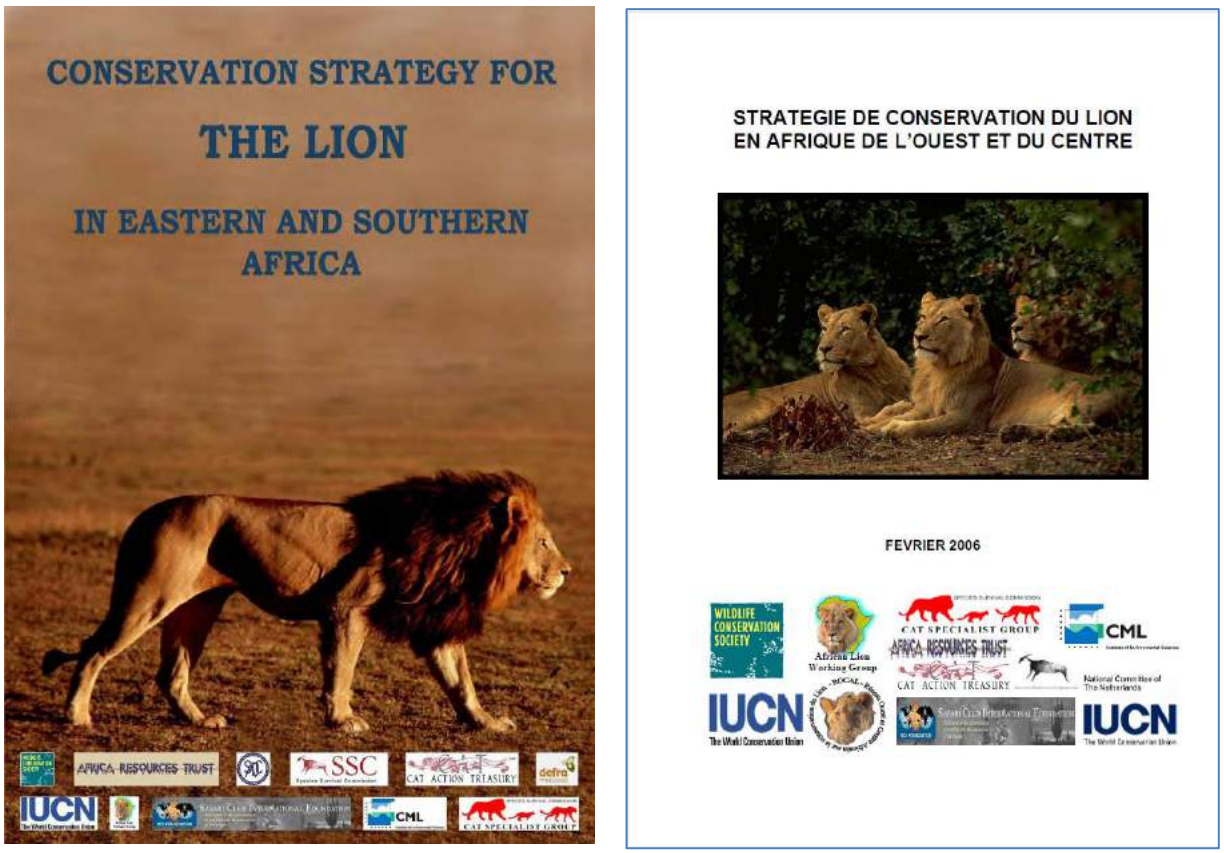

Fig. 3.1.1. The 2006 African lion conservation strategies. East and southern Africa were compiled in one Strategy (left), whereas the French version and its English translation contain the "Stratégie de conservation du lion en Afrique de l'Ouest" and the "Stratégie de conservation du lion en Afrique Centrale" (right).

The review concluded that the main threats to lions and the conservation challenges had not changed. The seven key threats at continental level were synthesised by Bauer et al. (2015) and are presented in Chapter 2.3.

The threat of increasing legal and illegal trade was newly identified since the establishment of the 2006 Strategies. The combined Objectives from the 2006 Strategies, with an additional one suggested by Bauer et al. (2015), taking into account the new threat of illegal trade in body parts (Threat 'g' in Chapter 2.3), are as follows:

Objective 1. **To conserve current populations of free ranging African lions**;

Objective 2. **To conserve current lion habitat and prey base**;

Objective 3. **To minimise human-lion conflict**;

Objective 4. **To equitably distribute the costs and benefits of long-term lion management**;

Objective 5. **To have global, regional and national policies and legal frameworks provide for lion conservation and associated socio-economic benefits**;

Objective 6. **To promote institutional strengthening towards an enabling environment for lion conservation**;

Objective 7. **To minimize illegal trade in lion bones and body parts**.

These Objectives are, with differing importance, the underlying aims for lion conservation activities in all regions of Africa and should hence be considered in the development or transboundary or regional conservation strategies or National Action Plans.

Although the Strategies are still valid, Bauer et al. (2015) questioned the then applied grouping of East and southern Africa, as the status of the lion populations in these region, according to the IUCN Red List differ considerably. However, in order to produce strategic documents that can be translated into action plans more directly, it would be useful to develop Regional Conservation Strategies (Chapter 4.2) for large, transfrontier populations or metapopulations, including all countries that share these populations. The 2006 Strategies can still serve as a blueprint with regard to the threat analyses and the Objectives.

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3.2. National and Regional Action Plans

Urs Breitenmoser and Roland Bürki

For the implementation of the over-arching Regional Conservation Strategies (RCS; Chapter 3.1), they should be translated into more concrete and specific Action Plans, either on a national level or on a regional/population level, as recommended in the 2006 Lion Conservation Strategies (IUCN Cat Specialist Group 2006a, b; see Chapter 4.2 for more information on the structure of Strategies and Action Plans.)

Up to now, we are aware of 13 African countries that have developed National Action Plans for lions or more general strategies or action plans that include lions (Table 3.2.1). All plans that have been endorsed and released are made available on the African Lion Portal of CMS or on the website of the IUCN/SSC Cat Specialist Group. Malawi, Senegal and South Sudan have been working on a NAP for lions, but the documents are not yet available. Furthermore, Namibia has developed a specific Human-Lion Conflict Management Plan for north-western Namibia.

According to Bauer et al. (2015), none of the NAPs have been formally evaluated so far. Based on circumstantial evidence, the authors concluded that some plans may have reached the goal of at least stabilising lion populations, others have not. A widespread problem of the implementation of NAPs is that the responsibilities are often not clearly assigned, and that the funding for its implementation is not available.

We recommend, as a next strategic planning step, to develop Regional Conservation Strategies at the level of transboundary population or metapopulation (Tables 4.3.1 and 4.3.2 in Chapter 4.3). The joint management and conservation of a lion population shared by several countries could best be organised in form of a Regional Strategy, e.g. under the auspice of CMS, in order to assist fundraising at international level. So far, there is one transfrontier conservation action plan including lions, the *Plan d'Action pour la Conservation des Grands Carnivores au niveau du complexe WAPO* (W-Arly-Pendjari-Oti-Mandouri Complex), developed in 2014 and including areas in Burkina Faso, Benin, Niger and Togo. A second one is being developed for the Kavango Zambezi Transfrontier Conservation Area (KAZA) and should be published by the end of 2018 (Box 3.2.1).

Table 3.2.1. Countries with National Action Plans for lions or other strategic planning documents that consider lions.

Country	Scope	Year	Remarks
Benin	Lion	2014	
Cameroon	Lion	2007	
Ethiopia	Lion	2012	
Guinea	Large carnivores	?	
Kenya	Lion & spotted hyaena	2009	Revision in process (2018)
Mozambique	Lion	2010	LogFrame revised in 2016
Namibia	Lion	2008	Draft, not endorsed by government
Rwanda	Biodiversity	2016	No specific actions for lions
South Africa	Lion	2015	
Tanzania	Lion & leopard	2006	Part of the 2009 *Tanzania Carnivore Conservation Action Plan*
Uganda	Large carnivores	2012	
Zambia	Lion	2009	
Zimbabwe	Lion	2006	Revision workshop planned for late 2018

Box 3.2.1 A Large Carnivore Conservation Strategy for KAZA

Kim Young-Overton

Through a consensus driven planning process, the KAZA Carnivore Conservation Coalition (KCC; Chapter 9.3) developed a KAZA Large Carnivore Conservation Strategy. The Strategy embodies 18 site-based priority projects (Map) and three KAZA wide projects which together ensure that:

(i) Carnivore populations and their prey are stable or growing in key habitats;

(ii) Connectivity pathways among key habitats are active and secured; and

(iii) Communities are empowered as active conservation and business players and partners in securing populations of carnivores and their prey.

The Strategy is adopted as KAZA's formal approach for the conservation of African lions and other large carnivores and this strategic and collective approach allows for integration, facilitation and funding of activities across boundaries, borders, sectors and organisations to secure a network of key habitats and connectivity pathways for lions and other large carnivores across KAZA.

The Strategy is a living document with regular review as new challenges and new opportunities present themselves. The Strategy and accompanying Action Plan detailing activities for all 21 identified projects are planned to be published by end of November 2018.

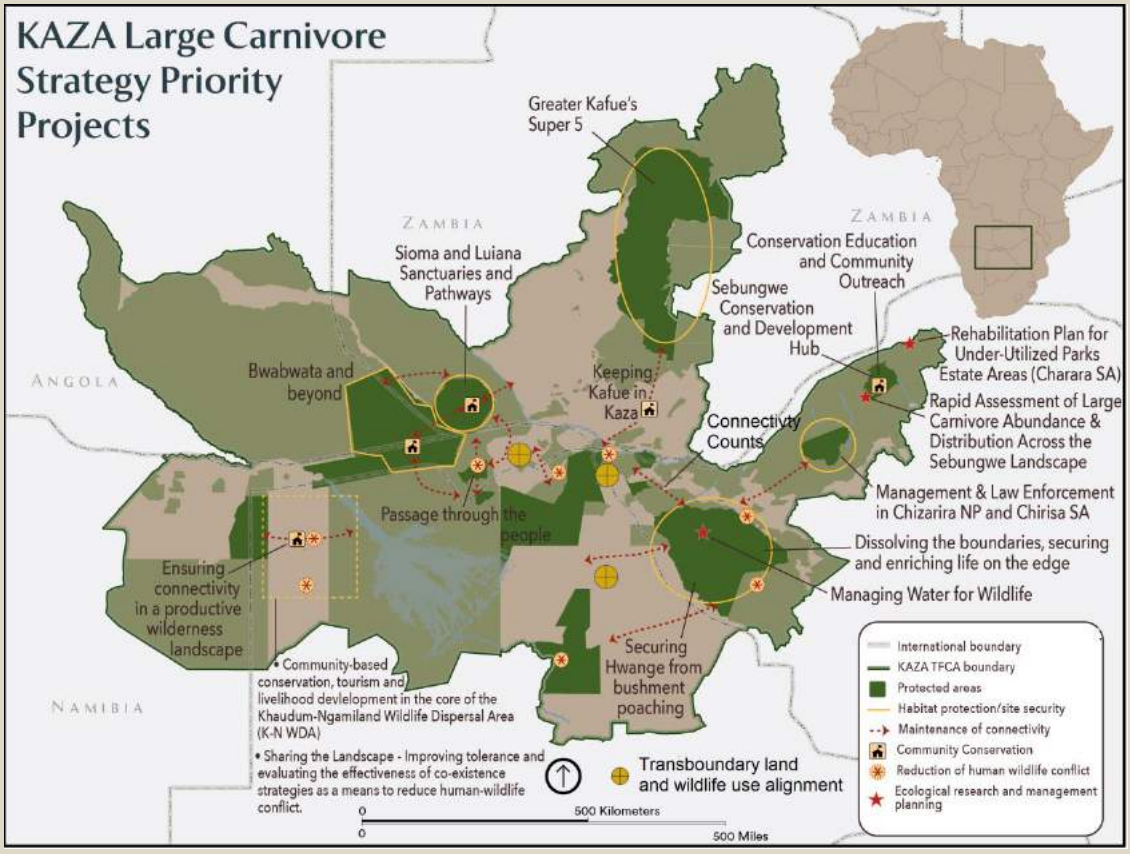

Fig. 1. Map of the 18 site-based projects embodied by the KAZA Large Carnivore Conservation Strategy.

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4 Policy frameworks for the conservation of the lion in Africa

Urs Breitenmoser and Clara Nobbe

The responsibility for the implementation of conservation and management measures to secure the survival or restoration of viable lion populations is primarily with the Range States. However, international cooperation at bi- or multilateral, continental and global level is of vital importance with regard to (1) conserving transboundary populations, (2) suppressing critical threats such as poaching and legal trade, and (3) generating income from and for lion conservation through tourism, trophy hunting or ecosystem services (e.g. carbon offset) or for executing research and conservation projects. In this chapter, we review the policy framework for international cooperation provided by CITES, CMS and IUCN.

4.1 International cooperation under the auspices of CITES and CMS

CITES and CMS, the two species-oriented international conventions under the auspice of the United Nations, have agreed on a joint work programme 2015–2020, which provides a framework for cooperation. The CITES and CMS Secretariats jointly developed the African Carnivores Initiative (ACI) with the objective to bring more coherence to the implementation of existing CITES and CMS Resolutions and Decisions related to four African carnivores, namely African wild dog, cheetah, leopard and lion, recognising that the four species overlap in their distribution and that overall threats, and the conservation measures called for to address them, are comparable to the four species.

At the 12th meeting of the Conference of the Parties to CMS (CoP12, October 2017, Manila), Parties agreed to the proposal of Chad, Niger and Togo for the inclusion of the lion (*Panthera leo*) in Appendix II of the Convention. Although felids are, in the strict biological understanding of the term, not migratory species, many of them, including the lion, meet the definition of a species to be considered under the CMS, as explained in the proposal: The Convention defines 'migratory species' as the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries (CMS Article I (1)). Lions move freely across international boundaries, meaning that trends in one country can impact the viability of the overall population, thus affecting conservation success in other countries (Bauer et al. 2015). Factors like sex, group size, rainfall, patterns of resource distribution, social effects, and stage of dispersal can all influence the lion migration and dispersal (Lehmann et al. 2008, Elliot et al. 2014). Dispersal (movement of individuals away from their birth site) is recognized as one of the most important life-history traits affecting species persistence and evolution and is increasingly relevant for conservation biology as ecosystems become more fragmented (Elliot et al. 2014). Dispersal as a mechanism to maintain the demographic and genetic viability of lion populations across international borders gains increasingly importance as the populations become more fragmented.

In a recent review article, Trouwborst et al. (2017) analysed the potential of international wildlife treaties with regard to their combined contribution to lion conservation. They concluded that CMS holds particular potential, especially if combined with other international treaties such as CITES, the Ramsar Wetland Convention, the Word Heritage Convention and the transboundary conservation area (TBCA) treaties (Box 4.3.1). There is a considerable amount of conceptual and spatial overlap of the different concepts, and a more conscious synergistic cooperation would help improving the efficiency.

At CoP12, the Parties also adopted Decision 12.60, requesting the CMS Secretariat to establish the Joint CMS-CITES African Carnivores Initiative (ACI) and work with the CITES Secretariat to jointly support Parties to CMS and CITES in implementing conservation measures in CMS Resolutions and Decisions pertaining to African carnivores.

The CITES Standing Committee, at its 69th meeting (SC69, November 2017, Geneva), noted the efforts of the CITES and CMS Secretariats, with the support of the International Union for Conservation of Nature (IUCN), to implement CITES Decisions on cheetah and African lion through the Joint CITES-CMS African Carnivores Initiative (SC69 SR).

The CITES and CMS Resolutions and Decisions related to the four species that are currently covered by the Initiative are the following:

- CITES Decisions 17.241 – 17.245 on African lion (*Panthera leo*);
- CITES Decisions 17.114 – 17.117 on Quotas for leopard hunting trophies;
- CITES Decisions 17.124 – 17.130 on Illegal trade in cheetahs (*Acinonyx jubatus*);
- CITES Decisions 17.235 – 17.238 on African wild dog (*Lycaon pictus*);
- CITES Resolution Conf. 10.14 (Rev. CoP16) on Quotas for leopard hunting trophies and skins for personal use;
- CMS Resolution 12.28 on Concerted Actions;
- CMS Decisions 12.55 – 12.60 on the Joint CMS-CITES African Carnivores Initiative;
- CMS Decisions 12.61 – 12.66 on the Conservation and Management of Cheetah (*Acinonyx jubatus*) and African Wild Dog (*Lycaon pictus*);
- CMS Decisions 12.67 – 12.70 on the Conservation and Management of the African Lion (*Panthera leo)*.

In particular, the ACI seeks to contribute to the enhanced conservation of the four species across their range in Africa, as provided in the relevant CITES and CMS Resolutions and Decisions, by:

- Implementing the activities called for in existing CMS and CITES Decisions concerning the four species;
- Developing concrete, coordinated and synergistic conservation programmes that benefit the conservation of all four carnivore species, with local and regional projects implemented across their African range;
- Developing policy guidance and recommendations for range States, CITES and CMS Parties concerning the four species; and
- Organising collaboration with other conservation initiatives and organizations, such as IUCN.

The Decisions adopted by CITES CoP17 and CMS CoP12 on the African lion are largely overlapping and provide for a set of broad conservation measures ranging from the collection of data and the improvement of conservation and trade management, to capacity building for Government officials and awareness raising in local communities. To bring these various activities into a refined state so that they can be implemented by Governments and other stakeholders, there is a necessity to develop a framework for lion conservation, which will provide an overview on tools and instruments available as well as specify the conservation needs for each geographic region in Africa. The Guidelines for the Conservation of the Lion in Africa have been compiled by the IUCN SSC Cat Specialist Group and were discussed and verified by Range State Parties to CITES and CMS at a meeting in November 2018 and for submission to CITES CoP18 (deadline for submissions is 24 December 2018) and CMS CoP13 in 2020.

To advance the conservation or recovery of transboundary lion populations (Chapter 4.3), we recommend developing Regional Conservation Strategies according to the IUCN recommendations for strategic planning in species conservation (Chapter 4.2), which will then be implemented by the respective Action Plans in each of the countries sharing the respective population. Such regional cooperation between several states can be organised under the auspice of CMS.

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4.2 IUCN approach to strategic planning in species conservation

Tabea Lanz and Urs Breitenmoser

According to CITES CoP Decision 17.241a) and CMS CoP Decision 12.67a i) the Secretariats have to "investigate possible mechanisms to develop and support the implementation of joint lion conservation plans and strategies, taking into consideration existing lion conservation plans and strategies" (cf. Chapter 3). The 2006 lion conservation Strategies were developed according to the IUCN approach to strategic planning in species conservation, which is presented in this subchapter.

Large cats, such as the lion, are, besides their intrinsic value as wonderful species, important to maintain ecological processes through their influence on trophic levels and their high evolutionary significance because of the co-evolutionary relationships with their prey (Dawkins & Krebs 1979, Ginsberg 2001). Thus they should be conserved not only as a viable population, but as an important ecological player across their "original range" (Breitenmoser et al. 2016). The lion is thought to be extant in 1,654,375 km², corresponding to only 8% of its historical range (Bauer et al. 2016; Chapter 2), but still including 25 Range States. Coordinated conservation efforts and international cooperation between range countries should be based on thorough strategic planning for its long-term success. The IUCN SSC has developed guidelines for the strategic planning for species conservation (IUCN SSC 2008a,b, IUCN SSC Species Conservation Planning Sub-Committee 2017) and the IUCN SSC Cat SG developed practical guidelines for strategic and project planning in cat conservation (Breitenmoser et al. 2015).

Strategic planning for species conservation should be participative, transparent and informed by the best available science. Effective planning for species conservation needs to address a wide range of situations and needs to be adaptable (IUCN SSC 2008a,b, IUCN SSC Species Conservation Planning Sub-Committee 2017). The purpose of a careful planning process helps building partnerships, getting the buy-in from stakeholders and local people, and thus enhances the implementation of widely accepted and supported conservation measures. For transboundary populations, first an international plan called a Regional Conservation Strategy (RCS) is developed, followed by National Action Plans (NAPs), implemented through a series of conservation projects (Breitenmoser et al. 2015, 2016). The international plan may also be developed as a Species Conservation Strategy (SCS) on a global level, instead of a RCS. Similarly, Action Plans (APs) can be set up on e.g. a provincial or on a regional (i.e. transboundary) level. To keep it simple, we'll only use RCS and NAP in the text, as they are the common case for lions (see also Chapter 10.1 for specific planning recommendations for lions).

Every strategy or plan has a defined time span which is generally 3, 5 or 10 years before review and revision (IUCN SSC Species Conservation Planning Sub-Committee 2017). The planning process is based on the "*Ziel-Orientierte Projekt-Planung"* (ZOPP, goal-oriented project planning) combined with the Logical Framework Approach (logical framework, LogFrame or LFA, GTZ 1997). The result is a strategic planning instrument (e.g. an RCS), possibly with an integrated action plan, in the form of a LogFrame matrix. The strategic planning cycle (Fig. 4.2.1) combines the different phases of a conservation project into a six–steps loop, which is repeated until the goal of the project is fulfilled (Breitenmoser et al. 2015, 2016):

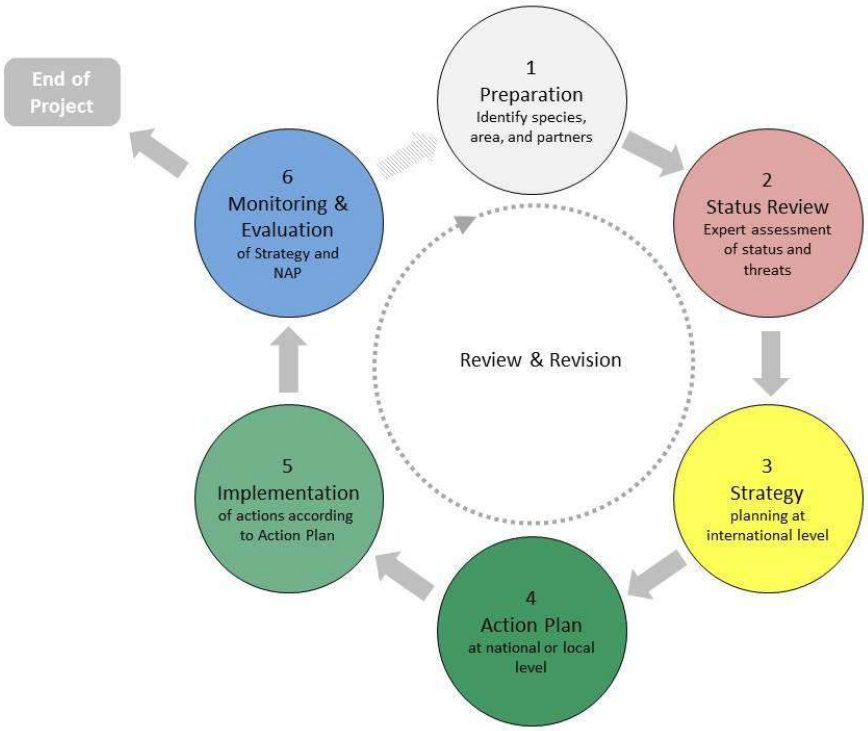

Fig. 4.2.1. Strategic Planning Cycle for species conservation projects. Step 1 and 2 are important for sensible planning and provide the baseline for the strategic planning. The actual planning process is covered by Step 3 and 4. The over-all purpose is the implementation of the defined conservation actions (Step 5), but these will only be successful if properly planned and subsequently monitored and evaluated (Step 6). The circle implies that conservation is an adaptive process (adapted from Breitenmoser et al. 2015).

1. Preparation: Before developing a RCS, the ground must be carefully prepared. The conservation unit (species, subspecies or meta-population) and the geographical scale are determined. If the unit stretches over several countries and cultural areas, the planning process may have to be organised in several stages in order to allow the participation of local people and stakeholders (see Step 4). In the case of the lion, there are already the 2006 Regional Strategies available, which have informed the development of several NAPs (Breitenmoser et al. 2015, 2016; Chapter 3). However, these RCSs were rather general, so that for some transboundary lion (meta-) populations, it might be helpful to develop a new, more specific RCS. Partnerships are built through early involvement of interest groups and consistent mutual information, and the support from relevant stakeholders is secured. The cooperation between key players is essential for the success of the planning process and its implementation. Governmental institutions, experts, relevant NGOs and stakeholders (including potential opponents) have to be integrated into the process and have to understand their different roles. The support from relevant national authorities and international institutions must be secured through a mandate, which can considerably ease the process and the subsequent political endorsement of the RCS and the NAP (Breitenmoser et al. 2015, 2016). For the planning workshops for the African lion strategies, based on a mandate from CITES, the Cat SG cooperated with the regional offices of IUCN, WCS, the two regional lion working groups and the wildlife conservation authorities of the host countries (Breitenmoser et al. 2015).

2. Status Review: In a second step, all information relevant for the planning process is collected. Compiling the Status Review is a scientific and technical process done by experts but with the involvement of partners and interest groups. Most important is a thorough assessment of the conservation status of the target species/unit within the target range, including an analysis of threats, e.g. using the IUCN Red List assessment procedures (IUCN Standards and Petitions Subcommittee 2017). The Status Review does not only consider biological and ecological aspects but also provides background information to understand the threats and constraints, human dimension aspects, socio-economic issues, policy, and enabling conditions (Breitenmoser et al. 2016, IUCN SSC Species Conservation Planning Sub-Committee 2017). Moreover, the Status Review will inform the strategic planning, but also serves as a reference point for the subsequent implementation of the conservation strategy and monitoring progress (Breitenmoser et al. 2015, 2016).

3. Strategy (global/international level): After the clarification of the scope and the mandate, the identification of partners and stakeholders and the compilation of the Status Review, the strategic planning is done in a participatory process, if possible as a facilitated workshop, where all relevant interest groups participate. A ZOPP pyramid is developed and a long-term Vision and Goal(s) are defined based on the Status Review (Fig.4.2.2). The Vision describes the future long-term ideal state of the species whereas the Goal describes the concrete, realistic and time-bound aim needed to achieve the vision (Breitenmoser et al. 2015, 2016, IUCN SSC Species Conservation Planning Sub-Committee 2017).

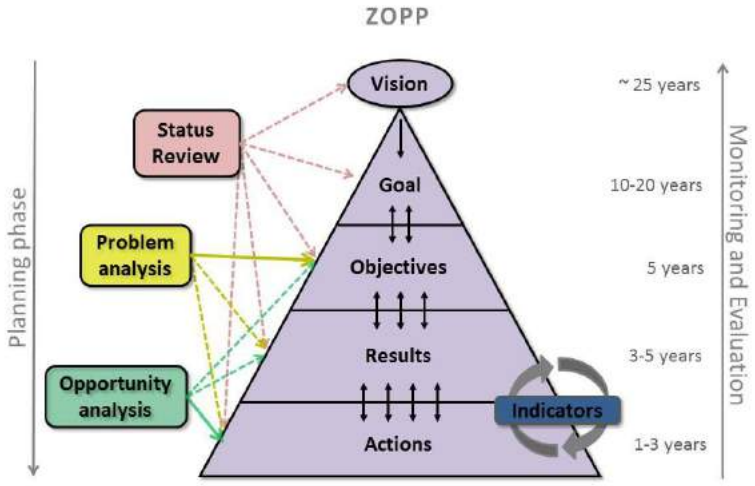

Fig. 4.2.4. The ZOPP pyramid for developing a Species Conservation Strategy. A Vision and a Goal are defined, and Objectives to reach the Goal and Results for each Objective are formulated. Actions to fulfil each of the Results are developed, and Indicators for monitoring and evaluating their effectiveness are defined. The Status Review is prepared before the workshop whereas the Problem and Opportunity Analyses are best done at the workshop. The time horizon for each planning step is indicated on the right (Breitenmoser et al. 2015).

To reach the Goal, the threats (identified in the Status Review and reviewed in a problem analysis during the workshop) must be overcome. Clear and realistic Objectives are identified, which directly address the priority threats and contribute to meeting the Goal. To achieve an Objective, one to several concrete Results, and for each Result one to several Actions are defined. Results must be SMART (Specific, Measurable, Attainable, Relevant, and Time-bound); their effectiveness is monitored by means of precise quantitative or qualitative Indicators and subsequently evaluated. Objectives, Results, Actions, Indicators, and additional parameters (responsibilities, methods, time-lines, budget frame, etc.) are compiled in a LogFrame, best by a designated committee (consisting of international and local specialists and representatives of national institutions; Breitenmoser et al. 2015, IUCN SSC

Species Conservation Planning Sub-Committee 2017). This committee also drafts the RCS after the workshop, organises its review and endorsement in all participating countries and at the global level (e.g. through international conventions), and finally oversees its implementation. The committee can also assist the translation of the RCS into NAPs (Breitenmoser et al. 2015, 2016), which will eventually provide concrete working plans.

4. Action Plan (national or local level): The strategic planning (see step 3 above) and the action planning are not really separated steps. However, in the case of large cats such as the lion, living in populations distributed over many countries, it is practical to distinguish between the planning at global (range-wide), regional (e.g. metapopulation) and at national (or even sub-national) level. The RCS is thus transformed into more concrete and more precise NAPs which are generally tied to a legally and administratively uniform management unit, typically a country (Fig. 4.2.3). Certain Actions will have to be defined on the global or transboundary level, but most activities need to be adapted to the national conditions and implemented at national and/or local level. The NAPs are informed by the RCS and describe the contributions of each country in solidarity with its neighbours to the overarching Goal(s) and Objectives (Breitenmoser et al. 2015, 2016).

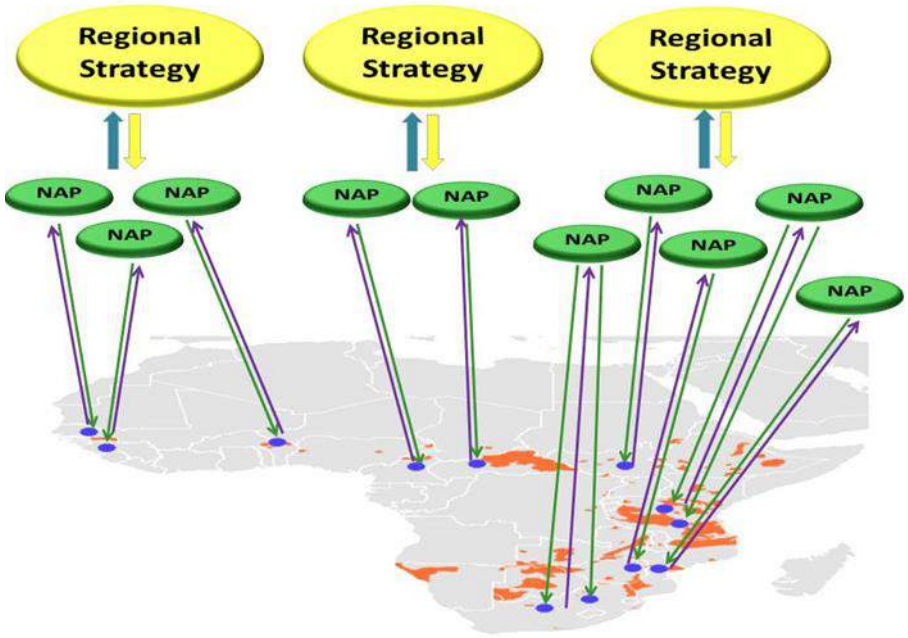

Fig. 4.2.3. Schematic model for the range-wide and regional coordinated conservation of a species through a Species Conservation Strategy, National Action Plans, and in situ conservation projects (blue dots). The plans (top–down) inform the in situ projects (yellow and green arrows), whereas the information collected during the monitoring process (bottom-up) help to evaluate and revise the NAPs and the Strategy (purple and blue arrows; Breitenmoser et al. 2016).

The process for developing a NAP is almost identical as for the RCS: Participatory, facilitated workshops including all partners and stakeholders (considering a status assessment and problem analysis, a strategic planning part, a LogFrame, etc.), but differs in three important aspects: (1) The development process must include all local interest groups, i.e. representatives from relevant GOs and NGOs, experts, and local stakeholders or people, which can for practical reasons often not be integrated at

the international level. (2) A NAP must be tailored to the national prerequisites, e.g. legislation, wildlife management and conservation systems, traditions, socio-economic and human dimension aspects. (3) The NAP must be developed and made available in the national language(s). In large countries or in countries with a federal structure, it may even be necessary to split the NAP into several provincial Action Plans. The lifespan of a NAP is typically 4-5 years. Its implementation is monitored and evaluated informing its regular revision. Just as for the RCS, the activities planned under the NAP must be realistic and implementable. The NAP needs to be endorsed by the relevant authorities and is published and advertised (Breitenmoser et al. 2015, 2016).

5. Implementation: The implementation of the actions is often regarded as the "real conservation" and the conceptual, planning, reporting and monitoring parts of a project tend to be ignored. But neglecting these tasks will reduce the efficiency and sustainability of the project, leads to a loss of time and funding, and hinder the transfer of experience (Breitenmoser et al. 2016). Also the lack of a (political) mandate, the exclusion of relevant stakeholders, a too ambitious and unrealistic plan, weak organisation or lack in funding for the implementation can lead to the failure of a RCS or NAPs (Breitenmoser et al. 2015). The interface between the planning process and the implementation of the conservation actions is the LogFrame. Depending on the scale and complexity of a project, a kind of an "adaptive project cycle" may even have to be developed at project level. The implementation of a plan is ideally overseen by a specific committee and should be translated into a concrete and detailed Work Plan (including Monitoring and Evaluation Plan; Breitenmoser et al. 2015).

6. Monitoring (and Evaluation): Implementation of conservation strategies and action plans must be iterative and adaptive processes, requiring a continuous, thorough, cost-effective and consistent monitoring and evaluation of the performance. Monitoring, evaluation and adjustment must therefore be an integral part of every RCS and NAP. The strategies and plans must be regularly reviewed, revised and updated (Breitenmoser et al. 2015, IUCN SSC Species Conservation Planning Sub-Committee 2017). Monitoring and evaluation are essential to assess the effectiveness of actions and allow a constant adjustment of conservation actions to changing situations and needs, providing a learning process. During the implementation of Actions, the parameters as defined by the Indicators are measured, analysed and reported, allowing to judge whether a given Result, the superior Objectives and finally the over-arching Goal are achieved. The careful definition of SMART Results and Indicators is crucial for an effective Monitoring. After the Monitoring and Evaluation, unless the Goal is reached, the Strategic Planning Cycle starts again and the RCS or NAP (including Work Plans) are adapted, and revised versions are published (Fig. 4.2.1). External evaluation can grant an independent review and advice. Supervision, monitoring, and intermediate or terminal evaluation of the implementation of a RCS or a NAP must be agreed at the planning workshops already. The IUCN Species Conservation Planning Subcommittee, IUCN SSC Strategic Planning Specialist Group or the species-oriented Specialist Groups can assist in the development and evaluation of species conservation plans according to the IUCN standards (Breitenmoser et al. 2015, 2016, IUCN SSC Species Conservation Planning Sub-Committee 2017).

To ensure the monitoring quality, clear, consistent, concise, and regular progress reporting and thorough communication are crucially important. Reporting should be against the LogFrame, standardised and shared with all partners. During the implementation of the conservation activities, all project partners and the local community concerned are regularly informed about the progress. After

the evaluation, the larger audience is updated, e.g. through media coverage or scientific publications (Breitenmoser et al. 2015, 2016).

A RCS or NAP are often implemented through several (local) projects addressing a series of Actions derived from a RCS or NAP following an adaptive project cycle (Breitenmoser et al. 2015). Besides monitoring of the immediate progress of each project, an over-arching monitoring at the level of the Objectives or even the Goal should therefore be organised to inform all project partners on the over-all progress. For instance, initial baseline surveys of lion and important prey species populations and a continuous monitoring of the development of these populations are important prerequisites for the total success of the RCS and the related NAPs. This will require a cooperation of all GOs and NGOs involved in the implementation of the plan and an agreement on a standardised monitoring scheme for lions (Chapter 5).

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4.3 Identification of transboundary lion populations

Hans Bauer, Roland Bürki and Samantha Page-Nicholson

Lion conservation has traditionally had a regional approach, as shown by the Regional Strategies (IUCN 2006a, b). Lions also benefit from transboundary management in areas that straddle international borders; the 'Peace Parks' Trans Frontier Conservation Areas (TFCA; Box 4.3.1). A global inventory in 2007 by UNEP-WCMC listed 227 TFCAs worldwide (Lysenko et al. 2007). Examples of established TFCAs in Africa include Niokolo Koba-Badiar, W-Arly-Pendjari (Fig. 4.3.1), Sangha Trinational, Greater Virunga Transboundary Collaboration, Serengeti-Masai, as well as Kavango-Zambezi Transfrontier Conservation Area, Great Limpopo Transfrontier Park, Lubombo Transfrontier Conservation Area, or Kgalagadi Transfrontier Park in the Southern African Development Community (SADC) area (Fig. 4.3.2; for more on SADC see also chapter 9.3).

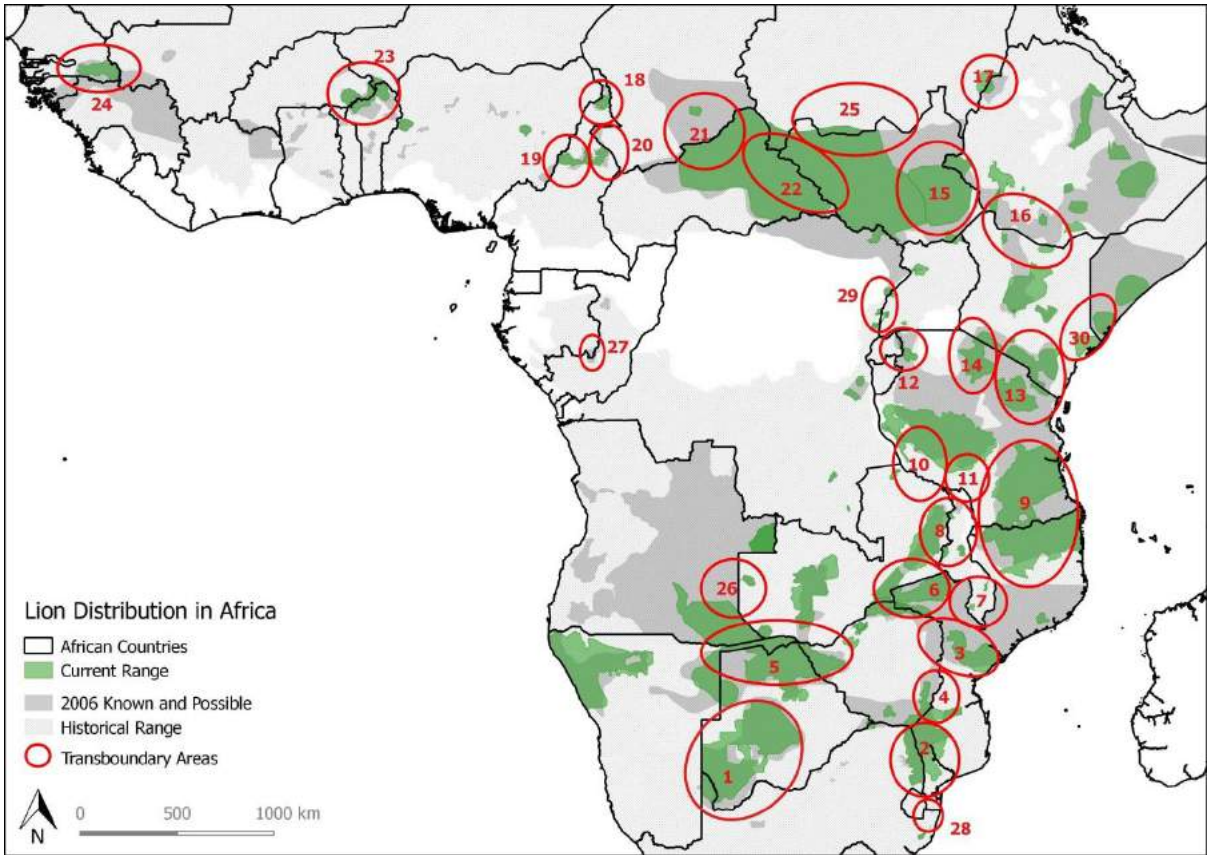

Fig. 4.3.1. Transboundary conservation areas. Numbers refer to numbers in Table 4.3.1.

In some areas lions roam widely and cyclically and predictably cross international borders (Elliot et al. 2014). Many important lion populations are transfrontier populations, and many of the ecosystems that represent lion strongholds are contiguous across multiple national borders (Cushman et al. 2018). In such cases trends in one country can impact the viability of the overall population, thus affecting conservation success in other countries (Bauer et al. 2015). It is therefore appropriate that lion conservation and management should be the subject of collaboration between countries, or even across regions, to benefit from conservation efforts that are harmonised between the relevant Range States.

Box 4.3.1 Transboundary Conservation Areas

Roland Bürki and Urs Breitenmoser

There are three different types of Transboundary Conservation Areas (TBCAs): Transboundary Protected Areas; Transboundary Conservation Landscapes and/or Seascapes; and Transboundary Migration Conservation Areas (Vasilijević et al. 2015). The word 'transboundary' is hereby interchangeable with 'transfrontier' or 'transborder' and especially in southern Africa, TBCAs are better known as Transfrontier Conservation Areas or TFCAs. All these types of TBCAs have in common that they involve some form of cooperation across one or more international boundaries.

The possible benefits of TBCAs identified include e.g.:

- A greater ecological integrity and improved long-term survival of species by contributing to the connectivity of areas (especially for migratory species);
- Generating substantial socio-cultural and economic benefits from biodiversity conservation;
- Enhanced regional integration; and
- A variety of benefits from enhanced cooperation in everyday activities and management (e.g. costs for shared heavy equipment, improved efficiency in law enforcement through joint patrolling, etc.).
- Promote and/or commemorate cooperation and peaceful relations between neighbouring countries (Braack et al. 2006, Vasilijević et al. 2015, Zunckel 2014).

The steps of a transboundary conservation process are basically the same as in the management cycle (Chapter 4.2) and the framework for assessing management effectiveness of protected areas by the IUCN's World Commission on Protected Areas (WCPA; Vasilijević et al. 2015; Table 1). Several publications dealt with the steps and stages of setting up a TBCA e.g. Braack et al. (2006), Erg et al. (2012), SADC Secretariat (2013), Vasilijević et al. (2015) and Zunckel (2014). Meanwhile, the experiences from WAP were summarised in a paper by Amahowé et al. (2013). For example, the Peace Parks Foundation supports efforts towards the establishment and management of Transboundary Conservation Areas (PPF 2018).

Table 1. Common stages of a transboundary conservation process (Vasilijević et al. 2015).

WCPA's Framework	Context and planning		Inputs and processes	Outputs and outcomes
Stages	**Diagnose**	**Design**	**Take action**	**Evaluate**
Goals	**Determine the need for transboundary conservation**	**Match the process to the situation**	**Secure resources and implement actions**	**Learn and adapt**
Step 1	Identify if there is a compelling reason to act	Determine who should lead the effort	Assess the capacity to implement plans	Assess progress and outcomes
Step 2	Determine if there is a constituency for change	Mobilise and engage the right people	Develop an action plan	Determine if there is a need to continue
Step 3	Estimate the scope of the issue	Define the geographic extent	Secure financial sustainability	Adapt the management and action plans
Step 4	Estimate the capacity to work across boundaries	Negotiate a joint vision and develop management objectives	Implement the plans	Communicate progress

Some TBCAs were created by the signing of an international treaty, others by the signing of an MoU, and some only exist as concepts so far (SADC 2018). Although generally aspired, it cannot be said that TBCAs always must be established with a high-level agreement. The form of the agreement should suit the prevailing political circumstances and the relationship between the partners (Vasilijević et al. 2015).

In some cases regional collaboration is more intensive than just the facilitation of movements, such as joint patrols and common infrastructure use between nations, e.g. in W-Arly-Pendjari (Bureau de Coordination Générale du PAPE 2014). Such 'lion landscapes', lion ecosystems or protected area complexes (Box 4.3.1) are important for species that have huge space requirements, not only lions but also e.g. cheetah, African wild dogs and elephants.

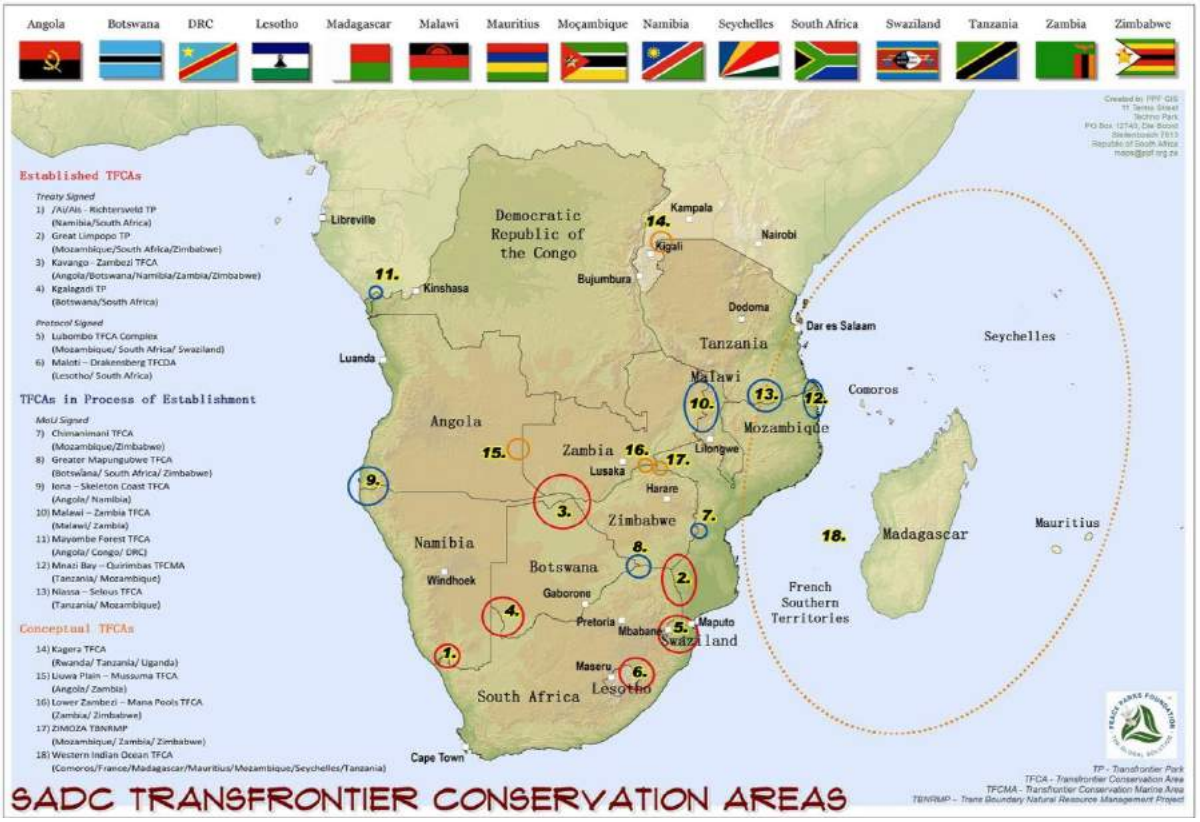

Fig. 4.3.2. Southern Africa's TFCAs supported be the Peace Park Foundation. A transfrontier conservation area. (TFCA) is defined as the area or component of a large ecological region that straddles the boundaries of two or more countries, encompassing one or more protected areas as well as multiple resource use areas. Source: SADC Secretariat (2013).

The recognition of the importance of transboundary lion management recently was one of the arguments leading to the listing of this species on Annex II of the Bonn Convention (CMS). The CMS listing proposal, submitted by Chad, Niger and Togo mentions 23 transboundary lion populations; we have listed them in Table 4.3.1 and added a column with the status as presented in Chapter 2 of the present document. Table 4.3.2 lists areas not included in the CMS proposal text, but that have some potential as transboundary populations according to inspection of the lion distribution map (Fig. 2.2, Chapter 2). As an illustration, we have circled populations, which are obviously or potentially shared by two or several countries in Fig.4.3.1 and labelled the circles according to the numbers in the first column of Table 4.3.1 and 4.3.2.

Considering the importance of transboundary lion management, a logical step forward is the design, adoption and implementation of transboundary lion conservation strategies (Regional Strategies) e.g. under the auspice of CMS (Chapter 4.1) or action plans (e.g. National Action Plans, Chapters 3, 4.2). These should be integrated into the framework of action planning for transboundary PA management. To our knowledge, a species-focused transboundary action plan currently only exists in the

Table 4.3.1. Transboundary lion habitat listed in the recently adopted proposal for listing of the lion on Annex II of the CMS. For geographic location of areas see Fig. 4.3.1.

#	Countries	Area	Status
1	BWA/RSA	Kgalagadi Transfrontier Park	Part of existing TFCA
2	MOZ/RSA	Kruger NP, Limpopo NP	Part of existing TFCA
3	MOZ/ZWE	Gairezi WMA, Nyangui State Forest, Manica Province	Status uncertain
4	MOZ/ZWE	Gonarezhou NP, Gaza Province	Part of existing TFCA
5	AGO/NAM/BWA	South Angola, Caprivi, Okavango	Part of existing TFCA
6	MOZ/ZMB	Along Zambia border with Tete Province	Potential for TFCA, should possibly incl. ZWE and further areas
7	MWI/MOZ	Liwonde NP, Namizimu FR, Mangochi FR, Niassa Province	Status uncertain
8	MWI/ZMB	???	Status uncertain, if present possibly part of 6 above
9	MOZ/TZA	Niassa NNR, southern Tanzania	Potential for TFCA
10	TZA/ZMB	???	Status uncertain
11	MWI/TZA	???	Status uncertain
12	RWA/TZA	Akagera NP, Kimisi GR	Status uncertain
13	KEN/TZA	Tsavo NP, Mkomazi NP	Inofficial Forum but no formal bilateral management structure
14	KEN/TZA	Serengeti-Mara	Inofficial Forum but no formal bilateral management structure
15	ETH/SSD	Gambella NP, Boma NP	Potential for TFCA
16	ETH/KEN	Northern East KEN – South East ETH	Status uncertain (High potential for transboundary management)
17	ETH/SDN	Alatash NP, Dinder NP	Bilateral convention exists, but limited impact on the ground
18	CMR/NGA	Waza NP	Status uncertain
19	CMR/NGA	Faro NP, Gashaka-Gumti NP	Potential for TFCA (occasional disperser)
20	CMR/TCD	Yamoussa Transfrontier Reserve, incl. Bouba Ndjida NP, Sena Oura NP	Formal bilateral management structure being initiated
21	TCD/CAF	Salamat Hunting Areas, Bamingui-Bangoran NP, ManovoGounda-Saint Floris NP	Status uncertain
22	CAF/SSD*	Easter CAF hunting areas, SSD NP	Status uncertain
23	BEN/BFA/NER	WAP	Part of RBT (Réserve Biosphère Transfrontalière), long history of regional integration

*In addition to the information in the CMS source document, we observe that this area possibly extends into Sudan where it includes Radom NP and surrounding areas.

W-Arly-Pendjari Transboundary Biosphere Reserve (WAP; Bureau de Coordination Générale du PAPE 2014; Fig. 4.3.3). One transboundary area of particular relevance is the Kavango Zambezi Transfrontier Conservation Area (KAZA), a major stronghold for the lion; this is the area where most studies on connectivity have been performed (e.g. Cushman et al. 2018). Each transboundary area will have its own implementation process; in the case of KAZA harmonisation of lion conservation is facilitated through the KAZA Carnivore Conservation Coalition.

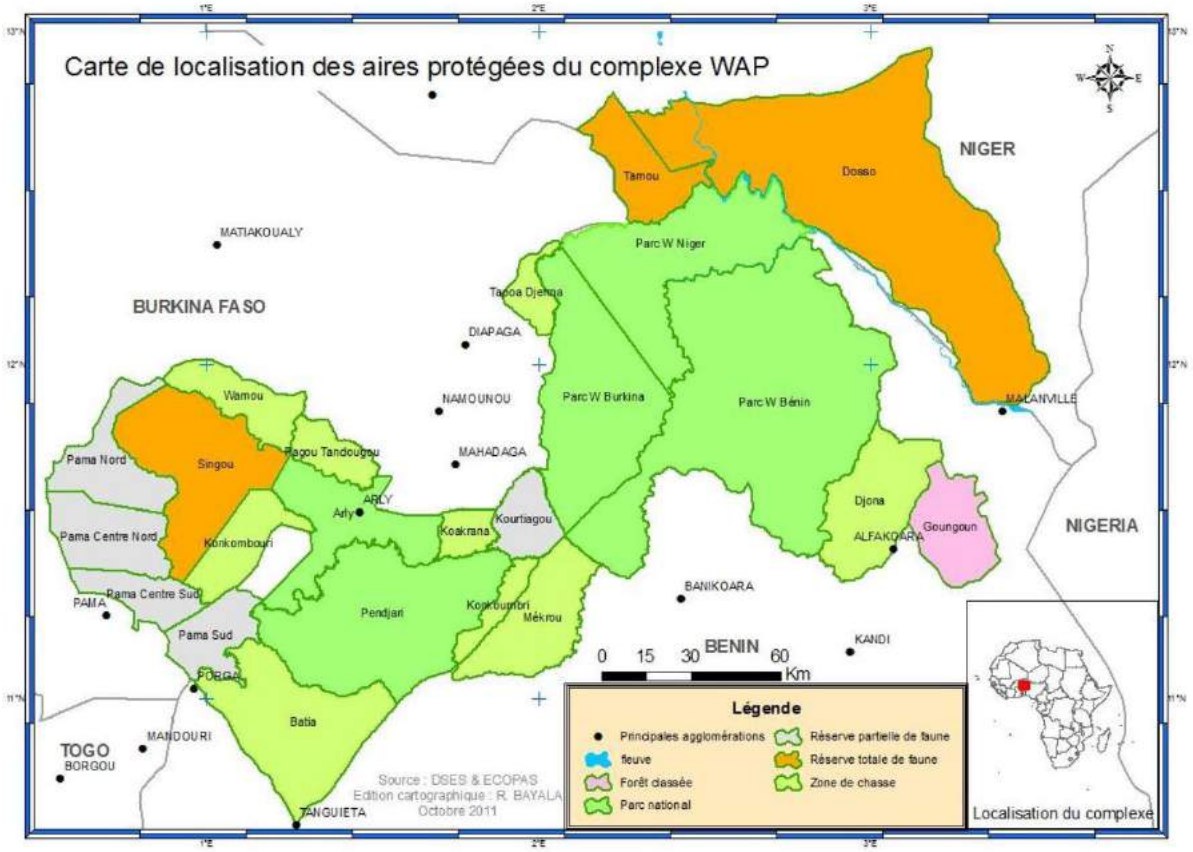

Fig 4.3.3. Map of the W-Arly-Pendjari (WAP) complex shared by Benin, Burkina Faso and Niger (PAPE 2011).

Table 4.3.2. Additional transboundary areas not listed in CMS lion listing proposal. For geographic location of areas see Fig. 4.3.1.

#	Countries	Area	Status
24	SEN/GNB/GIN	Niokolo-Koba	Status uncertain
25	SDN/SSD	Jebel mountains, Radom	Status uncertain
26	ZMB/AGO	Liuwa Plains, eastern Angola	Status uncertain
27	GAB/COG	Batéke	Status uncertain
28	ZAF/MOZ(/SWZ)	Tembe-Maputo	Part of existing TFCA
29	COD/UGA	Virunga – QEP	Greater Virunga Transboundary Collaboration
30	KEN/SOM	Bush bush – Boni Dodori	Status uncertain

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5 Lion survey and monitoring methods

Paul Funston and Philipp Henschel

Population size and trends of large carnivores are difficult to determine but are needed to inform conservation actions. Depending on the context at each site, counting or surveying African lions (*Panthera leo*) can vary from them being relatively easily monitored right down to the level of individual recognition (e.g. Packer et al. 2005), through to relatively course estimates of indices of relative abundance (e.g. Crosmary et al. 2018) or probability of occupancy (e.g. Midlane et al. 2014). Unlike other cats that are recognisable from their coat patterns and are thus universally best surveyed using camera trap surveys to derive spatially explicit mark recapture models (e.g. O'Brien & Kinnaird 2011, Gopalaswamy et al. 2012), for lions there is not yet one standardised method used to estimate density or abundance. Researchers and managers have so far tended to favour approaches based on (1) individual recognition via facial features (Pennycuick & Rudnai 1970), (2) call-up or capture surveys (Smuts et al. 1977, Ferreira & Funston 2010), and (3) spoor surveys (Funston & Ferreira 2010) to estimate abundance, and occupancy modelling to estimate probability of occurrence (Midlane et al. 2014).

This complicates deriving national, regional or global estimates for lions. However, as compared with other African large felids (e.g. leopards) lions have been repeat surveyed at more sites across their African range (about 47 sites) than any other large cat, which has allowed a degree of trend analysis, accounting for large differences in survey methodology (Bauer et al. 2015a). What these surveys have shown, however, was a striking geographical pattern: African lion populations are declining everywhere, except in four southern countries (Botswana, Namibia, South Africa, and Zimbabwe). Population models indicate a 67% chance that lions in West and Central Africa decline by one-half, while estimating a 37% chance that lions in East Africa also decline by one-half over two decades. The net estimate for wild lions in Africa now stands at about 20,000 individuals, which might have been closer to 30,000 individuals a decade or two earlier (Bauer & van der Merwe 2004, Bauer et al. 2015b).

Fig. 5.1. Lion spoor in Mana Pools National Park, Zimbabwe. Spoor or track surveys offer a reliable method for estimating lion abundance in many habitats where direct observation is difficult. Photo P. Meier.

As alluded to above, estimating animal numbers is often practically, and technically, difficult with lions at some sites being both relatively numerous and conspicuous, but at others being scarce and shy. Given that there is no "one size fits all" approach to surveying lion populations, most practitioners are advised to assess the local context and situation and then choose the most appropriate survey design and monitoring method that meets their specific needs. Approaches' such as individual recognition may yield very accurate tallies of all known individuals but suffer from having no estimate of precision. They may also only be feasible in relatively high-density populations occupying open habitats, where lions can be consistently approached by vehicle. Conversely spoor (Fig. 5.1) or call-up surveys of populations occurring at low density can also suffer from large variance in the derived estimates, making detecting trend particularly challenging.

Furthermore, cost can constrain the frequency with which the various approaches can be repeated, extending the time between surveys. This is problematic insofar as it is often more important to know the changes in numbers than their absolute value. Detecting change carries trade-offs between the precision of estimates, intervals between surveys and the risk of uncertainty during the time it takes to detect a change (Gerrodette 1987). The few studies that have overcome these constraints relied on intensive observations over long periods (e.g. Kissui & Packer 2004, Packer et al. 2005).

Thus, in areas where it is possible total counts of known individuals can be achieved and are a very effective tool for monitoring vital rates in lion populations. However, perhaps in the majority of instances practitioners are best advised to use indices of the population size. Indices offer advantages in that they are generally cost effective and can be easily repeated and can provide reliable estimates of the population size together with a measure of precision. One such approach, track counts, relies on the relationship between frequencies with which tracks (spoor) are detected and an estimate of the actual density (Stander et al. 1998, Funston & Ferreira 2010). We found consistent relationships between track densities and the actual carnivore densities, having taken account of the substrate (Funston & Ferreira 2010). The other commonly used approach is call-up stations, which works well for apex carnivores such as lions and spotted hyaenas (*Crocuta crocuta*) (e.g. Smuts *et al*. 1977, Ogutu & Dublin 1998, Ferreira & Funston 2010), although they are constrained by response rates not having been measured in most areas. However, once calibrated call-up stations defined by the appropriate survey effort can achieve estimates with known precision, from which age structures can be extracted to estimate survival rates (Ferreira & Funston 2010). Both survey methods produce accurate results, although precision tends to be higher for call-up surveys, despite lower costs (Midlane et al. 2015). A considerable advantage of track counts, however, is that it also produces vital data on presence/absence, distribution and abundance of other threatened carnivore species, such as cheetah (*Acinonyx jubatus*), African wild dog (*Lycaon pictus*) and leopard (*Panthera pardus*) (cf. Funston et al. 2010).

Spoor survey design

When conducting a spoor survey, we generally encourage that the area to be covered is divided into 225 km² blocks (15x15 km), which is similar to an average lion pride home range in medium-density populations. Such blocks should be sampled within one day, only counting fresh lion spoor, to avoid double-counting the same individuals repeatedly. Within the survey area, spoor transect locations are chosen based on the following criteria: (1) assure an even distribution of transects across the entire survey area, leaving no large gaps (each 225 km² block should be sampled if possible), (2) tar-

get dirt roads with a road surface adequate for the detection of spoor (no coarse laterite or compacted clay), (3) assure an even representation of major habitat types within each survey area, and (4) assure an even distribution of transects across wetter and more arid strata. We recommend a minimum transect length per sampling block of 15 km. Fig. 5.2 shows an example for a track transect design. Field teams should start transects at first light to ensure that any tracks left by large carnivores during the course of the night would still be visible, and that no other vehicle could have passed along the dirt track prior to the survey team. Transects are typically vehicle-based, with two experienced observers or trackers seated on the front of each vehicle. The vehicle should be driven at a maximum speed of 10-15 km/h to ensure that the observers can easily detect large carnivore tracks. Each transect team needs to be equipped with a GPS, or ideally a data-collection device incorporating a GPS. At the onset of each transect the starting point needs to be GPS logged and "track log" function of the GPS unit must be activated to trace the exact course of each transect. At 500 m intervals along transects, the team leader must note the quality and type of the road surface. Collection of this information is vital, as the probability of detecting tracks ultimately depends on the quality and type of the road surface.

Whenever the observers detect large carnivore spoor the vehicle should be stopped so that the observers can closely inspect the spoor to identify the large carnivore species. Only fresh tracks (<24 hours old) are to be recorded, following Stander et al. (1998). For carnivore tracks a photo can be taken with a photometric scale placed next to the track, to permit a quality control of species identifications and of track age assessments. At each track the team leader records the GPS location, the distance from the transect start point, time, large carnivore species, the number of individuals present and direction of travel. To minimize the risk of double-counting large carnivore individuals, teams should only count one spoor set if observers found two similar spoors within 500 m of one another and cannot identify these individually (Funston et al. 2010). Correctly aging tracks, as well as noting track size and the direction of travel can often help to reconstruct how many individuals used a particular section of road. Experienced local trackers should be used where possible. At the end of each transect, the team leader records the final GPS position to mark the end of the transect and deactivates the GPS "track log".

To avoid any possible loss of data and to reduce the risk of data transcription errors, the transect data should be entered into a laptop database by the field team directly after the completion of each transect. This can be greatly facilitated by collecting the data on a data-collection device. Simple spoor data-collection interfaces can be composed for Android or Windows Mobile devices using the CyberTracker (https://www.cybertracker.org/) or SMART (http://smartconservationtools.org/) software packages. Besides observations of large carnivore spoor, the teams also typically record any direct observations of large carnivores, obtained either during transects or opportunistically when travelling between transects, and spoor of all important ungulate species (locally important prey species) as well as of humans and livestock. The collection of data on potential threats, such as the presence of humans and livestock, can permit an advanced analysis of lion distribution in an occupancy modeling framework (see MacKenzie et al. 2006), which permits an empirical quantification of factors which may currently limit lion distribution (e.g. Everatt et al. 2014, Henschel et al. 2016).

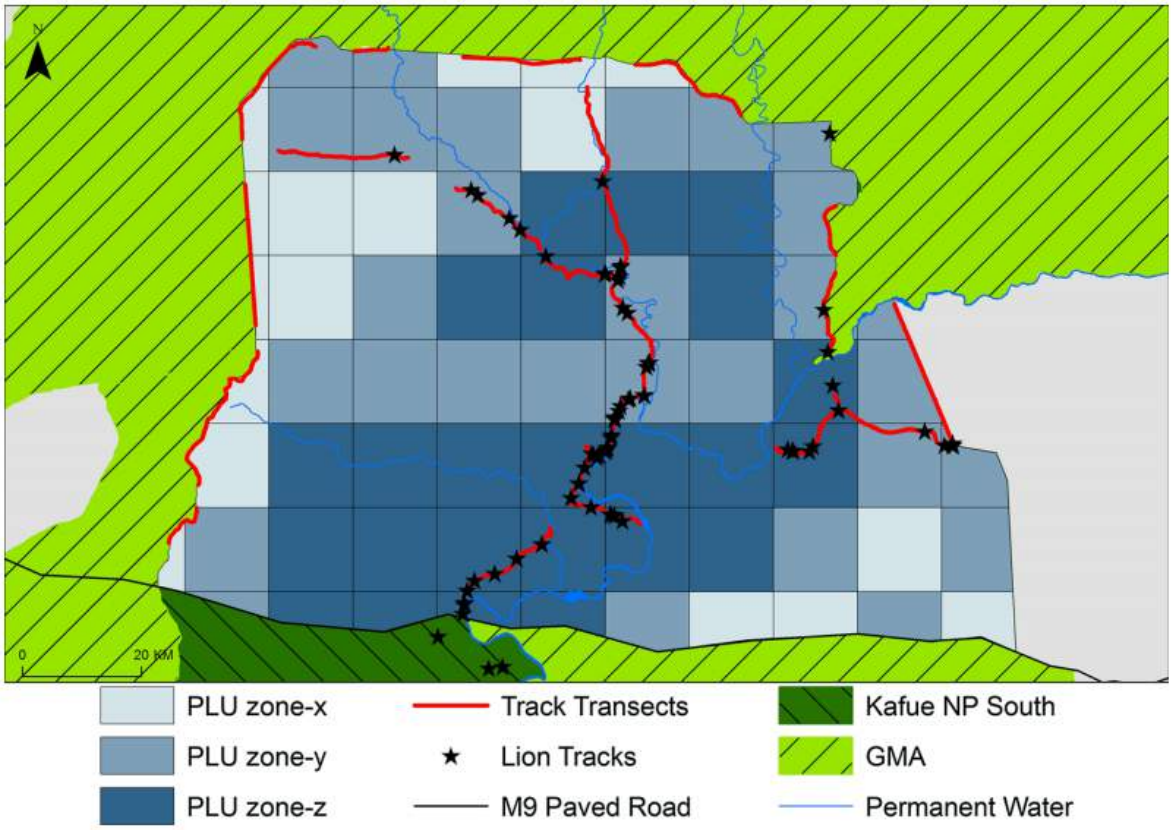

Fig. 5.2. Example of a track count survey design from a comparative study on methods for estimating lion abundance in Kafu NP, Zambia, by Midlane et al. (2015).

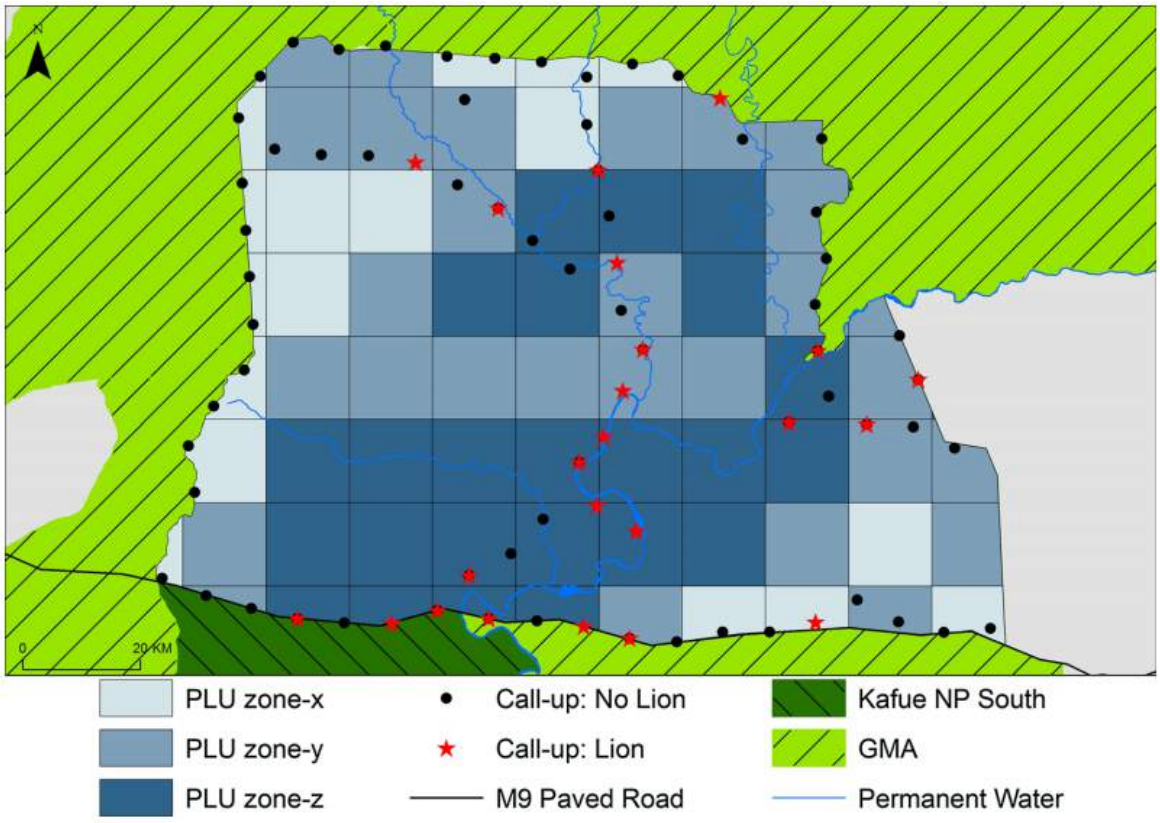

Fig. 5.3. Example of a call-up survey design from a comparative study on methods for estimating lion abundance in Kafu NP, Zambia, by Midlane et al. (2015).

Data analysis

During analysis for each transect the number of track observations for each species is calculated and transformed into "track densities", i.e. the number of tracks per 100 km of transect. This large carnivore track density is strongly and positively correlated with large carnivore population density in any given area (Stander 1998). Based on this observed correlation between track density and "true" large carnivore density, track densities can be transformed into population densities using the following equation developed by Funston et al. (2010) and refined by Winterbach et al. (2016) for low density areas:

$x_i = t_i/3.26$, where x_i is population density and t_i is track density for each species.

Track densities should be compared across transects, to assess if there are statistically significant differences in track densities between large carnivore densities in different areas and densities then calculated separately for those.

Call-up survey design

Although seldom used these days, call-up surveys using wild prey killed as bait at which lions are lured using both scent and sound (see Smuts et al. 1977) can be a very effective way to count lions in relatively localized areas. Increasingly, however, practitioners wish to cover much larger areas more quickly and for various reasons using wild prey as bait is seldom possible. This led to the development of call-up techniques for spotted hyaenas and lions (Ogutu & Dublin 1998), and subsequent efforts to refine these and get maximum value out of the data that is collected (Ferreira & Funston 2010, Ogutu et al. 2016).

Ideally any call-up survey should be preceded by a calibration exercise although this is rarely if ever done. To calibrate, one would opportunistically locate a sample of lion groups (ideally > 20) by driving and searching for lions. For each of these groups, an observer stays with the lions while a second team sets up a calling station at a predetermined distance away. To do so Ferreira & Funston (2010) played a 4.25-min recording of a buffalo calf in distress repeatedly for 1 h on a LG MF-FM12 MP3 player (LG Electronics Inc., Seoul, Korea). Other sound recordings, or intervals, could be used (see Ogutu & Dublin 1998). Once a series of responses at different distance have been noted, a probability of response can be calculated per distance, allowing one to adjust population size estimations for non-response.

Once the local calibration has been conducted, playbacks are projected across the study area through to a 12-volt 60-watt amplifier powered by the vehicle's battery. The amplifier is connected to two 40-M 4-ohm horn speakers (diameter 40cm), with 40-watt driver units connected in series and facing opposite each other. The vocalizations are then broadcast at full volume from the speakers that are rotated every 15 min to get an all-round sound distribution. To minimize the chance of double-counting individuals, stations are typically set about 10 km apart (Fig. 5.3) with three or four stations sampled per night playing a recording of a buffalo calf in distress for 1 h. Call-ups should commence about half an hour after dark in the evening from 1800 hours to 0100 hours, which is when lions are most active (Hayward & Hayward 2007). During the actual survey one records each group of lions that arrives during the hour and assigns sex and estimated age to each lion.

Data analysis

Two primary constraints affect the use of call-up stations to count lions, namely the probability that lions appear at a station and the chance of sampling the same lion more than once (Ogutu and Dublin 1998; Mills *et al*. 2001). The probability that lions may appear depends on whether a group reacts and whether all individuals in a responding group react in the same way. Lion groups containing cubs are likely to be more cautious when approaching call-up stations than are other types of groups (Ogutu and Dublin 1998; Mills *et al*. 2001). We recommend separating groups into those with and those without cubs and calculating estimates for each (see Ferreira & Funston 2010 for more details).

Conclusions

In a comparative study, accuracy of results from both spoor and call-up methods were found to be comparable, but call-up surveys were more precise and more efficient to complete (Midlane et al. 2014). We therefore recommend call-up surveys as the preferred method for surveying lions in areas where they occur in moderate to high densities and readily approach vehicles, and favor spoor surveys in low density areas and at sites where lions are known to be wary of people. Beukes et al. (2017) found that even in a relatively low-density population such as the Kgalagadi Transfrontier Park, South Africa/Botswana, that registering the population through individual identification and using open-population mark-recapture provided the most precise estimate of population size and a benchmark against which other techniques could be measured. Track indices provided a similar best estimate but were less imprecise. Thus, the technique of choice to monitor lion populations over time remains individual recognition of known individuals with both track and call-up indices being very useful techniques to conclude rapid surveys over very large spatial scales.

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6 Conservation solutions

6.1 Promoting coexistence and mitigating conflicts

Amy Dickman, Colleen Begg, Shivani Bhalla, Alayne Cotterill, Leela Hazzah and Stephanie Dolrenry

The significance of human-lion conflict

Although protected areas are critically important for African lions (*Panthera leo*),some populations have crucial range on community land (Riggio et al. 2013; Chapter 2). This means that they rely heavily upon human-dominated lands, particularly around protected areas. This co-occurrence of lions, as large obligate carnivores, with humans often leads to conflict, particularly where livestock are also present (Barua et al. 2013, Bauer et al. 2015, Dickman et al. 2014). Lions may also attack people (Packer et al. 2005). This conflict can have very damaging impacts on both humans and lions. People, especially in rural Africa, often depend heavily upon livestock as a key economic asset, which has huge value in poor, food-insecure areas, so livestock loss can be devastating at a household level (Barua et al. 2013). Around Tsavo in Kenya, lions were responsible for over 85% of depredation events, with each lion costing ranchers around USD 290 per year in attacks (Patterson et al. 2004). Similarly, in 1998 it was estimated that a small population of around 50 lions in Cameroon's Waza National Park caused more conflict than other carnivores, killing around 700 cattle and over 1,000 small stock a year, with an economic cost of around USD 130,000 (Bauer & de Iongh 2005). The impacts can extend beyond the monetary value of depredated stock: cattle in particular often have immense social and cultural value in traditionally pastoralist communities, and their loss therefore incurs high cultural costs in addition to economic ones (Dickman et al. 2014). Even more severely, lions can pose a real threat to humans themselves: in Tanzania, it was estimated that over 800 people were killed or injured by lions between 1990 and 2004 (Packer et al. 2005). Unsurprisingly, these attacks are devastating for the communities concerned, and have very long-term economic, emotional, and social impacts (Barua et al. 2013).

In addition to the obvious, visible costs of depredation and human attack, there are many, often significant, 'hidden' costs of conflict (Barua et al. 2013). People have to invest time and energy in protecting livestock against lions, and these opportunity costs can be high: for example, many rural children miss school, with long-term implications, as they are required to guard livestock (Barua et al. 2013). Living alongside high-conflict-causing species can damage peoples' wellbeing, with documented impacts on both physical and mental health (Barua et al. 2013). They can also lead to a decrease in tolerance for other conservation efforts (Hazzah et al. 2009). These underlying impacts are likely to be particularly severe if lions are associated with witchcraft and mythology (Israel 2009, West 2001), and if people feel that lion presence is being imposed upon them while any benefits accrue to other groups, such as the Government or tourism companies.

Although some of these costs of coexistence may be reduced to some extent depending on local mechanisms (see Chapter 6.9), in reality, costs and benefits of lion presence are usually inequitably distributed, so the people suffering the majority of the costs rarely have them sufficiently offset through any benefits. Therefore, unsurprisingly, people often tend to kill lions, either to prevent conflict or in retaliation for it. Levels of lion killing can be extremely high: in Tanzania's Ruaha landscape at least 37 lions were killed through conflict in 18 months, in an area of less than 500 km^2 (A. Dickman, pers. obs.), and in southern Kenya's Amboseli ecosystem nearly 200 lions were killed by humans due to conflict over a seven year period (Hazzah et al. 2014). Conflict poses a major threat to

lions not only in individual populations, but at a regional scale: conflict has been ranked by the IUCN as the greatest threat to lions in East and Southern Africa (where the vast majority of lions remain; Chapter 2), and fourth out of nine key threats in West and Central Africa (IUCN 2006a, b). More recently, a report stated that outside protected areas, pre-emptive and retaliatory killing is the primary threat to lions (Panthera et al. 2016).

It is therefore vital to reduce conflict and move towards easier coexistence, especially given how important human-dominated lands are for maintaining lion populations and their connectivity at a range wide scale. Some insights into how this can best be achieved are given below.

Moving from conflict towards coexistence

Human-lion conflict is usually a multi-faceted issue, as highlighted above. Therefore, several steps need to be taken in order to start mitigating conflict and moving towards coexistence. Underlying any effective conflict mitigation strategy is truly understanding the drivers of conflict, which may be markedly different in different sites. In one area - for example amongst commercial farmers in Laikipia - conflict may primarily be driven by depredation (an example of an obvious, 'dispute' level of conflict) while in another - for example amongst rural communities in Kenya, Tanzania and Mozambique - conflict may be strongly influenced by cultural beliefs (Dickman et al. 2014, Hazzah et al. 2009, Israel 2009, West 2001). Truly understanding the drivers of conflict – including the deeper, underlying issues such as the influence of religion, mythology, power and social and cultural norms as well as the more obvious, dispute-level factors – is likely to take a long time and require a high degree of trust with the communities concerned. It is important, though, that those deeper aspects should be investigated and considered wherever possible, as otherwise focusing only on reducing the 'actual' or dispute-level conflict (e.g. livestock depredation) is very unlikely to mitigate conflict in a meaningful, long-term way (Dickman et al. 2014) and may result in increasing conflicts within the community. Once the dynamics of conflict have been assessed, numerous steps can be taken to reduce it and move towards easier human-lion coexistence (Figure 6.1.1), and these are discussed more below.

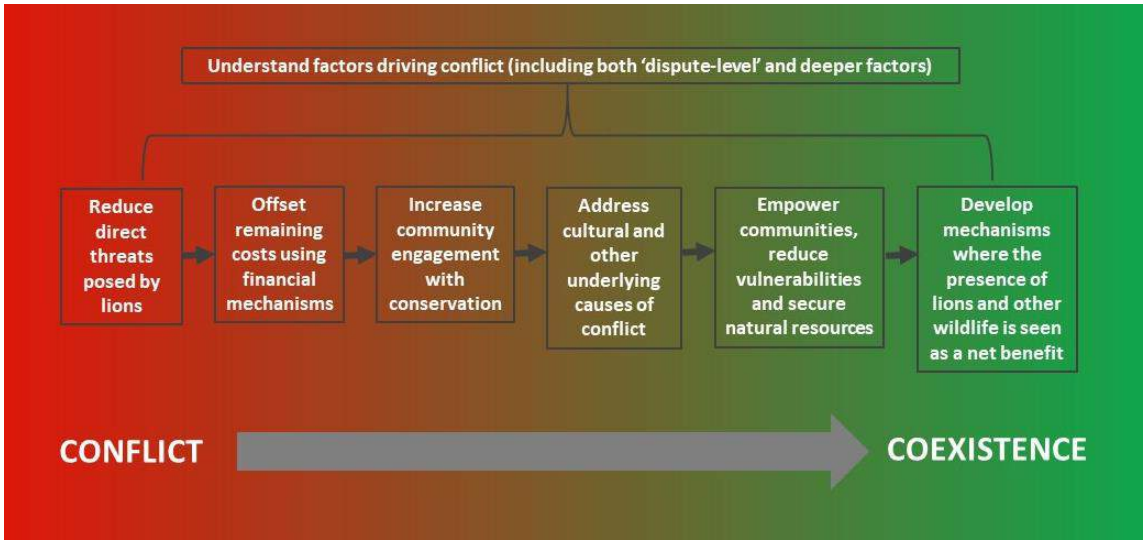

Figure 6.1.1. A schematic showing some of the key steps that should be considered to help move from a situation of human-lion conflict towards coexistence. Each scenario will be different; this is why understanding the driving factors is key to identifying which of the steps shown, or which others, would be most useful for mitigating conflict.

(i) Reduce direct threats posed by lions

This is usually the first step in many conflict mitigation projects, as people are obviously antagonistic towards lion attacks on livestock and/or humans. While the 'actual' (usually economic) costs of such attacks are often dwarfed by other issues, such as livestock loss to disease, it is extremely important to address this issue. Multiple technical approaches have been developed to protect livestock: at night, livestock can be effectively protected from carnivores by securing them within wire, canvas, or other reinforced enclosures (Fig. 6.1.2) such as 'living walls' (Lichtenfeld et al. 2015) and also see the human-lion conflict toolkit (Begg & Kushnir 2010). This needs to be combined with engagement with livestock owners, ideally to create a sense of ownership of the reinforcement, and also to stress the importance of attentive herding and enclosing all stock at night, as many attacks happen on lost livestock returning late and being left out at night. Reinforced, static enclosures may be less appropriate for more nomadic livestock-keepers, but in those situations mobile canvas or shade-cloth enclosures can be very effective (Loveridge et al. 2017). There are also multiple technical approaches which can help protect stock, such as flashing solar lights on or around enclosures (Lesilau et al. 2018, Begg & Kushnir 2010), or 'Lion Shield' deterrents, where collared lions activate alerts when they approach a 'base station', usually close to an enclosure, which means they can be chased away. Real-time GPS data from lion collars can also be used in conjunction with rangers/guardians on the ground to proactively chase lions away when they move close to livestock enclosures.

Fig. 6.1.2. Enclosures (bomas) improved with mash wire and natural logs. Photos Ruaha Carnivore Project (left) and Pat Erickson (right).

Reducing daytime lion attacks is more challenging, although again there is a proven role for encouraging attentive herding by adult guardians (Bauer et al. 2010, Tumenta et al. 2013). Local dogs are widely kept to help protect stock, but are often ineffective at preventing lion attacks (Tumenta et al. 2013). There has been a small trial of large, specialised livestock guarding dogs in Tanzania, which (although it had some problems, such as issues with villagers maintaining very large dogs) showed that the dogs were capable of chasing lions away from livestock (A. Dickman, pers. obs.). Again the close monitoring of lion movements using real-time GPS data from collars can again be used to keep livestock away from where lions are known to be resting during the daytime. Lower-tech approaches involve people walking in groups and using noise repellents to chase lions away from inhabited areas towards conservation areas (Bauer et al. 2010): it is hard to quantitatively assess the success of such impacts but they seem to have some immediate, local benefit at least. Novel approaches are continually being tested, including the 'iCow' approach, where eyes are painted on the rumps of cattle, which apparently has been linked to lower depredation during a small trial in Botswana. Meanwhile, lion attacks on humans can be reduced in many instances by reducing risky behaviour, such as stay-

ing out in crop fields or in poor shelters at night, walking alone at night without a torch, or being drunk and walking through the bush (Begg & Kushnir 2010). Sometimes, however, particularly for human attacks but also for livestock attacks, there may be evidence of a problem lion or group of lions, in which case rapid, well-targeted response may be the most effective solution for preventing ongoing conflict (Chapter 6.7). Ultimately, it is clear that in most cases, the direct costs of lion presence can be substantially reduced through the deployment of appropriate methods, with important benefits both for people and lions. However, it is very rare that reducing costs alone is enough to move from a conflict situation towards coexistence, so the following steps should also be implemented wherever possible.

(ii) Offset remaining costs using financial mechanisms

Even with relatively effective protection mechanisms, such as those outlined above, it is very unlikely that lion attacks will be completely eliminated. It is therefore valuable to also consider implementing some form of financial mechanism to offset (and hopefully outweigh) any remaining costs of depredation or lion presence, and these are discussed more in Chapter 6.9.

(iii) Increase community engagement with conservation

Engaging communities fully and effectively in conservation is fundamentally important for long-term coexistence, but all too often, conflict mitigation projects stop at the stage of reducing attacks, and/or the costs associated with them. In reality, however, conflict is about far more than lion attacks, and reducing the chances of an attack, or the financial costs associated with them, is very unlikely to be enough to encourage people to want lions around. Furthermore, many people do not understand why others (often outsiders) value lions, and do not know about the global decline of the species and the importance of human-dominated land for its conservation. Working with different stakeholders to have open discussions around these issues, and improve knowledge and engagement, is a key step forwards in conflict mitigation. This can take a wide variety of forms, with just a few examples being community meetings, educational film nights (Fig. 6.1.3), work with schools and community groups, locally relevant educational materials, Kids Camps working with young herding children, meetings with local governments and authorities, and educational visits to wildlife areas. They do not have to be formal – some of the best engagement is through fun activities based around conservation, such as Lion Fun Days, games, sports events such as the Maasai Olympics and Lion Guardian Games, and theatre and dance events. It is usually important to try to engage as many different parts of the community as possible, such as the young men (e.g. through the Lion Guardians programme (Dolrenry et al. 2016), in Kenya and elsewhere), children (e.g. through the Mariri Environmental Centre in Niassa), and women (e.g. through the Mama Simba programme in Samburu). These activities help build trust and connections between communities, conservationists and other stakeholders, and often leads to a better understanding of the deeper factors affecting conflict and views towards lions, which in turn informs the further steps below.

(iv) Address cultural and other underlying causes of conflict

People base their perceptions and attitudes not only on personal experiences (such as depredation), but also upon many other factors, such as the cultural and social norms, expectations and beliefs of the society they live in (Dickman 2010). For example, in some traditional pastoralist societies, killing lions remains an important ritual and is part of the perception of what a warrior ‘should’ be doing for the society (Hazzah et al. 2017). Lions may be associated with rival groups and witchcraft – in

Mozambique and Tanzania, there are beliefs that 'spirit-lions' can be summoned to kill people, and fears of such lions tended to increase during periods of higher social conflict (Dickman 2009, Israel 2009, West 2001). Religious beliefs can affect attitudes towards wildlife: in Kenya and Tanzania, adherence to formal religions, especially evangelical Christianity, was linked to more negative views towards lions and other carnivores (Dickman et al. 2014, Hazzah et al. 2009). These are just a few examples to highlight the complexity of factors likely to influence perceptions of human-lion conflict.

People often assume that deeply embedded cultural drivers of conflict are very hard to change, but that is not necessarily true. The key is to be aware of as much of the complexity as possible, and to engage communities in conservation in a way that respects their cultural and social norms. While, as mentioned above, pastoralist warriors traditionally value killing lions as part of their identity (Dickman 2009, Hazzah et al. 2017), culturally-appropriate methods have been developed to ensure that young men can still retain the cultural and social benefits associated with warriorhood and community protection through conservation rather than lion killing. This 'Lion Guardians' approach (Box6.1.1) was developed in Kenya (and has now been expanded to Tanzania, Zimbabwe and other sites) and has achieved impressive lion conservation success (Hazzah et al. 2014). Examining and addressing underlying issues can seem daunting, but understanding them can help inform practical conflict mitigation approaches: for example, knowing the link between a particular religion and conflict may help target which households are first engaged in mitigation, and/or may mean that the church is approached to see if improved conservation messaging could be delivered from within it.

Fig. 6.1.3. DVD night in a local village organised by the Ruaha Carnivore Project. Such film nights are not only fun, they have also an educational value and allow engaging with the local people. Photo Ruaha Carnivore Project.

(v) Empower communities, reduce vulnerabilities and secure natural resources

At its heart, conflict is often driven by people feeling disempowered and vulnerable regarding wildlife. People tend to be particularly antagonistic towards the presence of wildlife they feel are being imposed upon them, and when it is perceived that wildlife is being valued over local human needs (Dickman 2010). For example, community anger over a perceived lack of action to reduce depredation around Nairobi National Park, and the inferred prioritisation of lions over Maasai, led to the killing of six lions. People are also particularly prone to conflict if they have few strategies to prevent attacks, are heavily dependent upon one income source (such as livestock) and are economically or socially vulnerable (Dickman 2010).

Therefore, utilising peacebuilding techniques, empowering communities and reducing vulnerabilities is a key component of moving towards coexistence (Madden & McQuinn 2014). The most appropriate strategies will depend upon the context, but could include skills and literacy training, education and employment, diversification of income sources, benefit-sharing from conservation and other community development approaches. Reducing food insecurity and economic vulnerability through conservation can reduce reliance upon bushmeat hunting (a major indirect threat to lions; Chapter 6.3), and may reduce the chances of people killing lions for monetary gain (e.g. from the sale of body parts). A key part of empowering communities may include helping them secure land use rights, as conflicts over land can help exacerbate human-wildlife conflict. Land use planning, appropriate zoning and encouraging the protection of habitat and prey as well as lions themselves are all likely to be valuable components of a longer-term conflict mitigation and livelihood security approach.

(vi) Develop mechanisms where lions and other wildlife are seen as a net benefit

Ultimately, for sustained coexistence, people need to move towards a situation where they see the presence of lions and other wildlife as a meaningful, sustainable and relevant benefit. Furthermore, those benefits should be identified and led by the communities, with the distribution sufficiently equitable so that those who risk most costs from wildlife presence also receive most benefits. Through this approach, lion presence should be perceived not as a threat to human development, but instead as a valuable resource which can be used to drive community development in an equitable way and ultimately reduce poverty. Again, the most appropriate mechanisms will depend upon the individual situation, but examples could include equitable benefit sharing from conservation activities such as tourism, the development of conservation products, social impact bonds and conservation performance-payment (for more details see Chapter 6.9). Whichever mechanism is used, it is vital that the benefit is associated directly with the presence of wildlife on the land, not merely the presence of the implementing organisation. Although the scale of this issue is challenging, many cases across Africa have shown that it is possible to move from a high-conflict situation to one where people see benefits from lions, the level of killing is significantly reduced, and where lion populations rebound even on human-dominated land (Hazzah et al. 2014). The aim now is to learn from those cases and invest sufficient resources so that they can be scaled up, producing invaluable benefits for both human livelihoods and lions at a continental scale.

Box 6.1.1 Lion Guardians as a conflict case study (www.lionguardians.org)

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In January 2007, in response to the high level of lion killing in southern Kenya's Amboseli ecosystem, a conservation program called Lion Guardians was initiated, in which traditional warriors (henceforth guardians) were employed. Prior to being appointed as guardians, many of these warriors were renowned lion killers. The programme incorporates local values as a key component of conservation action, and respects the local culture and traditional knowledge of the communities. The guardians live and work from their home communities. They take pride in their abilities to track lions on foot and to protect their communities. This is a traditional role of a warrior, but instead of protecting communities by killing lions, they instead track lions, alert herders to lion presence to proactively prevent attacks on livestock, and help communities implement better husbandry practices.

Guardian jobs are in high demand because warriors work in their home communities, are given literacy training, and use their specialized tracking skills and their confidence working near large wild animals.

Collecting systematic data on the lion population endows each guardian with increased prestige within his community for becoming educated, employed, and engaged with a species traditionally admired for its power and charisma. The program give previous lion killers the ability to use their skills and ecological knowledge in productive and legal ways. One guardian stated, "Lion Guardians has given us the opportunity to gain formal, gainful employment. It has helped us as individuals and known lion killers, saved us from a life behind bars." The engagement in conservation and monitoring leads to a sense of responsibility for the lions as well as other wildlife. As another warrior stated, "A guardian is a wildlife protector, an indigenous conservationist."

Jobs are often scarce in rural pastoralist regions, and many young men leave. The guardians express gratitude at having employment while maintaining the essence of the warriors' traditional role in society. As another guardian put it: "I love being a Lion Guardian because I am not removed from my culture and my people." Guardians also assist their communities in a variety of ways while improving conservation outcomes. Each year at the program's core site, guardians recover more than USD 1,000,000 worth of livestock lost in the bush (which are likely to be killed by predators and could lead to retaliatory killings), reinforce over 300 corrals, find an average of 20 lost child herders, and stop an annual average of approximately 50 lion hunts by other warriors, often going to extreme lengths to prevent 'their' lions from being killed after livestock depredations (Dolrenry et al. 2016, Hazzah et al. 2014).

Ultimately, the Lion Guardians approach turns people who once killed lions into lion protectors. The model blends local communities' traditional knowledge with first-class science. With a >90% average reduction in lion killing in the areas where they work and a more than tripling of the lion population at their core site, the Lion Guardians model has had proven success. The program covers today approximately 4,000 km² at its core site, has been adapted to six other sites across Africa and has trained an additional four groups on the model to be adapted for other species and other continents. In areas where cultural lion killing remains a significant threat, this can be a very valuable approach for engaging the community, embracing culture and achieving clear benefits for both people and lions.

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6.2 Lion protection and law enforcement

Luke Hunter

The importance of formal protection

Historically, the primary driver of lion declines across Africa has been the conversion of habitat to support human populations. That process inevitably acts in concert with the accompanying threats of both indirect and direct killing of lions and their prey (Chapter 6.3) and has produced grave consequences to lion distribution. Lions now occur unequivocally in only <8% of historic range and in potentially a maximum of 16.3% of historic range including poorly-known areas where their continued presence is uncertain (Bauer et al. 2016). This dramatic range retraction has also resulted in a high correlation between current lion distribution and the level of statutory protection of remaining habitat. The majority of the lion range today is in formal protected areas (PAs) or is closely associated with PAs.

However, even in protected areas, lions are subject to anthropogenic threats with deleterious population-level impacts. Bauer et al. (2015) calculated the trend of 46 African lion populations across their range using repeated count data collected between 1993 and 2014. Importantly, the study focused on protected populations (mainly because PAs are typically the most practical sites for researchers to undertake long-term research); 44 of the sampled populations were formally protected, either entirely/mostly by the state (32 sites) or privately (12 sites). Nonetheless, all sampled West and Central African populations except Pendjari NP, and 53% of East African populations had declined over the period of the study. All sampled southern African (Botswana, Namibian, South African and Zimbabwean) populations were stable or had increased with the notable exception of the Okavango population which declined.

Illegal hunting (poaching) of lions and especially of their wild prey base inside PAs is a major contributor to such declines. Bushmeat poaching's direct impacts on the lion's prey base, and both direct and indirect effects on lion mortality make it the most serious threat to lions in a majority of PAs across Africa (Lindsey et al. 2017). There is also increasing evidence of targeted poaching of lions inside PAs to satisfy a demand from international as well as local markets. Everatt et al. (*in review*) documented targeted poaching of lions for body parts as the greatest single cause of mortality in Limpopo National Park, Mozambique, removing 12–26.2% of the lion population annually. Targeted lion poaching events in this study involved lions being lured to poisoned meat or into baited snares or traps, and thus were distinct from 'by-catch' deaths of lions in snares set for ungulates which added to overall anthropogenic mortality. Teeth and claws were the most sought-after body parts of poached lions with evidence pointing to Vietnam as the source of demand (Everatt et al. *in review*).

Under strong protection, lions are able to reach high densities, typically 1.5–3 lions/100 km² in semi-arid savannah woodlands, and in West and Central Africa (e.g. Kalagadi Transfrontier PA, Botswana/South Africa; Hwange National Park, Zimbabwe; WAP area, Benin-Burkina Faso-Niger; Benoue area, Cameroon), 6–12 lions/100 km² for mesic southern African habitats (e.g. Kruger National Park, South Africa), but sometimes as high as 38/100 km² (Lake Manyara National Park, Tanzania) to 55/100 km² (parts of Serengeti National Park, Tanzania). However, such densities are increasingly the exception rather than the rule: only 35% of 186 PAs sampled for the study by Lindsey et al. (2017) conserve lions at ≥50% of the species' potential carrying capacity. The lion must now be regarded as

highly conservation-dependent in which ensuring the integrity and status of PAs is essential to the species' long-term future.

Securing protected areas

The potential for conservation of lions (and other biodiversity) from the *existing* protected area network is vast. There is approximately 1.51 million km^2 within lion range that is already under formal protection, not including private and communal conservancies (Lindsey et al. 2016). Those areas alone could host an estimated total lion population of 3–4 times the current population if ecological potential was realized. In virtually all sites with existing, depleted lion populations, such recovery cannot occur without first achieving effective protection of the site. Effective law enforcement practises for site-level managers and practitioners in sub-Saharan African PAs were recently and comprehensively reviewed by Henson et al. (2016). They note emphatically that "there is no substitute for a well-equipped, well-trained, and highly motivated ranger" and they provide detail of essential best practises to achieve that outcome in three categories:

1. Law enforcement patrols. A common rule of thumb advocates for one ranger or scout for every 10–50 km^2 depending on the intensity of the poaching threat but just as importantly, it is essential to focus on the capacity and support of the patrol staff. Critical elements to achieving a well-functioning patrol effort include selection, recruitment and motivation (incentives) of rangers and patrol leaders, provision of basic and ongoing training, provision and maintenance of equipment and supplies, and very clear assigned roles and responsibilities (Henson et al. 2016)
2. Law enforcement management. Maximizing the effectiveness of law enforcement operations relies just as strongly upon experienced, highly trained managers with decision-making authority, and guided by very clear and consistent standards. Effective managers will be well versed in the use of adaptive and varied tactics to respond to rapidly-changing conditions, and will have access to the necessary infrastructure including operations rooms, satellite outposts, well maintained vehicles and a functioning road network (Henson et al. 2016). Managers also oversee the collection and application of patrol data to plan, adjust and report on the patrol effort. This increasingly entails a software-based skillset with the recent proliferation of ranger-based monitoring (RMB) tools including Cybertracker, SMART, MIST and MOMS (used mainly by conservancies and National Parks in Namibia). Open Data Kit (ODK) is a more general monitoring tool also appropriate for RMB.
3. Intelligence and investigations. This requires developing very specialised capacity and skills that builds upon and extends from the ranger-based patrol effort at the site; dedicated unit/s with appropriate resources, training and relationships is typically required. Effective intelligence and investigations capacity improves the ability of the law enforcement team in both increasing the rate of arrests and prosecutions of perpetrators, as well as enabling poaching activities to be prevented before they occur. Intelligence and investigations capacity should be viewed as additive once basic patrol effort and management is robust; and is often severely constrained in African PAs by financial and human resources (Henson et al. 2016)

The primary limitation to achieving effective management of African PAs is financial (see Box 6.2.1). Between USD 1,000–2,000/km² is required to achieve minimum conservation outcomes for lions

Box 6.2.1 The crisis posed by the under-financing of protected areas

Peter Lindsey

Africa is home to some of the world's most iconic protected areas (PAs) and some (particularly southern and East African) countries have set aside higher proportions of their land area as parks and reserves than the global average (Lindsey et al., in press). Many African countries have demonstrated clear and strong political will for conservation with well-developed and enforced laws pertaining to wildlife and habitats. However, as human populations expand and as demand for wildlife products, access to land, grazing and other natural resources increases, pressure on Africa's PAs is growing. Unfortunately, in many countries the funding available to manage PAs is far from adequate. Lindsey et al. (in press) estimated that the budget deficits facing PAs in lion range are as much as USD 1.2–2.4 billion per annum. Perhaps most disturbingly, their paper suggests that 80–90% of PAs in lion range are running at a deficit, and of those PAs, available funding is just 10–20% of what is needed. These data suggest that in the absence of a significant elevation in funding, the numbers of lions and other wildlife in most of Africa's PAs are likely to decline significantly. The majority of countries are not investing nearly enough in their PAs to protect them effectively, or to secure the wildlife assets required to develop viable wildlife-based tourism industries. In fact, some countries may well lose the large majority of their wildlife before they ever really have chance to benefit from it.

In some instances, photographic tourism and trophy hunting contribute to the generation of funds for the management of PAs. However, as in most other regions of the world, only a small proportion of African PAs generate enough revenue from such commercial activities to cover the costs of effective management at the site level. It is important to note, however, that PA networks typically confer strong net-positive economic benefits on the national level (Lindsey et al. 2014). This means that the large majority of PAs will require ongoing subsidy for effective management, even where they are used for tourism or trophy hunting. This subsidy should however be considered as investment in natural assets rather than mere cost. Indeed, there is a strong case for elevated funding for Africa's PAs from both, African countries and the international community. In addition to their obvious value for biodiversity, investing in Africa's PAs can confer significant benefits to people and economies:

- PAs can provide the basis for developing tourism industries, which can grow and diversify economies and create jobs.
- PAs provide environmental services such as the protection of watersheds and provision of fresh water supplies and the storage of carbon.
- Investing in the management of PAs can help bolster national and regional security, particularly where PAs occur along national boundaries.
- Investing in PAs can help to protect wildlife which is of massive cultural significance within Africa, and the source of pride within Africa, and confers significant 'existence values' to millions of people of outside of the continent.

However, these benefits are severely jeopardised by under-funding, making it impossible for wildlife authorities to tackle threats effectively. In situations of chronic under-funding, wildlife populations typically decline in abundance, diversity and distribution within PAs. Under those circumstances, PAs become unable to deliver benefits to their host nations and become increasingly vulnerable to political pressure for degazetting and downsizing, and reallocation for other land uses.

Box 6.2.2 Partnership between NGOs and wildlife authorities

Peter Lindsey

Collaborative management partnership between state wildlife authorities of African countries and NGOs for the management of protected areas is increasingly common. These arrangements represent one way to enable governments to access long-term financial and technical support for the management of PAs. There are three broad categories of collaborative management models for PAs (Baghai et al. 2016):

1. Financial and technical support

This is by far the most common arrangement, and one where the government retains responsibility for the governance and management of the PA, but where an NGO provides long-term financial and technical support to help the wildlife authority fulfill their mandate. For example, Frankfurt Zoological Society FZS provides financial and technical support to the Tanzania National Parks Authority for the management of Serengeti National Park. Though attractive to governments, this model typically attracts less funding than the other two models.

2. Co-management

Under this scenario, the governance of the PA is shared (with joint representation from the wildlife authority and the NGO on a governance board, which oversees the overall strategic direction of the PA and signs off on management and business plans), and responsibility for management is also shared. There are various ways in which management responsibilities are split in practice, but the most effective variant is called 'integrated co-management' – where a special-purpose entity is jointly created by the wildlife authority and the NGO, with standardised working conditions for staff from government and the NGO, and where key decisions (such as on law enforcement matters) and the appointment of key staff members are made jointly. An example of integrated co-management comes from Gonarezhou National Park in Zimbabwe, which is co-managed by the Zimbabwe Parks and Wildlife Management Authority and FZS.

3. Delegated management

Under this scenario, responsibility for the governance of the PA is shared between the NGO and the state wildlife authority, but the responsibility for management is delegated to an NGO partner. The NGO African Parks is the most frequent implementer of this model. For example, they have been delegated responsibility to manage: Chinko, Pendjari, and Zakouma in Central African Republic, Benin and Chad.

Financial and technical support is the model that is generally the most readily accepted by African governments, whereas governments are sometimes fearful to engage in co-management and delegated management models due to (largely misconceived) fears of loss of sovereignty. In reality, sovereignty is not in question for any of the models, because land ownership remains vested in the state, because the state plays a key role in the governance of the PAs, in the issuance of permits, and because agreements are invariably made for a finite period of time. Co-management and delegated management are typically associated with higher levels of investment, and the clearest examples of success come from the delegated management model.

Collaborative management models have significant potential to improve the conservation prospects of PAs in many African countries, in the context of acute budget deficits, and in some cases, lack of sufficient technical capacity. However, to effectively attract and administer NGO partners for support to the management of PAs, there is a need for some African governments to develop clear procedures and guidelines for the establishment of collaborative management models.

(50% of carrying capacity) but an average of only USD 200/km² is available to spend across 282 PAs within current lion range (Lindsey et al. *in press*). It is important to note that management budgets are not exclusive to law enforcement/park protection, and also include costs related to other staff, infrastructure and road maintenance, habitat management, and so on; however, costs of law enforcement including personnel always comprise a high percentage of effective park management budgets.

Long-term collaborative management partnerships (CMPs) between African statutory wildlife authorities and conservation NGOs have significant potential in helping to address funding and capacity shortfalls in PAs (see Box 6.2.2). CMPs are rarely developed around individual species such as lions (although severe levels of elephant poaching in some parts of Africa have helped catalyse their creation) nor have they featured as a priority for NGO actors focused on lion conservation which have given more weight to resolving human-lion conflict (Section 6.1). However, extreme situations have produced novel CMPs designed around lion-specific, anti-poaching activities. Everatt and colleagues (in review; and see www.facebook.com/greaterlimpopocarnivoreprogramme/) use data from GPS-telemetered lions in Mozambique's Banhine and Limpopo NPs to design and deploy anti-poaching patrols to areas where collared lions are most active. Similarly, NGO partners in certain CMPs are actively engaged in immobilising snared lions (and other charismatic species including other large carnivores and elephants) for de-snaring in areas that are particularly hard-hit, for example by Conservation South Luangwa and the Zambian Carnivore Program in Zambia; these groups also share telemetry data to prioritise patrols and snare-removal efforts. Whether focused specifically on protecting lions or the site in general, the value of CMPs is increasing. The perilous status of both lions and many African PAs means that they should now be viewed as an important component of securing both. The expertise of NGO partners in assisting with capacity needs, including types of available training and tools, is covered in detail in Chapter 7.5.

The recovery of PAs through increased protection can produce broad ecological and socio-economic effects that go well beyond stabilising or increasing the number of lions (see Box 6.2.1). African PAs support the world's highest diversity and abundance of megafauna (Ripple et al. 2016) which is a mainstay for the tourism industry of many range states (UNWTO 2014; see Chapter 6.8). However such tourism, especially at volume, is dependent on the presence of a thriving, wildlife-rich ecosystem, itself dependent upon effective park management. The lion has particularly useful role to play in both. It is one of the most sought-after species for wildlife tourists and also acts as an iconic umbrella that may attract investment that improves park protection (see Box 6.2.3).

International considerations

Relative to the killing of lions *in situ*, international trade and trafficking of lions has historically been considered a low conservation priority with limited impact on wild populations. Prior to 2008, legal trade of lions and their derivatives was restricted largely to live animals (mostly captive-bred) and hunting trophies (considered non-commercial trade), both of which have been administered under CITES since the lion was listed in 1977. The number of hunting trophies exported by range states steadily increased until about a decade ago. The total number of trophies from wild lions subsequently decreased while the total overall continues to increase, due to massive growth in exports by South Africa of captive-bred lion trophies. The steady decline in the percentage of trophies coming from wild lions has been furnished as a conservation benefit by the South African captive lion hunt-

ing industry, i.e. by alleviating demand for wild lion hunts although captive-bred and wild lion hunting are widely regarded by hunting clients as different products (Lindsey et al 2012).

The first CITES permits for commercial trade in lion bones were issued to South Africa in 2008, apparently in response to demand from Asian consumer nations seeking substitutes for tiger bone (Williams et al 2017). The legal trade in bones has since grown rapidly, reflected by the issuance of CITES permits which averaged 314 skeletons/year from 2008–2011, and grew to 1,312 skeletons/year from 2013–2015 (Williams et al 2017). Williams and colleagues (2017) estimate that >6,000 skeletons weighing at least 70 tonnes have been shipped to East-Southeast Asia (mainly to Lao PDR and Vietnam, less so to China and Thailand) since 2008, almost all from South Africa (<1% of exports originated in Namibia). An annotation added to the CITES-listing at the 2016 CoP now restricts international commercial trade in lion parts from January 2017 only to captive-bred sources from South Africa (Outhwaite 2018).

Both forms of legal trade, in trophies and bones, have the potential to impact wild lion status. The impact of poorly regulated trophy hunting on wild lion populations is well established. Excessive and/or unselective offtakes can produce population declines, including in protected populations where hunting occurs along the boundaries of protected areas (Loveridge et al. 2007, Groom et al. 2014). Population-level impacts also occur where lions are already exposed to high levels of anthropogenic mortality, especially from poaching, such that trophy hunting produces additive rather than compensatory mortality (Creel et al. 2016). Lindsey et al. (2013) provide a detailed analysis of the current practices that impede the sustainability of legal trophy hunting of lions with recommendations for the necessary corrections.

The impact of the legal bone trade on wild lion populations is more speculative. Outhwaite (2018) summarized seizure records since 1999, and provides detail on 355 seizures of 3,283 individual lion parts and 87 kgs of lion parts. Claws were the commodity seized item (1,601 pieces, plus an additional estimated 3 kg), followed by teeth (748 pieces plus 3 kg; Outhwaite (2018). The origin – wild versus captive – of seized items is often unclear although seizures in Mozambique, Uganda, Tanzania and Zambia associated with other wildlife contraband indicate that wild lions are clearly involved in some and probably most of these cases (Everatt et al. in review, Outhwaite 2018).

Everatt and colleagues' case study in Mozambique (in review) provide more granular detail. They observed that most anthropogenic lion mortality entailed lions being killed illegally and their body parts removed, with targeted poaching of lions accounting for 34.7 % of all recorded lion deaths. Skin, meat and fat was sold locally however bones, teeth and claws were intended for the same international markets currently supplied by the legal trade; two shipments of teeth and claws confiscated by the Mozambican government authorities at an international airport in 2016 were destined for Vietnam, with one of the seizures including a combination of lion parts and elephant ivory (Everatt et al. in review). Everatt et al.'s study population in Limpopo National Park declined 68% between 2012-2017, due almost entirely to anthropogenic mortality.

Cases such as this raise significant concern over the opportunities for illegally killed wild lion parts to enter a porous legal trade but the extent to which the poaching-mediated decline of Limpopo NP's lions is mirrored elsewhere in Africa is opaque, highlighting the need for more data (see Williams et al. 2017, and Outhwaite 2018 for recent overviews). In the meantime, they also further highlight the urgent need for intensifying site-based and international efforts to increase the level of protection afforded the lion and the landscapes it occupies.

Box 6.2.3 Case study of Kafue National Park, Zambia

Luke Hunter

Zambia's Kafue National Park is emblematic of the challenges faced by protected area managers across Africa. The park is very large, 22,500 km², surrounded by a further 41,500 km² of communal Game Management Areas, a vast area in which to provide effective management. However, the budget provided to the Zambian Department of National Parks and Wildlife (DNPW) is only around USD 1.25 million (in 2011; Martin 2011) or ~USD 56/km², drastically short of the USD 1,000–2,000/km² required for effective management. Wildlife populations are significantly depleted inside the National Park as a result of pervasive bushmeat hunting over many years. The Zambian DNPW has developed CMPs with two NGOs Panthera and Game Rangers International to supplement anti-poaching capacity in and around the national park. If the poaching pressure on wildlife populations was successfully alleviated, populations of large carnivores and large ungulates inside the NP would increase an estimated 2.7 (elephants) to 8 (cheetahs) times their current levels. Additionally, if Kafue's wildlife populations were at capacity, their tourism potential has been estimated at almost 20 times their current value.

The potential growth in wildlife populations (Panthera, unpubl. data) and tourism revenue (Martin 2011) for Kafue National Park, Zambia, under robust protection.

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6.3 Settings for the conservation of wildlife and habitats

Kristoffer Everatt

The depletion of prey is recognised as one of the greatest, most pervasive and long-term threats to the conservation and viability of many of the world's large carnivore species, including lions (Ripple et al. 2015, Bauer et al. 2016). Ungulate populations across African protected areas have declined by approximately 59% from 1970–2005 (Craigie et al. 2010). As an apex predator lion biomass is limited by prey biomass at a ratio of approximately 0.009/1 (Carbone & Gittleman 2002) and areas depleted of prey beyond a critical threshold are unable to support lions (Everatt et al. 2014). Lion populations faced with depleted prey populations exhibit larger home range sizes and higher levels of transient individuals (Van Olsen et al. 1985, Packer 1986), both of which can lead to increased levels of conflict with humans. A reduction in prey may result in lions supplementing their diet with domestic livestock, creating conflict with agro-pastoralists (Chapter 6.7). Dispersing lions are especially prone to livestock depredation when moving through landscapes depleted of wild prey, exacerbating the challenges of predator conservation (Khorozyan et al. 2015).

While rainfall and soil nutrient availability are ultimately the factors limiting the distribution and abundance of ungulates across African savannas (Fritz & Duncan 1994) several anthropogenic factors are also responsible for limiting ungulate numbers, and in many cases these have become responsible for the severe declines of wild ungulate populations (Ripple et al. 2015).

Fig. 6.3.1. Commercial bushmeat poachers arrested in Limpopo National Park, Mozambique. Photo Greater Limpopo Carnivore Programme.

The conservation status of ungulate populations is not homogenous across Africa. Ungulate populations are closest to their carrying capacity in the National Parks (NPs) of Botswana, Namibia, South Africa, Tanzania and Kenya and show the greatest declines in the protected areas of Ethiopia, Central Africa, Malawi, Tanzania, Kenya, Zimbabwe and Zambia (Lindsey et al. 2017). Socioeconomic factors, including lower human infant mortality and higher GDP, both themselves associated with stronger economies and better governance, best explained these trends (Lindsey et al. 2017). Prey depletion is a consequence of one or several immediate anthropogenic pressures, including the unsustainable hunting of wildlife for meat, 'bushmeat' (Fig. 6.3.1), the loss of habitat and exploitive competition between wild ungulates and domestic livestock (Ripple et al. 2015). The status of ungulate populations however is also correlated to wider and more pervasive factors including economic investment in and management of protected areas (PAs) (Lindsey et al. 2017, Baghai et al. 2018), local economic development (Lindsey et al. 2017), quality of governance and levels of corruption (Smith et al. 2003), regional conflict and war (Daskin & Pringle 2018), wildlife disease (Preece et al. 2017) and climate change (Mduma et al. 1999, Ripple et al. 2015). Here, we will first present the different reasons for the decline of prey populations, before summarising possible solutions.

Challenges

Over hunting

Bushmeat poaching, defined here as the unregulated and/or illegal hunting of wildlife for meat is leading to the widespread loss of ungulates across much of Africa, Asia and Latin America (Ripple et al. 2015). Meta-analyses have shown that bushmeat poaching is the primary threat to wild ungulates in 60% of African NPs (Lindsey et al. 2017). For instance, ungulate populations in Zambian NPs are only at an average of 21% of their ecological carrying capacity and ungulate populations in Mozambican NPs exist at only 2–60% of their ecological carrying capacity; in both countries this is largely due to overhunting (Lindsey et al. 2017, Baghai et al. 2018; Box 6.3.1). Bushmeat poaching operates on a continuum from smaller scale subsistence hunting to larger scale commercial hunting to supply foreign markets (Lindsey et al. 2013). It is often directly related to inadequate law enforcement, but is also influenced by wider social-economic factors including food security and poverty, local access to other economic opportunities and cultural preferences and trends (Milner-Gulland et al. 2003, Lindsey et al. 2013, Rogan et al. 2018). In West Africa, an increase in commercial bushmeat poaching was correlated to a collapse of commercial offshore fish stocks and subsequent loss of protein sources for a large portion of the population (Brashares et al. 2004), while in Botswana bushmeat poaching was largely undertaken as a means of revenue (Rogan et al. 2018). Commercial bushmeat poaching is also often associated with other, often illegal, commercial resource extraction industries such as mining, logging, and charcoal making (Lindsey et al. 2013). Workers in logging and mining camps may be fed bushmeat to reduce costs and trucks carrying logs or charcoal are often used to smuggle meat from the bush to cities. The building of new roads as development projects, into previously inaccessible wilderness, facilitates an increase in the extent of bushmeat poaching (Laurance et al. 2015). Bushmeat hunting is also simply a component of some cultural traditions (Milner-Gulland & Bennett 2003).

Box 6.3.1 The impacts of bushmeat poaching on prey populations and lion viability in Mozambique National Parks

Kristoffer Everatt

The unregulated hunting of 'bushmeat' (wild meat) for subsistence or commerce, may be one of the greatest threats to biodiversity and ecosystem health across much of Africa, Asia, and South America (Milner-Gulland & Bennett 2003; Wilkie et al. 2011). This pressure can result in the reduction, extirpation and extinction of species (Milner-Gulland & Bennett 2003), a decrease in habitat suitability (Michael & Hebblewhite 2012), changes in community structure (Peres 2000), including the loss of functional groups (Vanthomme et al. 2010) and consequent shifts of ecological stable states (Estes et al. 2011). However, despite the extensive ecological impacts of unregulated hunting, its effects can be disguised by the appearance of intact habitat; the "empty forest" syndrome (Redford 1992; Wilkie et al. 2011) or in relation to lion habitat, "the empty savannah syndrome" (Lindsey et al. 2012).

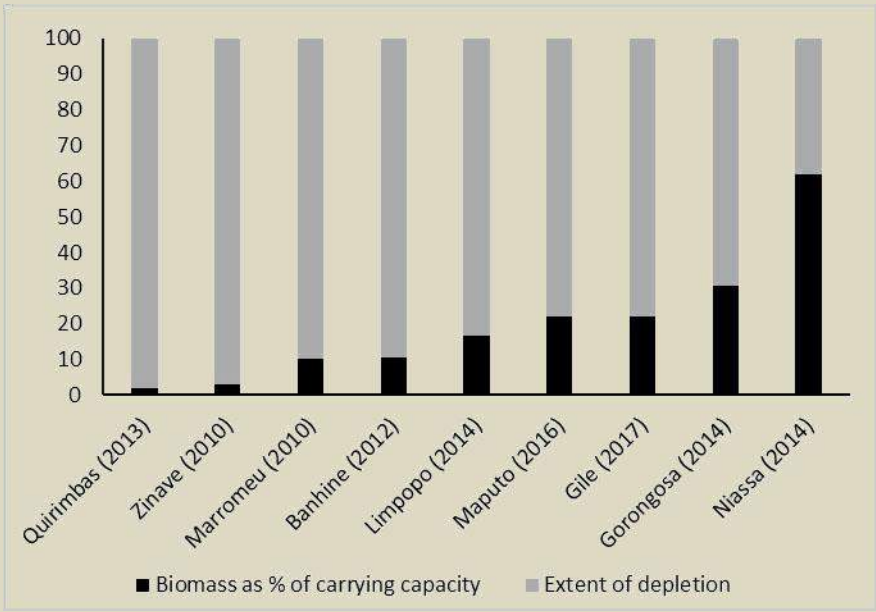

Fig.1. Percent depletion of wild ungulates in Mozambique National Parks from Baghai et al. 2018.

As an obligate predator lion biomass is correlated to prey biomass (Van Orsdol *et al*. 1985; Hayward et al. 2007). The emptying of the African savannahs for meat has, therefore, been one of the greatest contributors to the declining status of lions (Bauer et al. 2015). For instance, prey depletion by bushmeat poaching is listed as one of the key challenges to lion conservation in Mozambican National Parks (Lindsey et al. 2017). An analysis by Baghai et al. (2018) compared the realized biomass of wild ungulates, obtained from aerial surveys, with the ecological carrying capacity of ungulates based on rainfall and soil. Mozambican National Parks were found to suffer an average of 80 % depletion of ungulates (individual parks ranged from between 37.8 % to 97.9 % depletion) (Fig. 1) (Baghai et al. 2018). For instance, Baghai et al. (2018) found wild ungulate biomass to be 83.2 % below ecological carrying capacity In Mozambique's Limpopo National Park where Everatt et al. (2014) had previously shown lion biomass to be 67.5 % below the estimated carrying capacity based on available ungulates. Theoretically this park which currently supports only between 22-66 lions (Everatt et al. 2018) could, according to trophic scaling, support 1130 lions (based on Carbon & Gittleman's, 2002, model relating lion density to prey biomass) or a lion density of 10/100 km^2 which compares to the realized density of up to 11/km^2 in adjoining Kruger NP (Ferreira & Funston 2010).

While the biomass of wild ungulates is far below the ecological carrying capacity in Limpopo NP, 82% of the park's potential carrying capacity is consumed by domestic livestock (Baghai et al. 2018). More than 35000 head of cattle, sheep and goats can be found in the park, owned by resident communities, contributing to almost 5x the biomass as that of wild ungulates (Grossman et al. 2014). Here livestock are kept as a source of wealth rather than subsistence and the park's communities largely rely on bushmeat for their protein (Limpopo National Park management pers comms). The communities themselves are located along the few perennial water holes which allows their cattle to outcompete wild ungulates for much of the parks' higher quality riparian habitat (Everatt 2016). In addition, by hunting optimally, bushmeat poachers will deplete the wild ungulate populations from areas closest to settlements first (Everatt et al. 2014) leading to the replacement of wild ungulates with cattle.

While cattle are within the ideal weight range of prey for lions, this high biomass of cattle in the park is not available for lions. Lions which depredate on cattle in the park, often young dispersal age males, are typically killed in retaliation by the communities (Everatt et al. 2018). Lion viability in the park is hence strongly limited by this double-edged sword of pastoralism and poaching (Everatt et al. 2014; Fig. 2).

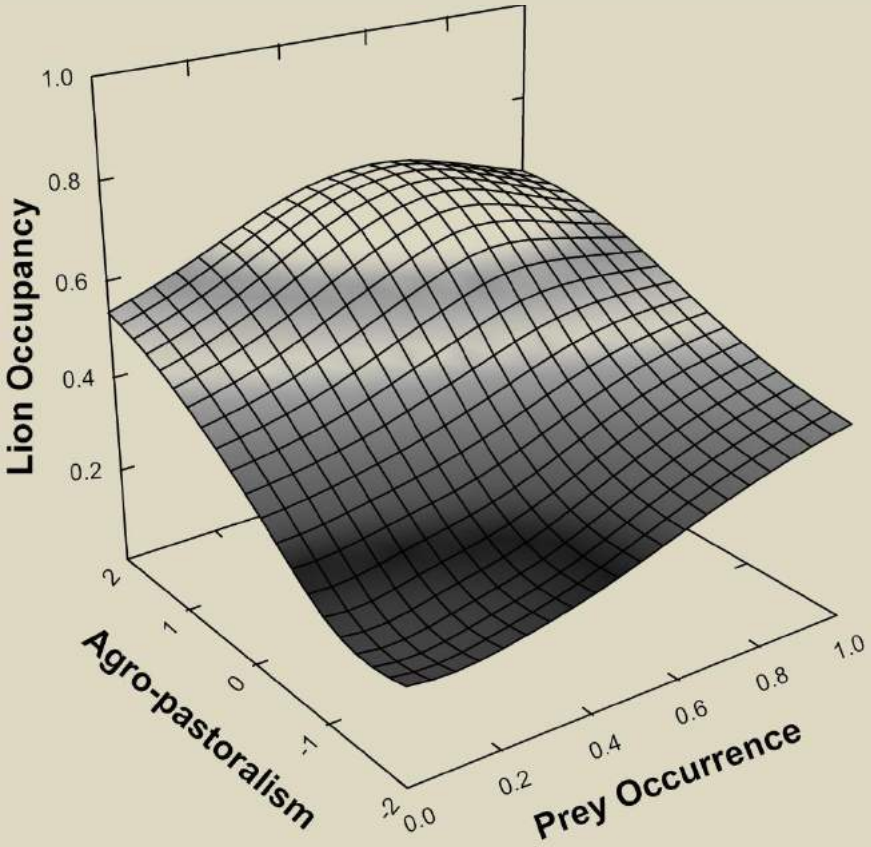

Fig. 2. Impact of pastoralism and poaching on lion occupancy in Limpopo NP, adapted from Everatt et al. 2014.

Bushmeat poaching has a potentially greater impact on ungulate populations than managed hunting activities because the methods employed by bushmeat hunters, including nets, traps and snares, are non-discriminant in their prey selection, killing female and young animals across a wide range of species (Lindsey et al. 2013). Also, many bushmeat hunting parties only return to their traps and snare lines every few days during which time snared animals will rot attracting carnivores, or hunters may simply not remove all snares, leading to further deaths as other animals are caught as 'by-catch' (K. Everatt, pers. obs.).

During some of Africa's civil wars or periods of unrest ungulate populations within National Parks have been depleted by military troops as a source of meat (Hatton et al. 2001). For instance, populations in some NPs in Mozambique and Angola have yet to recover from widespread slaughters during the last civil wars (Funston et al. 2017, Baghai et al. 2018).

Loss of habitat

Habitat loss is a significant threat to many of the world's ungulate species (Ripple et al. 2015). Human population growth rates in Africa are approximately 2.5% per annum, with populations expected to reach 2.5 billion people by 2050 with over half of this population living in rural areas. Furthermore, human population growth rates are much higher along PA boundaries, at the wildlife-human interface, than in other rural areas (Wittemyer et al. 2008). Habitat for African ungulates is rapidly disappearing across Africa with the expansion of small-scale agriculture, unplanned settlements and urban development (Newmark 2008, Riggio et al. 2013, Ripple et al. 2015). Rapid human population growth coupled with the increasing number of settlements and farms is the primary cause for large scale wild ungulate declines (up to 72% for some species) in the Maasai Mara system between the 1970s and 1990s (Ogutu et al. 2008), and population declines of up to 95% for some ungulate species in the Tarangire system between 1988 and 2001 (Newmark 2008). Land use management can also pose a serious threat to many ungulate populations across landscapes and entire countries. Government land reform programs such as those experienced in Zimbabwe during the 1990s reduced the established wildlife tourism industries and led to increased wildlife lands being utilised for subsistence agro-pastoralism (Cumming 2003).

The building of fences can fragment ungulate habitat and impede migrations. Veterinary fences built to protect commercial cattle farms from diseases transmitted by wild ungulates can exclude wildlife from critical habitat with detrimental impacts on populations (Williamson & Williamson 1984, Gadd 2011). This happened for various ungulate species e.g. in the Okavango delta region, Botswana, with the cutting off from seasonally important habitats (Mbaiwa & Mbaiwa 2006), in the Kalahari region, Botswana, with the cutting off from dry season water holes (Williamson & Williamson 1984, Knight 1995), as well as in northern Botswana (Albertson 1997) and Namibia's Caprivi region (Martin 2005). In the Kalahari, these fences resulted or at least aided in the extirpation of zebra (Williamson & Williamson 1984), the death of 300,000 wildebeest in 1962 alone (Child 1972) and the decline of wildebeest from 262,000 individuals in 1979 to only 260 in 1987 (Gadd 2011).

In addition to preventing migrations and access to critical habitat, fences are also responsible for the direct deaths of large numbers of ungulate specimens through entanglement (Gadd 2011). Fences built along international borders to stop illegal human movements can have much the same effect on ungulate habitat, migrations and populations (Gadd 2011).

The damming of rivers for hydroelectric projects has eliminated substantial swathes of prime ungulate habitat across Africa. In the Zambezi river valley, the building of the Kariba Dam flooded 5,580 km^2 of prime wildlife habitat in 1963, and later the building of the Cahora Bassa dam in 1975 flooded an additional 2,700 km^2 of wildlife habitat, causing up to 95% population declines of buffalo, waterbuck, reedbuck and zebra in the now-dry former floodplains downriver (Beilfuss 1999). There are currently several plans to build further hydroelectric dams in Africa, which would again flood large areas of important habitat for lions and their prey (Conlen et al. 2017, Dye 2017). Although there is a great need for affordable energy for many developing nations, often such activities have significant repercussions for wildlife.

Competition with livestock

Livestock benefits from protection offered by their owners and wild ungulates compete for and/or are excluded from resources by domestic livestock (Young et al. 2005, Odadi et al. 2011, Ripple et al. 2015, Ogutu et al. 2016). Cattle (*Bos indicus*) occupy a similar ecological niche of many medium to large wild ungulate species, while sheep and goat herds occupy similar niches as small to medium sized ungulates, and their occurrence diminishes resources available to important lion prey species including African buffalo, eland, zebra, wildebeest, impala and Grant's gazelle (Young et al. 2005, Odadi et al. 2011). There are approximately 156 million cattle in Africa with herds continuing to grow (Van den Bossche et al. 2010) and the increase of cattle herds is closely associated with the reduction of wild ungulate species across Africa (Prins 1992, Ripple et al. 2015).

In Kenya, wild ungulate herds declined by approximately 68%, between 1977 and 2016, while sheep and goat herds increased by 76%, resulting in livestock outnumbering wild ungulates by eight times (Ogutu et al. 2016). Domestic livestock herds are often associated with the highest quality habitat along permanent water sources and are more sedentary than wild ungulate herds, leading to local overgrazing and the reduction of prime habitat availability for wild ungulates. These high stocking rates of domestic livestock accentuate the effects of drought, ultimately leading to desertification (Ogutu et al. 2008).

The impact of livestock grazing on wild ungulate viability also extends into many NPs across Africa (Lindsey et al. 2017; Box 6.3.2). Cattle herds are increasingly occupying the Masai Mara reserve (Ogutu et al. 2008) and cattle biomass is approximately 5 times higher than wild ungulate biomass in Limpopo NP of Mozambique (Baghai et al. 2018).

In many cases political will to remove livestock from protected areas is limited as basic sociological problems are prioritised over conservation (Prins 1992). For example, the planned resettlement of agro-pastoralist communities and their livestock resident within Limpopo NP has been incredibly slow (Baghai et al. 2018).

Wild ungulates and domestic livestock are however known to co-occur at relatively high densities in some larger systems where traditional semi-nomadic pastoralism is practiced (Tyrell et al. 2017) indicating a need to further examine livestock husbandry practices and land use management for conservation purposes.

Box 6.3.2 Competition between livestock and natural prey

Hans Bauer

Livestock incursions are common in unfenced Protected Areas across Africa; anti-poaching is a top-priority for most area managers but anti-grazing is often of a different category. In many areas, the distinction between inside and outside the Protected Area is not very clear and both wild ungulates and livestock occur in a mosaic of land use (e.g. Amboseli landscape). In other areas, parks are officially 'hard-edged', but due to a lack of enforcement capacity livestock enters illegally. In some areas, this is happening at massive scales; Waza NP in Cameroon had resident and nomadic pastoralists with a total of 100,000 heads crossing in the dry season (Bauer 2003), the WAP-ecosystem in Benin – Burkina Faso – Niger had an estimated 162,000 cattle and 10,000 shoats (Bouché et al. 2015), and Nechisar NP in Ethiopia had 20,000 cattle in an area where the most abundant wild ungulate was zebra, numbering only 1,500 (Yirga et al. 2014). When livestock outnumbers wild prey, there is almost certainly competition for resources (fodder and water), a potential for disease transmission, direct disturbance from herders (e.g. in the case of Nechisar NP, food intake by zebra was limited as they do not graze when close to shouting herders), and an indirect impact on the ecosystem through harvest of firewood and other products by people attending their livestock.

In such areas, there is a high risk of human-wildlife conflict (Chapter 6.1), leading to substantial depredation and retaliatory killing of lions. Much attention has been given to mitigation of conflict (Bauer et al. 2010, Hazzah et al. 2014, Gebresenbet et al. 2018), but one aspect is of interest for areas where livestock has become dominant. Using a VORTEX model, Bauer (2003) showed that the probability of lion persistence in Waza NP would decrease if livestock were to be suddenly removed from the system, due to the time lag in the build-up of wild prey populations. Long term viability depends on management scenarios and their impact on lion killing, and gradual replacement of livestock by wild prey (Fig. 1).

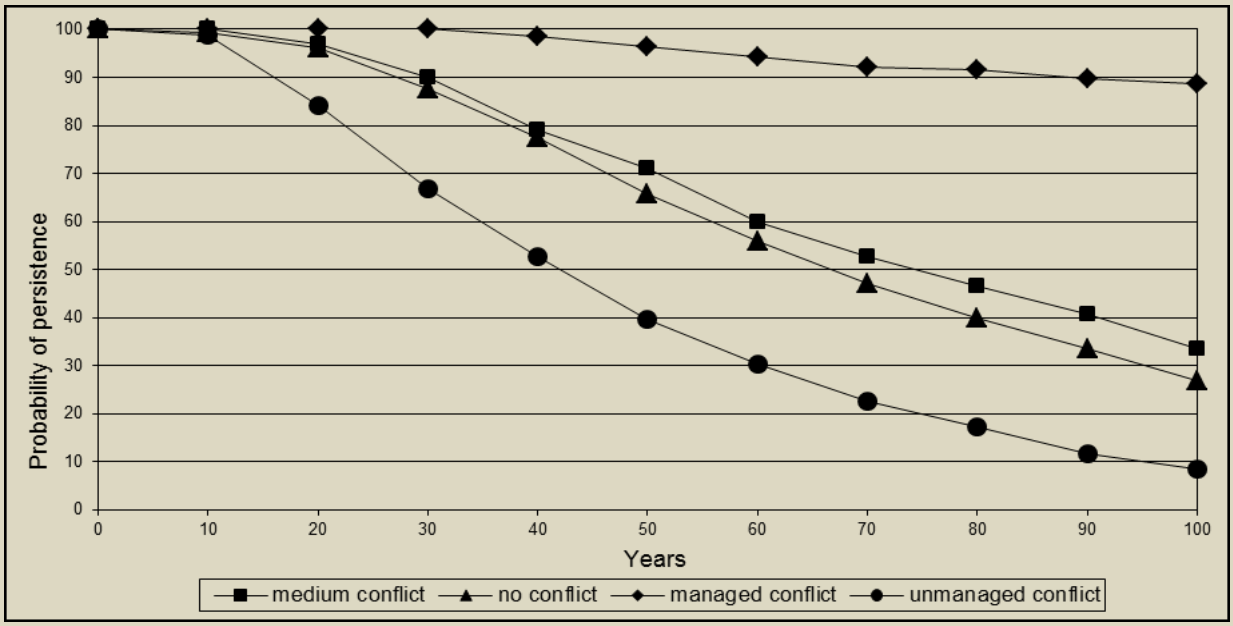

Fig. 1. Results of the Population Viability Analysis, probability of persistence of lions over 100 years. The four scenarios are, all else being equal; (1) no conflict: removal of livestock leading to absence of depredation, 'background' lion killing set to one male and one female, (2) managed conflict: depredation continues but is mitigated leading to background lion killing only (3) medium conflict: depredation remains tolerable but lion killing is doubled, and (4) unmanaged conflict: depredation is intolerable and leads to the killing of 2 female and 4 male lions. Managed conflict leads to higher viability than no conflict or medium conflict, while unmanaged conflict leads to substantially lower viability in this model.

Unlike wild ungulates, domestic cattle are susceptible to bovine trypanosomosis and as such are limited by the distribution of tsetse flies which transmit the disease. Large scale programmes to eradicate the flies and/or the disease consisted in the past in the mass slaughter of its host, i.e. wild ungulates (Ford 1971), and today in the distribution of pesticide laden fly traps (Kuzoe Schofield 2004). The successful removal of tsetse flies has in turn allowed for further habitat encroachment of prime wildlife areas by livestock, including within NPs.

Disease

Infrequent disease outbreaks have been responsible for massive and sudden declines of ungulates across Africa. The best-known case may be the great rinderpest epidemic at the turn of the 19th century, a disease passed on from cattle, which reduced buffalo abundances by approximately 90% (Plowright 1982). Climate change is also expected to result in distribution shifts and expansion of diseases with increase pathogen survival rates and host susceptibility (Harvell et al. 2002). For instance, the distribution of bovine trypanosomosis may shift leading to changes in cattle distribution (Carter et al. 2018) and ultimately wild prey habitat availability.

Climate change and desertification

Increased atmospheric carbon dioxide levels are causing generally hotter, drier conditions across savanna Africa with more frequent droughts (Hulme et al. 2001). It is predicted that Africa will warm by up to 6^{o}C over the next 100 years (Hulme et al. 2001). Drier, warmer conditions are expected to result in large scale shifts in mammalian species distribution patterns across Africa possibly resulting in widespread range loss (Thuiller et al. 2006). A critical condition for species' resilience towards climate change will be their ability to migrate or shift their distribution in accordance to changing environmental conditions (Thuiller et al. 2006), however wildlife areas in Africa are becoming increasingly isolated, either by increasing human settlements or fences (see above), thus limiting opportunities for species spatial adaptability.

Climate change coupled with the destruction of forests for timber and fuel wood or charcoal and overgrazing by Africa's growing cattle, goat and sheep herds is resulting in the rapid desertification in Africa (Economic Commission for Africa 2007). For instance, desertification is increasing at a rate of 20,000 hectares per year in Ghana and 351,000 hectares per year in Nigeria (Economic Commission for Africa 2007). A negative feedback is created whereby the loss of suitable habitat for humans and their livestock forces the expansion of the agro-pastoralist frontier, with its associated removal of more forests and overgrazing of more land (Economic Commission for Africa 2007). Climate change is expected to place increased pressure on African food production which in turn will place greater pressures on wildlife habitat (Zewdie 2014).

Governance

Political corruption undermines conservation programs worldwide (WWF & TRAFFIC 2015), being the biggest facilitator of illegal wildlife trade (Smith et al. 2003, Garnett et al. 2011, WWF & TRAFFIC 2015, Packer & Polasky 2018). It is estimated that corruption costs Africa approximately USD 150 billion per annum, which includes 50% of the continent's tax revenue, 25% of the continent's GDP

and USD 30 billion dollars in aid money consumed by corruption per year (Economic Commission for Africa 2016). Specifically, corruption hinders the conservation of wildlife in Africa through the embezzlement of conservation funding, reducing the quality of services and volume of tax revenue, deepening of income inequality and poverty, adversely effecting good moral values in society, undermining the rule of law including acceptance of bribes to overlook illegal activities such as poaching and trafficking and allowing political gain to override responsible governance and wildlife management (Garnett et al. 2011, WWF & TRAFFIC 2015, Packer & Polasky 2018, Baghai et al. 2018). Generally, corruption extends from lower level officials, including National Park rangers, police and customs and border officials, up through the ranks of wildlife authorities to high level government positions; in Africa it is found throughout the major state institutions, including the executive, legislature and judiciary (Economic Commission for Africa 2016), with detrimental impacts to the success of wide-reaching conservation programs (WWF & TRAFFIC 2015).

Investment and management capacity

Africa includes many of the world's poorest countries and consequently many PAs are grossly underfunded undermining the ability of wildlife authorities to manage or conserve these landscapes (Lindsey et al. 2017, Packer & Polasky 2018). Africa as a whole is home to 33% of the world's most underfunded countries for biodiversity conservation (Waldron et al. 2013). While European and North American NPs are funded by country tax bases, most African countries do not have this luxury and conservation funding is therefore dependant on either income generated directly by the PA or on international donor funding (Packer & Polasky 2018). In addition to a lack of adequate funding, many African countries continue to suffer from poor technical and scientific capacity related to PA and wildlife management (Lindsey et al. 2017).

Solutions

The ultimate cause of ungulate declines across Africa is human population growth (Ripple et al. 2015), which is linked to economic development and welfare. As such, nature conservation is eventually benefitting from economic development and welfare, as long as policy facilitates nature conservation. The OECD has developed several documents on green growth, i.e. "fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental service on which our well-being relies". Curbing the human population growth in Africa requires decreasing fertility rates, which is achieved when women have increased access to education and economic development (Bremner 2012, Zulu 2012).

Investment & management capacity

Given that, with a few notable exceptions (mainly in Kenya, South Africa, Botswana and Namibia), most of Africa's National Parks are grossly underfunded (Lindsey et al. 2017; Box 6.2.1 in Chapter 6.2), greater financial investment in NP and other wildlife areas is therefore a conservation priority in order to enable parks to e.g. hire staff and buy equipment, allowing them to perform their conservation duties (Ripple et al. 2016). While the success of PAs at protecting prey populations is higher where there is economic utilisation of wildlife (Lindsey et al. 2017), it is unrealistic to think that reve-

nue generated locally, through either consumptive or non-consumptive tourism, could be sufficient to support the management and the protection of an adequate protected area network (Packer & Polasky 2018). Furthermore, because most African governments, unlike North American or European governments, do not have access to a tax base to be able to adequately support a protected area network (Packer & Polasky 2018), it becomes clear that international investment is critical for the conservation of African ungulate populations and general biodiversity (Balmford & Whitten 2003, Ripple et al. 2015). Increased funding to African conservation can be available from Western country's tax bases, private philanthropy and payment for biodiversity services programs (Balmford & Whitten 2003). For example, during 2017 African Parks brought in approximately US$ 32 million in funding from international donors towards the reclamation of PA's in Africa (African Parks 2017). International carbon credit programs can be an option for funding the acquisition and protection of forests and woodland habitat as carbon sequestration banks which, if protected from over hunting can serve as wildlife refuges. Biodiversity offsets (measurable conservation outcomes of actions designed to mitigate biodiversity impacts of development projects) could also provide additional funding for PAs (Githiru et al. 2015; Chapter 6.9).

Funding is also needed in order to buy expertise in the form of training from external trainers. Management, technical, scientific, law enforcement and judicial capacity and expertise are lacking in many of Africa's PAs and wildlife management authorities, which greatly hinders the conservation of species and habitat. These issues can be tackled e.g. by implementing National Park co-management models (Box 6.2.2 in Chapter 6.2), and providing training courses to staff ranging from field rangers, to customs and border officials, police and prosecutors. Such training courses are often offered by International GOs and NGOs (Chapter 7). In countries that lack the capacity, the most effective co-management models for rehabilitation of national parks and protection of wildlife populations have been delegated management models where the external partner has full management power of the PA for the duration of a lease (Baghai et al. 2018; Box 6.2.2 in Chapter 6.2).

Over-hunting (trophy hunting)

The building of a wildlife-based economy to provide economic incentives to citizens and the willingness of governments to set aside wildlife areas or keep existing wildlife areas free of livestock has positive effects on prey populations (Lindsey et al. 2017). Photographic tourism can support this economy however it is dependent on political stability, relatively easy accessibility to the concerned wildlife area and high densities of wildlife. Trophy hunting is generally more robust to political insecurity and poor infrastructure and has less of a requirement for high wildlife densities (Lindsey et al. 2007). Trophy hunting therefore has the potential to act as a more sustainable, wildlife supporting land use than agro-pastoralism in areas where a different form of tourism is not viable, and is already the primary economic industry in 1.4 million km^2 of wildlife areas of Africa (Lindsey et al. 2007). However, trophy hunting quotas must be properly guided by robust population ecology and sustainable wildlife management practices, and not by local politics or economics (Loveridge et al. 2007, Lindsey et al. 2013; see also Chapters 6.5; 6.6). Trophy hunting also has the benefit of being able to provide communities with meat, as a bi-product of the hunt, which may increase community sense of ownership and support of the land use (Lindsey et al. 2007).

Loss of habitat

Community-based conservation programs (Chapter 6.9) have been widely implemented across Africa as an alternative to and partner to, the largely colonial developed, National Parks system (Hulme & Murphree 1999). As such, community-based conservancies have the potential to play an especially important role in providing dispersal and wildlife corridor habitat between existing source populations in NPs (Brown & Bird 2011).

The Namibian conservancy model, the Community-Based Natural Resource Management model (CBNRM; see e.g. Namibian Association of CBNRM Support Organisations (NACSO)), has been very successful at contributing to the conservation of ungulate populations and lessons can be learned from there and applied elsewhere (Brown & Bird 2011). There are 50 community conservancies (in 2007) together expanding available wildlife habitat in the country by 50% (Brown & Bird 2011). The success of the Namibian CBNRM model is attributed to the quality of leadership of the Namibian government and collaborations with NGOs (Brown & Bird 2011). The CBNRM was largely based on the successes and failures of the earlier established Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) program in Zimbabwe (Brown & Bird 2011; see also Chapter 6.9). CAMPFIRE has funnelled millions of US dollars to local government sectors, both through direct sales of wildlife and through international aid and is therefore generally lauded as a success (Frost & Bond 2008), however less emphasis has been placed on evaluating the programme's success from a wildlife conservation point of view. Repeat aerial surveys of the Sebungwe region of Zimbabwe revealed significant declines of elephant (-76%), buffalo (-73%), sable (-80%), zebra (-80%), kudu (-93%), waterbuck (-58%) and impala (-62%), corresponding with increases in cattle, goats, sheep and elephant carcasses between 2001 and 2015 (Dunham et al. 2015). CAMPFIRE does not reflect a conservation success; the political situation in Zimbabwe has arguably led to the programme's failure (Mapedza 2007) and strongly contrasts with Namibia's CBNRM program.

Competition with livestock

Community grazing programs, where seasonal movement of cattle is managed to preserve dry season refuge habitat can also improve co-existence of pastoralist activities with wild ungulates (Tyrell et al. 2017). Alternatively, the strategic use of fences to restrict livestock encroachment from wildlife areas can contribute to ungulate conservation (Lindsey et al. 2017). However, ill placed fences may cut off migrations and cause large scale die-offs of ungulates as exemplified by the veterinary fences of Botswana (Gadd 2011). The impacts of these fences on ungulate ecology should be carefully considered and efforts made to remove fences, which are detrimental to wildlife migrations.

The creation of trans-boundary protected areas (Box 4.3.1 in Chapter 4.3) has had positive impacts on ungulate conservation by providing the mechanism for the removal of fences along some international borders (e.g. in the Greater Limpopo TFCA) thereby allowing ungulate populations to resume historic migrations and recolonise lost habitat as well as simply increasing the size of protected area networks (Hanks 2000).

Over-hunting (bushmeat)

The demand for bushmeat can be reduced by providing access to alternative proteins and alternative livelihoods, and increasing the costs of bushmeat poaching through improved law enforcement. Examples of successful community level alternative protein projects have included the development of

fish farms in Zimbabwe (Shava & Gunhidzirai 2017) and rabbits, duck and domestic guinea fowl keeping in Niassa Reserve (Niassa Carnivore Project 2014). Such projects are generally implemented by international NGOs as they require significant investment including the building of infrastructure, supplying the source animals and training of local people and their success relies on maintaining community motivation (Shava & Gunhidzirai 2017). Large-scale commercial bushmeat poaching, supplying customers in urban areas, could also be reduced by providing alternative proteins. The development of more efficient industrial meat farming could fill this need. However this requires significant financial and technical investment and is thus dependent on political stability. Given the declining conservation of many fish stocks (Pauly et al. 1998), increasing reliance on commercial fishing should not be encouraged as an alternative to commercial bushmeat poaching. Promoting the consumption of insect or vegetable proteins, as an alternative to red meat, has however the potential to greatly reduce the demand for bushmeat. Insect and vegetable proteins also require less land, less water and contribute less to climate change and desertification than beef farming (Sabaté et al. 2014).

Access to revenue streams based on sustainable uses of wildlife is another important tool for tackling the bushmeat poaching problem. Photo tourism and hunting tourism can each bring in revenue to communities and encourage the conservation of wildlife. In some areas where neither of these industries are viable, there is the potential for community and cultural tourism ventures, including developing community campsites. However, the relationships between increased economic development and reductions in bushmeat use are not always simple and bushmeat is often consumed out of preference, or people with access to legal revenues may continue to poach commercially for additional income (Milner-Gullanda & Bennett 2003). Where the decision to eat or buy bushmeat is cultural, particularly for urban consumers, encouraging a cultural shift from bushmeat is required. For instance, a large scale media commercial campaign, "THIS IS NOT A GAME" has been implemented by the Wildlife Crime Prevention to discourage urban Zambians from buying bushmeat through focusing on the risk of zoonotic disease to consumers of bushmeat, the legal risks to buyers and economic losses brought on by poaching.

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6.4. Conservation landscapes for lions

Andrew J. Loveridge and Lisanne Petracca

Threats to Africa's natural environment and biodiversity have never been more severe. Africa's human population is growing at an unprecedented rate, the current population being predicted to have almost trebled by 2060, from 1.1 billion to over 2.8 billion people (Canning et al. 2015). Burgeoning human populations are predicted to exacerbate the already significant demand for conversion of wild lands to agricultural production. Tilman et al. (2017) predict that to feed Africa's 2060 population 430 million hectares of wild habitat will need to have been cleared for food production, an area of land equivalent to the continental USA. This is likely to have dire consequences for the amount of wild habitat available for conservation of natural ecosystems. Furthermore, heavy investment in infrastructure geared towards industrial resource extraction, such as China's international Belt and Road Initiative, may well exacerbate environmental degradation (Demissie et al. 2016, Manongdo 2018).

Whilst there is a moral imperative to develop Africa's economies for the benefit of Africans and alleviation of poverty, if the continent's unique fauna, flora and ecosystems are to survive, conservationists and African governments need to plan for zonation of development and prioritisation and preservation of critical habitats. Wide-ranging species such as lions that conflict considerably with people and whose survival depends on extensive space and large populations of medium-sized ungulate prey, may need particular attention. Furthermore, because lions function as an umbrella for many species, conserving viable lion populations is likely to protect whole ecosystems (Macdonald et al. 2015).

Against this backdrop, African lion populations have become increasingly fragmented in the last 50 years (Chapter 2). This process of fragmentation is highly likely to accelerate, with lion range increasingly reduced to small habitat pockets. Small isolated populations are vulnerable to edge effects and highly prone to extinction through catastrophic events, such as disease epizootics, and demographic stochasticity (Woodroffe & Ginsberg 1998, Loveridge et al. 2016). It is clear that in the face of rapidly changing social, economic and environmental circumstances a 'business as usual' conservation approach is likely to fail.

The African protected area network protects 56% (926,450 km^2) of extant lion range (Lindsey et al. 2017) and should be protected and managed as an absolute conservation priority. However, Lindsey et al. (in Press) found that most African protected areas are chronically underfunded and as such are likely to fail to safeguard the most vulnerable species and ecosystems (Box Underfunding in Chapter 6.2). Lindsey et al. (in Press) argue that support for conservation of Africa's protected areas should be funded as an international development priority.

However, effective conservation of African lions may hinge not only on protection and management of the current network of national protected areas, but also on identifying and protecting the habitat that links protected areas to allow long term gene-flow. Borklund et al. (2003) show that in order to maintain adequate levels of genetic diversity and avoid inbreeding lion populations should consist of at least fifty prides. In reality only a handful of large stronghold populations, (sensu Riggio et al. 2013) are likely to fulfil this theoretical criterion and some populations are by implication likely to already be suffering from some degree of inbreeding. Nevertheless, lions are highly mobile, with sub-adult

male dispersers having been recorded moving several hundred kilometres from their natal prides to settle in other regional populations (Elliot et al. 2014, A. Loveridge, pers. obs.). Where habitat corridors connect populations, as is likely to still be the case in large parts of southern and East Africa, it is probable that there is genetic exchange across a larger meta-population via dispersing animals. Maintaining this connectivity is critical for long term conservation and genetic integrity of the species. Methods in landscape ecology can provide empirical evidence to identify threats to habitat linkages and for prioritisation and conservation of critical habitats contributing to habitat connectivity within current lion range (Elliot et al. 2014, Cushman et al. 2015). Such initiatives also provide policy makers with clear visualisation of planning needs (Cushman et al. 2018). Box 6.4.1 provides an example of landscape prioritisation for lions within the Kavango-Zambezi (KAZA) Transfrontier Conservation Area in central southern Africa.

Whilst it is clearly desirable to maximise connectivity across lion range, this is not always feasible and conservationists must be realistic about the challenges African people face living with large predators. Because of this, it is sometimes more effective to limit lion movement through fencing isolated populations that are likely to be heavily impacted by edge effects and/or come into conflict with human communities. Packer et al. (2013) show that fenced lion populations are significantly more likely to persist than those in unfenced reserves and such populations require much smaller management budgets to protect. This has occasionally been a controversial view and it is self-evident that fencing is not always an appropriate intervention, particularly in ecosystems with migratory ungulate species (Pfeifer et al. 2014). Fencing is also expensive to install and maintain and if not adequately managed and repaired, quickly becomes ineffective (Kesch et al. 2015). Furthermore, steel fencing wire on poorly maintained fences is often used to manufacture wire snares for use in bush-meat poaching which exacerbates biodiversity loss.

Within the framework of creating landscapes that contribute to protection of lion populations, the attitudes and motivations toward lion conservation of human communities that live within putative habitat linkages between core protected lion populations are of utmost importance. Lions are dangerous predators, that threaten human lives and cause significant economic damage when they kill domestic stock. If people are to tolerate lions and other large predators, measures to mitigate these threats need to be put in place as part of landscape-level conservation. Programmes, such as the Lion Guardian Programme in southern Kenya, have been successful at promoting co-existence with lions (Hazzah 2006, Hazzah et al. 2014). Promoting effective livestock protection is also critical in order to reduce levels of conflict (Kissui 2008, Loveridge et al. 2017). Tolerance for lions and other large predators outside protected areas may hinge on cultural and economic valuations of these species (Dickman 2010) and as such income generation from wildlife-based economic activities, such as tourism, may play an important role. Such initiatives are essential if habitat outside the protected area network is to be maintained for wildlife. Nevertheless, in some situations conservationists need to be pragmatic about whether it is practical or indeed morally appropriate to expect people to co-exist with lions. In such cases clear land-use planning to ensure zonation between wildlife areas and community land may be required. Landscape ecology approaches may be useful in prioritising such land use decision making and maximising conservation outcomes.

Box 6.4.1 KAZA Lion connectivity model

Andrew J. Loveridge and Lisanne Petracca

Landscape connectivity models allow the conceptualisation of long-term process over large spatial scales and test possible land use scenarios to inform future land use management decisions. These empirically-based models allow decision makers to design policy based on likely animal behaviour and avoid ad hoc designation of wildlife corridors. They also facilitate identification of threats to existing wildlife corridors. A team from the Wildlife Conservation Research Unit, Oxford University, modelled patterns of connectivity based on lion movement data across the 500,000 km^2 Kavango-Zambezi (KAZA) Transfrontier Conservation Area landscape in central southern Africa (Figure 1). Lion movements were predicted from GPS data collected from dispersing sub-adult males to create a cost or resistance surface (Elliot et al. 2014). Predicted movements of dispersing lions were calculated across the resistance landscape using software package UNICOR (Landguth et al. 2012) to generate maps of potential habitat connectivity and predicted corridor networks between habitat cores (Cushman et al. 2015, Cushman et al. 2018). To provide priorities for conservation policy makers, lion movement core areas and linkages between them were ranked according to their importance in connecting key populations and their predicted viability. The model also predicts potential human-lion conflict hotspots based on lion movement in the landscape.

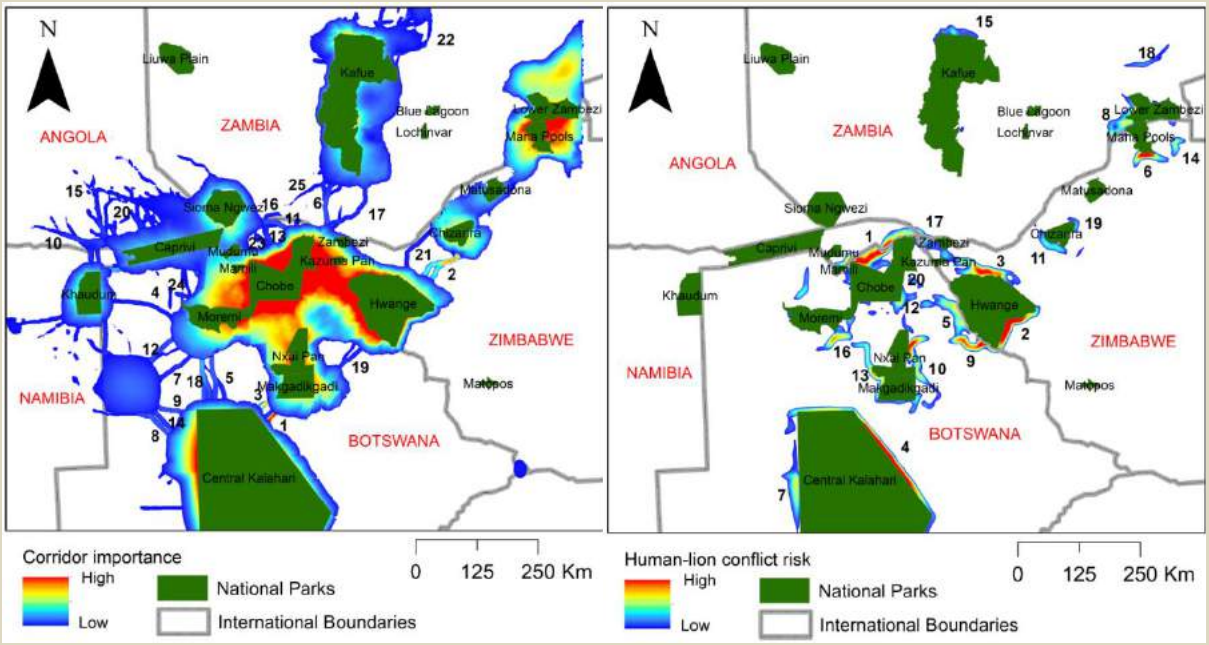

Fig. 1. KAZA lion landscape connectivity model (Cushman et al. 2018). Left: Core population areas and linkages/ corridors between lion core areas outside national parks/game reserves (green) in and adjacent to the KAZA TFCA ranked in order (1 being highest priority) of their conservation priority by their relative strength, importance in connecting potentially isolated elements of the landscape (see Cushman et al. 2018 for detailed methodology). Right: Human-lion conflict risk in and adjacent to the KAZA TFCA ranked by their relative conflict risk (1 being the highest conflict risk).

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6.5 Lion trophy hunting

Amy Dickman, Matt Becker, Colleen Begg, Andrew Loveridge and David Macdonald

Introduction and overview

This sub-chapter provides an overview of lion trophy hunting and suggested best practices if it is used as part of a country's wildlife management strategy. It is important to note that only trophy hunting (also known as safari hunting or sport hunting) is covered here, which is defined by the IUCN as follows: "*Trophy hunting generally involves the payment of a fee by a foreign or local hunter for a hunting experience, usually guided, for one or more individuals of a particular species with specific desired characteristics (such as large size or antlers). The trophy is usually retained by the hunter and taken home*" (IUCN 2016). We are not covering the hunting and killing of lions for other reasons, such as for trade, retaliatory killing, traditional hunting etc., although these are likely to be of conservation interest in many populations (Box 6.1.2). We are also focusing on the hunting of wild lions, so the 'canned' hunting of captive lions is only included where specifically indicated.

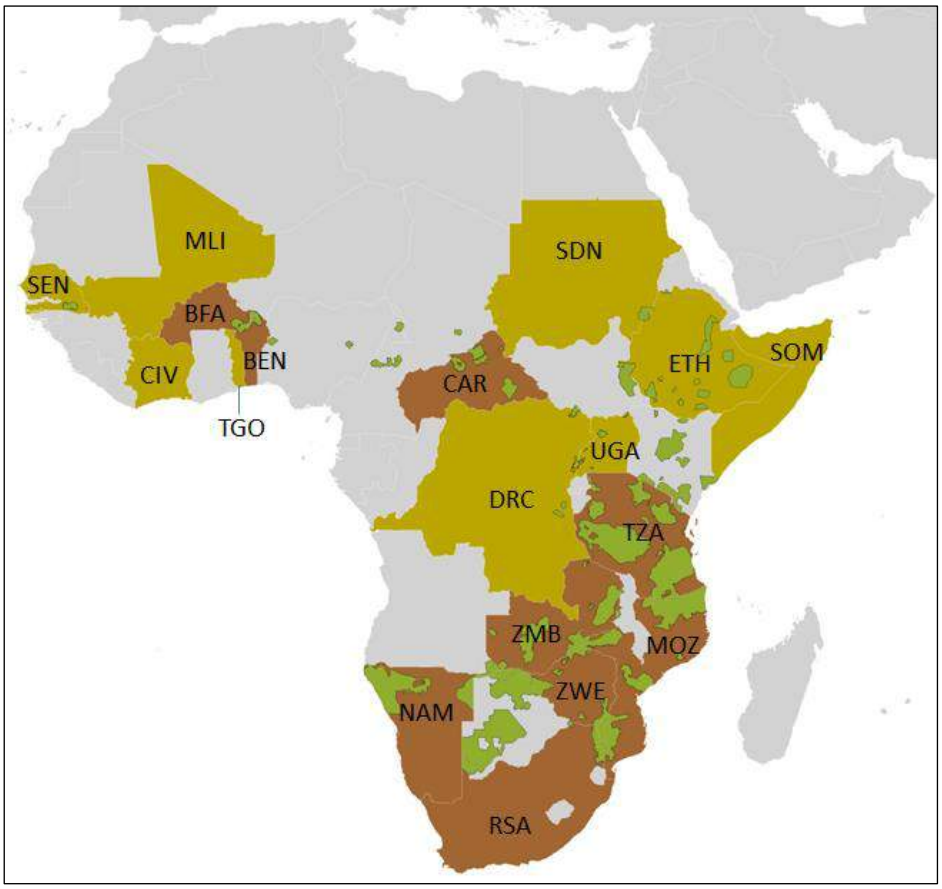

Fig. 6.5.1. Trophy hunting for lions is legally possible in 18 African lion Range States (yellow and brown), of which 9 countries (brown) have exported lion trophies in recent years (USFWS 2015, Macdonald 2016). Lion distribution in green (Chapter 2).

Trophy hunting has not been regarded as one of the most significant threats to lions at a regional level – out of 9 ranked threats, experts ranked it as 8th in West and Central Africa (IUCN 2006a) and

6th in East and Southern Africa (IUCN 2006b) – but it can still be an important (and sometimes even primary) threat to specific populations, so the topic deserves careful attention. The US Fish and Wildlife Service found that as of May 2015, lion trophy hunting was legal in 18 African countries (U.S. Fish and Wildlife Service 2015), but this does not mean it actually happens across all of them – several of those countries no longer have extant lion populations, and/or have not trophy hunted lions in the recent past. Data collated in 2016 revealed that 9 African countries (Benin, Burkina Faso, Cameroon, Ethiopia, Mozambique, Namibia, South Africa, Tanzania and Zimbabwe; Fig. 6.5.1) exported lion trophies in 2014–2015 (Macdonald 2016); Fig. 1. Zambia did not export lion trophies in those years, but reinstated lion trophy hunting in 2016 after a 2013 moratorium (Macdonald 2016). Even including Zambia, lion trophy hunting has therefore recently occurred in less than half the 25 current African lion range countries (Bauer et al. 2016). However, it is worth noting that the 10 countries where trophy hunting has recently occurred collectively represent around 70% of remaining wild African lion range and around 75% of the wild population (Dickman et al. in prep).

Trophy hunting occurs on various land use zones, depending on national legislation. The extent of land covered by trophy hunting has been debated (and changes with national policies), but is extensive: in 2007, Lindsey et al. estimated that in countries where it was permitted, trophy hunting covered 22% more land than National Parks (Lindsey et al. 2007). In 2013 (before Botswana's trophy hunting ban), Lindsey et al. (2013) estimated that lions were hunted across at least 558,000 km^2, representing 27–32% of the species' range in lion hunting countries (Lindsey et al. 2013), and around 16% of the lion's continental range (Riggio et al. 2013). This maintenance of lion range under a wildlife-based land use has been highlighted as one of the main conservation benefits associated with trophy hunting (Di Minin et al. 2016, Macdonald 2016). It can also generate substantial economic revenue, which often supports the country's wider conservation efforts: di Minin et al. (2016) reported that before the ban in Botswana, trophy hunting generated around USD 217 million annually across Botswana, Mozambique, Namibia, South Africa, Tanzania, Zimbabwe and Zambia. These figures include many species other than lions, but (Lindsey et al. 2012) found that lion hunts attracted the highest mean prices of all trophy hunts, that lions generated 5–17% of gross national trophy hunting income and that if lion hunting stopped, trophy hunting could become financially unviable across around 60,000 km^2, risking the loss of that habitat (which is equivalent to around 4% of current African lion range; Dickman et al. in prep, Chapter 6.4).

However, trophy hunting can have marked negative impacts on individual lion populations, especially where harvest rates are high (Caro et al. 2009, Creel et al. 2016, Loveridge et al. 2007). Trophy hunting can have particularly damaging impacts where it occurs alongside other threats in poorly-regulated areas (Creel et al. 2016. Macdonald 2016), although sometimes trophy hunting can be the main or sole driver of decline (Packer et al. 2009, Rosenblatt et al. 2014, Mweetwa et al. 2018). Trophy hunting females (which is still legal in Namibia and South Africa), or young or prime-aged males is particularly damaging, with long-term population impacts including the disruption of social structures, rapid turnover of pride males and additional mortality through infanticide and the deaths of sub-adults (Elliot et al. 2014, Loveridge et al. 2007, 2010). There is particular concern over trophy hunting on the borders of National Parks, where a 'vacuum effect' draws territorial males into hunting zones, potentially affecting the long-term viability of lion populations even within core protected areas (Loveridge et al. 2010, Whitman et al. 2004). In areas where there are substantial other threats to lions, such as illegal killing, the legal offtake adds to the overall anthropogenic mortality in the population, so the overall mortality levels can be unsustainable (Mweetwa et al. 2018, Rosenblatt et

al. 2014). The degree of impact of trophy hunting varies considerably - in Hwange for example, lion mortality was the single largest cause of mortality for male lions (Loveridge et al. 2016), while on land adjacent to Ruaha National Park, mortalities from conflict dwarfed trophy hunting impacts, with over 35 lion conflict deaths in 18 months in an area of less than 500km^2, including pregnant or lactating females (Amy Dickman, pers. obs.).

It is also a topic which raises significant ethical issues and concerns about animal welfare (Nelson et al. 2016), and is viewed by many people worldwide as unacceptable, especially after the high-profile trophy hunting of 'Cecil the lion' in 2015 (Macdonald et al. 2016). Nevertheless, the Communique from the African Lion Range States meeting in 2016 declared that '*We…..Highlight the benefits that trophy hunting, where it is based on scientifically established quotas, taking into account the social position, age and sex of an animal, have, in some countries, contributed to the conservation of lion populations and highlight the potentially hampering effects that import bans on trophies could have for currently stable lion populations*'. It is clearly important that if trophy hunting is part of a range country's wildlife management policy, then it should be well-regulated, humane and ensure that it contributes significantly towards conservation. Here, we provide some general guidance on how that could be achieved.

Suggested lion trophy hunting criteria and considerations

Overall, based on extensive examination of the subject (Macdonald 2016), we suggest that as best-practice guidance, trophy hunting of lions should only occur if two specific criteria are met: (i) that any such hunting is unlikely to cause detriment to the lion population from which it was taken and (ii) that the hunting contributes to lion conservation. It is worth noting that although within CITES, 'non-detriment' generally refers to an action 'not detrimental to the survival of the species' (see also Chapter 6.6), here, we interpret it as not only ensuring that the population survives, but also that lion numbers are maintained at a level healthy for the ecosystem concerned. With any hunting, there is of course detriment to the individual concerned, but our detriment consideration is aimed specifically at the population level, to ensure that any hunting does not negatively impact its conservation. Regarding the contribution to conservation, this has to be assessed at the level of that particular lion population. Good conservation management (e.g. through anti-poaching efforts, community engagement and financial support to conservation) should protect significantly more lions over the long term than are killed on trophy hunts.

The individual aspects of these criteria (such as defining suitable target animals and quotas), and some additional suggested considerations, are discussed more below.

Ensuring that trophy hunting does not cause detriment to the lion population

Defining suitable trophy lions

In order to avoid detriment, female lions should not be eligible as trophy animals, due to their significance for the reproductive success of populations (Macdonald 2016, Packer et al. 1988). Furthermore, to avoid additional mortality from social disruption, pride-aged males should be avoided: the best available science recommends restricting hunts to male lions aged 7 years or older (Creel et al. 2016). However, there is a high degree of uncertainty surrounding the threshold age at which remov-

ing males from the population causes minimal disruption, and there is an urgent need for more research on this topic. In well-studied populations such as Hwange, data suggests that 6-8 year old males are often pride males with dependent cubs, so hunting 7 year old males under such circumstances causes high levels of social disruption and is likely to have negative impacts on population dynamics. The impacts of removing males of a certain age (e.g. 7 years) may vary between populations, or even within populations at different times. Therefore, although many national policies now use 7 years as a guideline, we advocate that the precautionary principle is applied and conservatively only older males (possibly 8 years or above) being hunted, and continued research is needed to monitor the impacts of the offtake and adjust recommendations as needed.

It is possible (particularly with adequate training of professional hunters; (Miller et al. 2016)) to age lions with relatively good precision using nose colour as well as additional characteristics such as mane length and coverage, tooth colour and facial scarring (Miller et al. 2016, Whitman and Packer 2007); Fig. 6.5.2). In addition to those ageing guides, there are now open-access sites where people can learn how to age lions and test themselves for accuracy. However, under field conditions, ageing can be inaccurate, particularly in the 5–6.9 year age range (Miller et al. 2016), which is another reason to set trophy eligibility to 7 years or above (Fig. 6.5.3), if not older, to increase likelihood of accurate ageing. It is therefore important that professional hunters should receive adequate training and testing in identifying a suitable lion under their field conditions, and also that professional hunters are not influenced in their choice by pressure from the client.

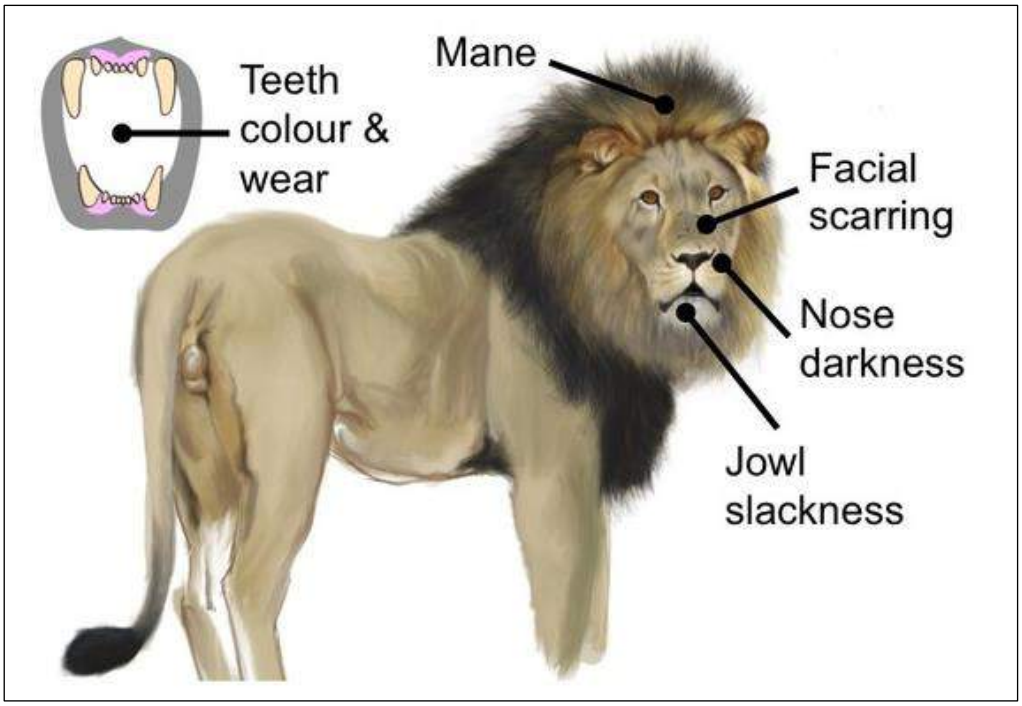

Fig. 6.5.2. Phenotypic characteristics used for aging lions in the field. Source of the picture is "Aging the African Lion", a website created by lion biologists to facilitate training in lion aging.

Defining appropriate quotas

Some of the earlier guidelines on trophy hunting offtakes based their recommendations on the percentage of adult males (or sometimes adult lions in general) which could sustainably be removed. Creel and Creel (1997) suggested that a 5% removal of adult males would be sustainable, while Greene and Mangel (1998) put the level at 10% of adult males. Caro et al. (2009) recommended offtake of 5% of total population, which (as most trophy hunted lions are adult males) would lead to a higher removal of adult males than either Creel and Creel (1997) or Greene and Mangel (1998) indicate would be sustainable. However, very few lion populations have sufficiently accurate and regular population surveying to determine population size, composition and dynamics (Chapter 5), so setting quota numbers based on a percentage of the adult males (or even total population) is not generally recommended (Macdonald 2016). Instead, it is better to set quotas for the removal of adult males based on lion age and/or the area of land hunted, as outlined below.

Quotas should ideally be set and managed at the level of the hunting area (not at a national level), and should be verified and audited by an independent committee of stakeholders in each country (Macdonald 2016), which should not be just a government agency, or a hunting agency, but a truly independent and representative group of relevant stakeholders. That committee should, according to (Macdonald 2016):

- Audit hunting practices;
- Set and monitor quotas;
- Encourage certification of hunters;
- Ensure adequate training of professional hunters (especially in marksmanship and animal welfare issues);
- Ensure transparency and compliance, and
- Verify the age of hunted lions based on hunt reports, photos and tooth X-rays.

The costs of operating these committees would normally be met by stakeholders such as the hunting industry, relevant NGOs, international and local governments.

The age-based approach to quota setting is founded on the principle that removing older males (which are likely to have already reproduced successfully) has little impact on population sustainability, regardless of the population size or numbers hunted (Whitman et al. 2004). Removal of such males should lead to less social disruption and killing of sub-adults, although it is not guaranteed: Data from some locations such as Hwange (ZWE) suggest that even old males can still be reproductively active and their killing may still have wider negative social impacts (Macdonald 2016). Whitman et al. (2004) et Whitman et al. (2007) originally suggested that males aged 5 years or over could be sustainably harvested without marked negative population impacts, but for caution, more recent studies recommend only hunting males aged 7 years or older (Creel et al. 2016). However, even restricting hunters to males of 6 years or older has proved to reduce pressure on hunted lion populations in Mozambique (Begg et al. 2018). Several countries have now developed age-based adaptive quota setting, where a hunting operator's quota for the next year is based on the number and ages of the lions hunted that year, with penalties for hunting younger males and rewards for compliance with age restrictions (Box 6.5.1). These have proved effective at improving hunter compliance with age restrictions and reducing pressure on hunted lion populations (Begg et al. 2018).

Box 6.5.1 Point system for lion trophy hunting

The procedure for the first "points system" established in Niassa Reserve, Mozambique in 2006 (Begg et al. 2018), which has now been utilised successfully in other countries such as Zimbabwe. A worked example is shown below. The Niassa Point System is a three-step process:

Step 1: At the end of each hunting season (November) each lion trophy taken is aged by SRN (Sociedade de Gestão e Desenvolvimento da Reserva do Niassa) representatives (currently K. and C. Begg) based on teeth, nose colour, mane development and general body condition.

Step 2: Points are assigned to each trophy according to the following system:

Quota	Number of points for each trophy				
	>6 yrs	no trophy	4–6 yrs	<4 yrs	incomplete info
For quotas of 3 or more	4	3	2	-3	0
For quotas of 2	4	3	2	0	0
For quotas of 1	6	3	0	0	0

For each concession, points are tallied for that year, divided by 3, rounded to the next whole number up to a maximum of 5 lions and that is the quota issued for the next hunting season. (An example is given in the Table below, taken from the Supporting Information to Begg et al. 2017).

Step 3: SRN will endeavour to inform operators of the new quota to allow time for marketing at safari shows in January.

Some examples of quotas calculated using the Niassa Points System for African lion.

Current quota	Number of lions in each age-point-categroy					Points calculation			New quota
	>6 yrs	4–6 yrs	<4 yrs	No info	Not taken	Sum	Total points	Pts / 3	
Quotas of 2	4 pts	2 pts	0 pts	0 pts	3 pts				
2 lions	1	1	0	0	0	4+2	6	2.0	2 lions
2 lions	1	0	1	0	0	4+0	4	1.3	1 lion
2 lions	2	0	0	0	0	4+4	8	2.6	3 lions
Quotas of 3	4 pts	2 pts	-3 pts	0 pts	3 pts				
3 lions	0	0	0	0	3	3+3+3	9	3.0	3 lions
3 lions	0	0	0	1	2	0+3+3	6	2.0	2 lions
3 lions	2	0	1	0	0	4+4-3	5	1.6	2 lions
3 lions	0	3	0	0	0	2+2+2	6	2.0	2 lions
3 lions	3	0	0	0	0	4+4+4	12	4.0	4 lions
Quotas of 4	4 pts	2 pts	-3 pts	0 pts	3 pts				
4 lions	1	3	0	0	0	4+2+2+2	10	3.3	3 lions
4 lions	3	0	1	0	0	4+4+4-3	9	3.0	3 lions
4 lions	4	0	0	0	0	4+4+4+4	16	5.3	5 lions
Quotas of 5	4 pts	2 pts	-3 pts	0 pts	3 pts				
5 lions	4	0	1	0	0	4+4+4+4-3	13	4.1	4 lions
5 lions	3	0	2	0	0	4+4+4-3-3	6	2.0	2 lions
5 lions	5	0	0	0	0	4+4+4+4+4	20	6.6	5 lions
5 lions	2	1	0	1	1	4+4+2+0+3	13	4.1	4 lions

Age-based quota settings have proved useful in reducing the negative impacts of trophy hunting, but given the likelihood that many lion populations are declining, and subject to multiple other threats, and the possibility of errors in accurate ageing, the most precautionary approach is to combine an age-based method with an area-based one. Creel et al. (2016) recommend that alongside restricting hunting to adult males of 7 years or above, there should be a maximum offtake of ~0.5 lions per 1,000 km^2, with intermittent 2–3 year periods of non-hunting used to enable population recovery. Appropriate quotas will depend on the population concerned: hunting could be conducted at a higher level if there are good data to show that well-managed lion populations subject to that pressure are nevertheless stable or increasing (Macdonald 2016, ZPWMA 2015). Some high-density lion populations (e.g. the Selous, TZA) could probably sustain an offtake of 1 lion per 1,000 km^2 (Packer et al. 2011), while in low-density populations the quota may need to be reduced (Macdonald 2016).

If needed, then even relatively short moratoria (e.g. 3 years) have proved effective at markedly improving the status of lion populations in hunted areas (Mweetwa et al. 2018).

Fig. 6.5.3. Old male lion suitable for trophy hunting. Photo Ewan Macdonald.

Although the points-based system shown in Box 1 appears to have worked well in places like Niassa (Begg et al. 2018), substantial concerns remain about the potential negative impacts of trophy hunting lions right on the edges of a core protected area such as a National Park, as it is possible to draw suitable trophy lions from the Park without managing the hunting area well. Given how difficult it can be to accurately monitor lion populations, we suggest that prey surveys should also be undertaken in hunting concessions, as prey populations tend to be easier to survey and show a strong correlation with lion densities. If hunters are able to kill relatively high numbers of trophy lions (even of the right age) in areas with low prey densities, then it should raise concerns about whether those lions are being drawn from nearby areas, such as National Parks. Ideally, lion quotas should be kept as low as possible and an index of prey base should also be included as a metric in the points system, to try to ensure that the hunting area is maintaining its own wildlife populations sustainably rather

than drawing animals from other, better-managed areas. It would also be good to conduct prey surveys (and implement better wildlife protection, if needed) even within the protected areas as well as on any adjacent hunting zones, as many protected areas have both lions and prey populations substantially below carrying capacity (Lindsey et al. 2017). The aim should be to ensure that the entire ecosystem, including both core protected areas and trophy hunting zones, is managed as effectively and holistically as possible.

Ensuring that trophy hunting contributes to lion conservation

Trophy hunting should not only be sustainable where it is practiced, but it should also provide a net contribution to lion conservation. There are some forms of trophy hunting where this is clearly not the case. For example, although legal in several countries (and conducted most extensively in South Africa) most reputable scientists conclude that the practice of 'canned' hunting, i.e. the hunting of captive lions in very small, fenced areas, has no such conservation benefit. Canned or captive lion hunting raises considerable ethical and welfare concerns and has been condemned by a wide variety of stakeholders, including the IUCN, the Operators and Professional Hunting Associations of Africa, the Dallas Safari Club and the African Lion Working Group. Safari Club International does not allow the recording of trophies from canned lions in its record books, and the US Fish and Wildlife Service does not allow the importation of captive-bred lion trophies. There is no definition for how small an area constitutes 'canned' hunting, but a reasonable best-practice recommendation would be to only trophy hunt lions in areas sufficiently large to offer conservation benefit (suggested $\geq$ 500 km^2), and where the lion population is demonstrably well-managed within a functional ecosystem (Macdonald 2016).

Other aspects of trophy hunting should also be improved to maximise potential conservation benefit. Most hunting areas are leased to the operator, but if these leases are short-term with no guarantee of a long-term stake, there is little incentive to invest in conservation, and it is likely that the maximum number of animals will be hunted to maximise return on the cost of lease, even if this means that wildlife are over-exploited as a result (Damm et al. 2008, Macdonald 2016). We would suggest minimum leases of 10 years, with an option to renew if conservation requirements have been met (Macdonald 2016). Hunting areas are also not always allocated transparently, so it is hard to gauge whether good conservation management has been a key part of the decision-making, or whether the process is fair. We suggest that areas should be allocated transparently using open auction systems (Dickson et al. 2009), that recognizes the extent of past conservation investments in each block (Macdonald 2016). In some countries, the outfitter has to pay a mandatory fee for the lions they are allocated to hunt, even if they are not shot, which does not provide any incentive for hunting operators to reject lions that are too young, leading to reduced trophy quality and unsustainable harvesting (Packer et al. 2006). Ideally, trophy hunting fees should only be applied for hunted animals (rather than fixed quotas, where operators pay for lions allocated, even if they are not shot) to reduce the killing of unsuitable animals (Packer et al. 2006). Fees should ideally also reflect the scarcity of lions, so areas with few suitable trophy animals should have higher fees. Professional hunters should be trained to the highest standards, and hunting operators could also be certified using an adaptive method to ensure compliance with strict environmental, social and ethical criteria (Wanger et al. 2017). Professional hunters should be encouraged (for instance through long-term leasing of blocks, see below) to remain in the same area for several years at least, in order to im-

prove their ability to age lions accurately and ensure they have a vested interest in the long term conservation of the area where they hunt. Beyond conducting trophy hunting in the best possible way, trophy hunting operators should also perform valuable conservation activities to reduce other forms of lion mortality, which could include (1) assisting with or conducting anti-poaching activities, (2) working with local communities to engage them in conservation and reduce conflict, and (3) ensuring that the local communities receive direct revenue and benefits from trophy hunting. These direct, local benefits could include (i) actual revenue, (ii) meat distribution, (iii) social responsibility, (iv) community development projects (such as investments in education and healthcare) and (v) clear commitments to hire staff from local communities. Furthermore, at all levels, from the national government down to the trophy hunting operator, it would be optimal to maximise the amount of trophy hunting revenue allocated to conservation efforts.

Currently, most of the records regarding the export (and sometimes re-export) of trophy hunted lions are collated by CITES, providing an invaluable resource for monitoring the trophy hunting industry. However, at present it is possible for multiple different parts of the same lion (e.g. skull, skin, claws) to be recorded individually, so the records of body part exports cannot easily be equated to a number of individual lions. It would be important to adapt these CITES procedures to ensure that body parts exported are assigned to a single trophy lion, so that the level of export (and re-export) of lions could be tracked most effectively. Furthermore, given the growing threat of the lion bone trade (Williams et al. 2015), all non-exported bones from hunted lions should be verifiably destroyed, in order to help prevent trafficking.

Although by necessity this is only a brief summary of the issues, these recommendations are intended to help ensure that where trophy hunting is practiced, it minimises the risk of adverse outcomes on the population and maximises the chance of effective conservation.

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6.6 Non-Detriment Findings

Byron du Preez and José Vicente López-Bao

Background

The CITES convention requires that a permit should be issued only where the exporting Scientific Authority has determined that trade is not detrimental to the survival of the species. As populations of many species, especially large carnivores, vary across the extent of their range in terms of relative densities, protection afforded, amount and type of trade, and robust population data available; regulating the international trade in such species at a sustainable level is challenging. Compounding these complexities, many contiguous populations extend across the international borders of two or more countries, each with potentially differing wildlife management plans or regulations. There is therefore no single formula that can be applied to every situation; however it is possible to define a set of guidelines that will help the Scientific Authority of a Range State to evaluate the potential impact of trade on the conservation status of a particular species.

A Non-Detriment Finding (NDF) for a CITES Appendix-I or -II species is the result of a scientific assessment, in which the Authority takes into account a wide range of information and parameters, with the aim of verifying that a proposed export from a Range State is not detrimental to the survival of that population (Resolution Conf. 16.7 (Rev. CoP17)). General guidance on how to perform a NDF was provided by Rosser and Haywood (2002) and Parry-Jones (2013). A NDF is essentially a risk assessment. The precautionary measures and the amount of monitoring and research required should be proportionate to the risk that the harvest of a specimen will be detrimental to the species in the Range State concerned. Such a finding is necessarily reliant on the available data. However, the data quality varies along with the population dynamics, wildlife management, and monitoring effort throughout the species' range, and even within a given Range State.

Fig. 6.6.1. Ernest Hemingway posing with a lion shot during a safari in Africa in 1934 (photo Wikipedia). The author did likely not care about NDF. In his days, as many as 200,000 lions are estimated to have roamed sub-Saharan Africa.

Practical Non-Detriment Finding for lions *Panthera leo*

The majority of international trade in lions *Panthera leo* has historically been mainly comprised of trophy hunted specimens (Macdonald et al. 2016; Fig. 6.6.1) with a secondary, but recently escalating, demand for lion body parts, especially bones (Riggio et al. 2013; Williams et al. 2015), to be used in traditional medicine (Chapter 2.3). Robust population data is lacking for many areas (Chapter 2.1). Consequently, in the cases where lions are rare, under-researched, and not subject to specific management and monitoring, the making of a robust NDF will be challenging.

As per *Conf. 16.7*, there are various ways in which a Party's Scientific Authority can make NDFs. There exist a range of various different management approaches in the lion Range States in Africa, which may lead to the different assessment strategies. However, extant lion populations can be generally placed into one of two categories:

- *known* – those for which robust population data exist; and,
- *unknown* – those that are data deficient (the majority).

Those lion populations for which robust density and/or demographic data exist are better placed to make a NDF. For the lion populations that are data deficient, a far more cautious and restrictive approach to harvest must be applied. In these cases, it is necessary to rely on knowledge of the species' behavioural ecology with which to guide the assessment of sustainability.

With regard to the guiding principles contained in *Conf. 16.7*, the NDF for lion may include:

- Information relating to distribution, status and trends of populations based on national conservation plans, where applicable, and which inform harvests;
- A review of the sustainability of harvest levels taking account all mortality sources affecting the wild population of the species, including mortality due to illegal killing.

As a broad principle, the consumptive use of a species should be part of a wildlife management plan. It should be sustainable, adaptive, and producing tangible conservation benefits for the species and local people. In terms of trophy harvest, it is recommended that when undertaking a NDF, the Scientific Authorities should consider the following principles with regard to lion export:

- Lion trophy harvest is sustainably managed, with respect to:
  - a transparent regulatory framework relating to the harvesting of the species;
  - an effective enforcement mechanism with adequate deterrents and penalties for non-compliance;
  - a monitoring system designed to effectively monitor population trends and status;
  - an adaptive management system through which harvest levels can be adjusted according to the needs of the specific population and based on results of the monitoring programme;
- The harvesting practice does not undermine the conservation of the species (or any other);
- The harvest activity provides benefit to local communities.

In practical terms, based on the available information, and specific to lions, the Scientific Authorities could consider the following key attributes for satisfying a NDF:

- ***Age*** –With respect to lion trophy harvest, several Range States have self-imposed a minimum age criterion (of generally 6 years and older). This rule targets males surplus to breeding, and tends towards ensuring that harvesting of the population is compensatory to mortality, not additive (e.g. Begg et al. 2018; Whitman et al. 2004). The age-restrictive criterion is performance-based for which there are consequences that include quota adjustments for subsequent seasons. As such, once implemented, this system is self-regulating: Any areas that export underage animals on average will be penalised with a reduced quota in future. Those areas consistently exporting older animals surplus to breeding will be rewarded with an increased quota for their selectivity and investment in the conservation of the area that has led to a large and stable population. Range States that have applied this system include Zimbabwe, Tanzania, Zambia and Mozambique, which notably have some of the largest levels of both trade and lion population densities throughout the extant lion range. An advantage of this system is that it is easy to judge the age of lions post-harvest, and the system is transparent allowing all stakeholders to review the performance-based quota allocation process (Box 6.6.1).
- ***Sex*** – Due to the complex social relationships within the pride, where related females of several generations form the core structure, and in which all females may take part in caring for the cubs (e.g. Schaller 1972), it is generally accepted that trophy harvest should target males past prime to limit impact on population recruitment and survival (e.g. Whitman et al. 2004). Most range States limit harvest to males (past prime) with a view to reducing disturbance to the group.
- ***Rate of offtake per unit area*** – Lion density (and indeed carrying capacity) varies throughout the species' range, but many areas lack robust density estimates or even information on population status. However, it has been modeled that limiting off-take to 1 lion per 2 000 km^2 reduces the risk of over-harvesting resulting in a population decline (e.g. Packer et al. 2010). Permitting harvest at this level would allow data deficient areas to benefit from having lions on their land, however it would be recommended that these areas increase their efforts to obtain reliable population estimates, trends and threats, from which sustainable offtake levels in subsequent seasons may be calculated.

Though additional factors may be considered, these three attributes (age, sex, and rate of offtake per unit area) in particular have a distinct advantage from a regulatory perspective in that they are applicable across the board, and are all easy to assess post-mortem, and in a transparent manner that is open to all stakeholders.

As an example of a desirable attribute that is difficult to regulate, it is generally agreed that trophy hunting should exclude pride members (e.g. Bertram 1975; Packer et al. 2009). However, due to the intricacies of lion society as discussed, and because post-mortem assessment of pride status is difficult, this criterion may thus be impractical for assessment of Non-Detriment.

Another factor that may be encouraged by the overall NDF process is the inclusion of a dedicated anti-poaching effort in the area where the harvest is conducted. This benefits the overall conservation of wildlife, but in particular reduces potential additive mortality. The presence of an anti-poaching unit is not necessarily required to achieve a NDF, though the process of performance-based quota allocation may subsequently encourage and facilitate this activity.

Conclusion

In the case of lion trophy harvest, trade is only permitted where the CITES Scientific Authority can issue a positive opinion, stating that the specimen was obtained in a sustainable manner and, as appropriate (*Conf. 17.9*), provides benefits for both species-habitat conservation and local communities. However, the CITES Scientific Authorities of both exporting and importing nations are continually challenged to determine whether a particular export will be detrimental to the lion population – especially with a general lack of robust data and inconsistent information throughout its range relevant to assessing the impact of trade on the species, conservation, and local communities. Compounding this, specific rules cannot be uniformly applied across the extant lion range due to variation in populations, habitats, threats, land use, management, and government systems.

Trophy harvest should be part of a species management plan, be sustainable, adaptive and produce tangible conservation benefits for the species and local people. Populations with robust data may have greater flexibility in how they are managed, however a more cautionary approach should be applied to populations of unknown size and demographic structure. Given that minimum age, sex, and rate of off-take restrictions may be safely and practically applied to populations of unknown status, these criteria are therefore preferable. Age-based regulations (in combination with sex-restriction) are advantageous in being self-regulating and site specific, and encourage sustainable trade, reducing the risk of over-harvesting the resource.

Recommendations

The age-based restriction (in most cases combined with sex-based restriction), being performance-based and thus self-regulating, is the preferable method for limiting impact of harvest and improving sustainability, and facilitates the process of NDF.

In the cases where age-based restrictions are impractical to implement for whatever reason, and where there is limited information on population status or density to support an NDF, then a precautionary rate of offtake per unit area approach of allowing 1 lion per 2 000 km^2 would be prudent (together with sex-based restrictions where appropriate). This would enable limited harvest whilst encouraging efforts to obtain reliable population estimates, trends and threats, based on robust and on-going surveys.

Box 6.6.1 Example of a sustainable quota setting practice

Byron du Preez and José Vicente López-Bao

Several of the more significant lion trophy-exporting Range States have implemented both sex and age-based criteria with a *minimum* acceptable trophy being a male of 6 years old.

This system is performance-based, where current quotas are established from the results of the previous season; and the present year's performance will in turn affect subsequent quota allocations. The most practical implementation of this method is a point system (Table 1), where older trophies are awarded higher points and younger trophies are penalised and cost points; with the overall effect that the system is therefore self-regulating.

When implementing this system, each hunting area would have a starting quota, based on previous performance. In the cases where an area was previously not hunted it would be awarded a conservative quota as a starting point (e.g. 1 lion per 2 000 km^2, unless robust population data and density estimates are available with which to calculate an acceptable initial quota).

Table 1. Example of the point allocation for a performance-based quota allocation system (Begg et al. 2018).

	≥7 years old	**No hunt**	**6 years old**	**5 years old**	**<5 years old**	***Failure to submit return/ incomplete hunt returns***
Quotas of ≥3	4	3	3	1	-3	0
Quotas of 2	5	3	3	1	0	0
Quotas of 1	6	3	3	1	0	0

Quota setting process: *The total points for each area are added up and divided by 3 to yield the quota for the next year.*

Table 1 is based on a similar system successfully implemented in Zimbabwe (see du Preez et al. 2016; Macdonald et al. 2016); points are allocated to each trophy harvested based on age. The total points for each area are divided by 3 and rounded down to determine the next season's quota. A hunting operator can choose not to utilise some or all of their quota with no penalty for the subsequent season, which encourages selectivity; whereas harvesting a young animal would be detrimental to future hunt opportunities. Failing to comply with the system also results in reduced quota allocation.

As an example of this system in practice, at the end of each hunting season in Zimbabwe, all stakeholders (including professional hunters and safari operators, photographic tourism operators and guides, ecologists and conservationists, non-governmental organisations, and the Zimbabwe Parks and Wildlife Management Authority) gather to review every lion trophy harvested within the country that year. The trophies are aged by a panel of experts representing the stakeholders, and the results are presented to the audience along with photographs of each of the harvested animals and their skull with which to explain how the age was judged. Any queries regarding the ageing of any particular animal are openly discussed until the issue is resolved. In many cases this process has encouraged professional hunters and operators to conduct their own lion research projects, for example collecting time-stamped photographic records of all lions in their areas with which to provide accurate ages in future based on unique whisker spot patterns of each individual. This practice is an excellent outcome of the process and is endorsed by the lion-ageing panel as photographic proof of age trumps expert opinion. Once all ages are agreed upon for each specimen, the points are allocated and the next season's quotas are calculated and presented to the entire audience. This process produces a public record of the quota allocated to each area and for the country as a whole, and makes the system entirely transparent.

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6.7 Persistent stock-raiding lions and problem animal control

Laurence Frank

Populations of lions and other African predators are in rapid decline, also due to retaliatory killing by humans over livestock losses (Fig. 6.7.1). Livestock depredation is most serious where wild prey has been reduced by overgrazing, agricultural development or widespread bushmeat poaching, and where traditional livestock management practices have been abandoned. Most losses to predators can be prevented through diligent application of practices which have been used by African pastoralists for millennia. These include close herding during the day, by men rather than children, accompanied by dogs to warn of predators. At night, stock should be enclosed in secure bomas or kraals, with strong gates to keep cattle from breaking out when panicked by lions, and to prevent hyenas and leopards from entering. Traditional thorn bush bomas are effective if the walls are thick, regularly maintained, and if suitable bush is abundant. A variety of highly effective 'lion proof bomas' have been developed in recent years, including portable panels of chain link fencing (Frank 2011), walls of stone or wood posts (Ogada et al. 2003), and 'living bomas' of dense thorn bush (Lichtenfeld et al. 2014; see also Chapter 6.1).

However, some individual lions persist in taking livestock despite protective measures. Persistent losses can cause resentment against wildlife and conservation, and can lead to indiscriminate poisoning (Frank et al. 2011a, Ogada et al. 2015), spearing, trapping or shooting. In such cases, precisely targeted lethal Problem Animal Control (PAC) of identified persistent stock raiders is far preferable to indiscriminate killing by individuals or communities. In most countries, local or national wildlife authorities are legally tasked with the removal of persistent problem animals.

Fig. 6.7.1. Male lion shot after killing calves, 1998. Photo Lance Tomlinson.

Lion Management in Laikipia County, Kenya, 1995-2018

On the commercial beef ranches of Laikipia County in central Kenya, all five species of large African carnivores share 3,700 km² of well managed semi-arid Acacia savanna rangeland with cattle and abundant wild prey (Frank et al. 2005, Frank 2011). Low intensity wildlife tourism augments income from livestock on many ranches, an incentive for conservation. To protect livestock from predators, ranchers use traditional African husbandry methods: Cattle are attended by herders while grazing by day and brought back into secure bomas at night.

Living with Lions has been working with Laikipia ranchers since 1997 to assist in conserving predators while minimizing depredation losses. In 1995–96, 15 surveyed ranches reported shooting 31.5 cattle-killing lions per year, or 2.1 per ranch per year. In 1998–2002, shooting in response to livestock losses removed a mean of 19.4% of the lion population annually (Woodroffe & Frank 2005). Although mortality was high, lethal control was carefully targeted at offending individuals: When losses became excessive, the rancher would 'sit up' over a lion-killed cow the following night and shoot the lion which returned to feed.

The great majority of cattle depredation occurred either when stock were lost in the bush and left out of the boma overnight, or when lions approached a thorn bush boma, stampeding cattle which broke out through the boma gate, typically the weakest point (Ogada et al. 2003). Steady improvements in boma construction culminated with the development of 'mobile bomas', interlocking panels of chain link mesh, by rancher Giles Prettejohn in 2007 (Frank 2011). These are nearly 100% effective in preventing stampedes and were rapidly adopted by most commercial ranches, dramatically reducing cattle losses and lions shot in retaliation.

When the mobile bomas essentially eliminated lions' ability to take cattle at night, some ranches saw an increase in day time depredation. A variety of effective incentive systems have been developed on different ranches to reward diligent herders who do not lose cattle to lions.

Research activities also contributed significantly to reducing losses. We found that both Laikipia ranchers and Maasai pastoralists in southern Kenya were less likely to kill radio-collared lions they had come to know as individuals through our research; a lion with a name and a known history may be forgiven for depredation, which would have previously provoked retaliation. Day time losses declined when we fitted one female in each group with a Vectronic Aerospace GPS collar which recorded hourly fixes and uploaded the data at 07:00 h each morning via the Iridium satellite phone system. Initially, we e-mailed daily maps of lion movements and morning rest sites to all ranches, allowing ranch managers to direct herders away from lion locations. These were subsequently replaced with a real-time website showing the movements of each collared lion. Improved livestock management resulted in a marked decline in both cattle losses and lions killing. In 2001, 20 lions were known to have been shot on the ranches, declining to two in 2017 (Fig. 6.7.2). The lion population of Laikipia has been largely stable since at least 2003, currently standing at 7.8 /100km², or about 295 for the county. Omitting cubs, the density is 5.8/100km², or 220 adults and subadults (Living With Lions, unpublished data). The decline in shooting has led to more young animals dispersing onto community lands adjacent to the commercial ranches, where there is little wild prey and superabundant goats, sheep, and cattle; we believe that most dispersers are killed when they turn to taking livestock.

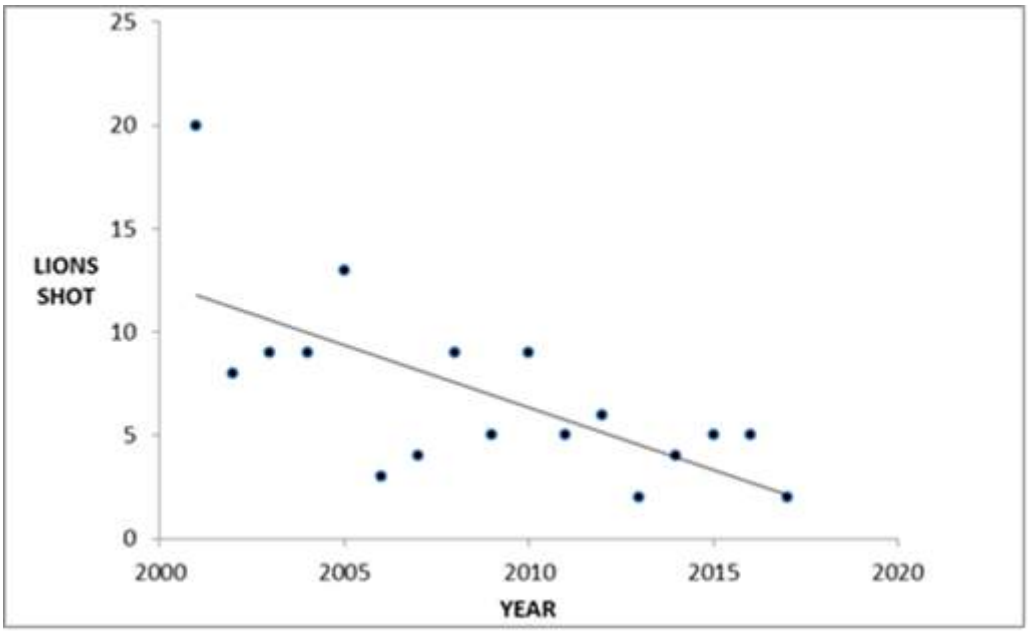

Fig. 6.7.2. Number of lions known to have been removed from commercial ranches in Laikipia County, Kenya. Decline in lethal control was due to improvements in cattle management which reduced depredaation losses. “Lion proof” mobile bomas were introduced in 2008 and today shooting is rare except on the few ranches with no tourism, poor cattle management, and little comitment to conservation.

However, a breakdown in cattle management can reverse progress. In 2016, the Laikipia ranches were invaded by heavily armed pastoralists from further north, bringing over one hundred thousand cattle. These were not kept in secure bomas at night and many were killed by lions. Unusually high rates of depredation on ranch cattle persisted even after the invaders were eventually removed by the government a year and a half later, demonstrating that good management must be consistent over time and on a wide geogrpahic scale in order to maintain the good behaviour lions gradually learn when management reduces livestock avialability.

Recommendations

Even when lethal problem animal control was still routine in Laikipia, most ranchers tolerated considerable loss before removing a lion, and were conservative and highly selective in doing so. Based on their practices, we offer the following recommendations to wildlife conservation authorities.

Definition

It is essential to have a clear definition of what constitutes a problem animal that warrants removal, and these may vary depending on land use, conservation priorities and other factors. At one extreme, in areas with high densities of people and livestock and little wild prey, any lion that strays into the area might be defined as a problem animal. Where tourism or trophy hunting provide economic benefits to rural people, some degree of depredation losses might be tolerated before a lion is deemed to be a problem. Where restoration of a lion population is a paramount goal, significant livestock loss may need to be tolerated. In each management area, definitions must be set and followed.

Investigation and education

The first response of a PAC team should be to investigate the circumstances of livestock loss to assess measures short of killing a lion which might resolve the problem. In some cases, disease or drought deaths may be blamed on predators if carcasses are subsequently fed upon by scavengers. In cases where depredation is not chronic and severe, the simple act of responding promptly to discuss complaints may satisfy livestock owners. Perhaps the most common cause of losses is leaving stock out of the boma at night, usually a result of inattentive herding. Basic education on livestock management reminds pastoralists that their ancestors effectively protected livestock through strong bomas and diligent herding. However, a low level of loss may be unavoidable where lions and livestock coexist: Cattle which stumble onto sleeping lions by day are at risk, and lions will take stock in the bush at night, even if they are not habitual problem animals.

Lethal control

The decision to remove a lion should only be made when there is evidence that people are doing their part to avoid depredation, and that an individual lion meets the definition of a problem animal set for the area.

Every effort should be made to kill only known problem animals. If good trackers are available, the best method is to track a lion from its kill the next morning and shoot it. However, lion hunting requires advanced skills and must never be attempted by the inexperienced. A wounded lion is extremely dangerous and every effort must be made to track it down.

As lions normally return to finish a carcass the night after the prey was killed, a PAC team can 'sit up' in a hide (blind) by the carcass, and shoot the lion that returns to it, normally the offending individuals. To avoid wounding, a spotlight should be switched on when lions are heard feeding on the bait. Personnel should be well trained in basic anatomy, shot placement and quick, accurate shooting by spotlight. Military rifles carried by most rangers are inadequate and appropriate heavier calibre weapons should be used.

Alternatively, a trap can be set using last night's carcass as bait. However, trapping has several disadvantages:

- Compared to shooting, traps are not selective – nontarget animals are frequently caught.
- Cats captured in cage traps frequently badly damage their claws and teeth (Frank et al. 2003) which may severely impede hunting success and ability to defend against conspecifics or competitors.
- Leg hold (gin) traps, if not used with great care and checked frequently, may cause serious wounds and suffering. Foot snares (Frank et al. 2003) are humane, but both types of foothold trap nontargets (e.g. hyenas, leopards, young lions) which must be chemically immobilised to remove them from the trap. Darting requires the necessary training, drugs, and equipment.

Translocation

Although widely used, translocation of trapped problem predators is rarely justifiable because it usually leads to prolonged suffering and eventual death. Lions, leopards and hyenas are highly territorial and strangers newly released into occupied habitat are chased or killed by residents. They will try to find their way home, moving long distances and often taking livestock along the way. They have usually been caught in cage traps, with consequent damage to claws and teeth. Young males may be an occasional exception, as they are adapted to dispersal and avoidance of resident males.

Translocation is only justifiable when animals are moved into vacant habitat that have no or very few resident lions and where humans will no longer kill them, i.e. newly created reserves. In those rare cases, released animals should be radio collared and closely monitored. Translocation should not be undertaken if there are not adequate financial and logistical resources to allow proper monitoring.

Poison

Poison should never be used under any circumstance! Poisoning is extremely destructive, killing whole prides and all other species that eat the bait (Frank et al. 2011, Ogada et al. 2015). Poison should be universally outlawed, all infractions vigorously investigated, and offenders subject to heavy penalties.

Record-keeping and Research

We have a great deal to learn about effective PAC, and local situations may present unusual circumstances. It is essential that good records be kept of all complaints and interventions, including details of the complaints, the results of investigations, details of any interventions performed, and whenever possible, follow-up monitoring of results. Records should be kept in a uniform format which should be standardised across all lion Range States. A central database of all PAC activities would allow continent-wide analysis of circumstances, interventions and results, resulting in the development of more effective response.

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6.8 Reintroduction, genetic management and genetic rescue of lion populations

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The overarching goal of African lion conservation efforts should be – besides securing the survival of viable populations – to restore any missing ecological processes and allow populations to recover on their own with the minimum amount of human intervention. Where it is not possible to restore ecological processes, lion conservation efforts should seek to mimic natural processes using appropriate interventions such as reintroduction, genetic management and, in extreme cases, genetic rescue. 'Genetic management' is intended to be used to add to a population to maintain genetic diversity and prevent inbreeding, while 'genetic rescue' can be used to reverse inbreeding. While this approach is not highlighted in the generic guidelines for reintroductions and other conservation translocations published by the IUCN in 2013, much of the information contained in these guidelines is applicable to the African lion (IUCN/SSC 2013). The IUCN guidelines should therefore be consulted before embarking on any reintroduction or reinforcement of African lion and this section is intended to compliment these guidelines. In this section, we will report on past reintroduction efforts and provide details specific to African lion.

Historic reintroduction and reinforcement projects

South Africa has a long history of reintroducing African lions into small (<1,000 km^2) fenced[1] wildlife areas, or reserves. For the purpose of this document, we define reserve as any publically or privately owned conservation area where lions are free-roaming. Starting with a few reserves in the early 1990s, there are now approximately 700 lions in 45 reserves (Miller et al. 2015a; Chapter 2). All of these reintroductions were into areas where lions historically occurred and were extirpated by the early 1900s (Nowell & Jackson 1996). While scientists have questioned the conservation value of these reintroduced populations (Hunter et al. 2007, Hayward & Kerley 2009, Slotow & Hunter 2009), a managed metapopulation approach is now being implemented and should increase their conservation value (Miller et al. 2015a, 2016). The lion populations on these small reserves now account for approximately 25 percent of wild lions in South Africa (Miller et al. 2016). Most of these efforts were reintroductions with follow-up reinforcement over the years to prevent inbreeding. In one case, Hluhluwe-iMfolozi Park, genetic remedy was required due to a small founder population and subsequent inbreeding (Trinkel et al. 2008, 2010). The success of this genetic remedy, or genetic rescue, has been confirmed (Miller et al. in prep).

Much has been learned from these reintroduction and reinforcement efforts. In 2010 the Lion Management Forum (LiMF) was started by wildlife managers in South Africa to share their experiences and improve the management of lions in small populations (Box 6.8.1). The ethos of LiMF is to mimic natural systems as much as possible (Miller et al. 2013, Ferreira & Hofmeyr 2014) and this is the approach taken in this section.

[1] All of the African lion populations in South Africa are fenced due to legal requirements. A public liability insurance programme should be considered to protect the landowner from any potential legal liability that may occur if any individual lions break out of the property. This will vary by country.

Box 6.8.1 Lion Management Forum

Susan Miller

The Lion Management Forum (LiMF) was formed in 2010 by a small group of people who met to discuss the unique challenges associated with the management of free-roaming lions in small protected areas in South Africa.

Since this first meeting LiMF, has expanded to over 70 members and includes managers, veterinarians, researchers and government officials. LiMF is committed to a holistic approach that seeks to restore ecological processes, and if not possible, mimic the outcomes of such processes when developing management strategies.

LiMF Vision: The managed wild lion population of South Africa is a robust lion population that contributes to the well-being of people.

LiMF Mission: To provide a platform for the development and sharing of best practice guidelines for managed wild lions in South Africa through facilitating relevant research, risk assessments and socio-economic development initiatives.

LiMF will achieve this through:

- Recognition of the contribution that lion makes to conservation, culture and economics;
- Integrated and common approach to conservation management across conservation agencies and the private sector;
- A holistic ecosystem approach rather than a species-specific approach;
- Being broadly inclusive of all stakeholders;
- Incorporating economic outputs and outcomes into an integrated plan;
- Applying ethical principles to defining best practice management for lion;
- Using evidence based decision-making;
- Developing documented and agreed best practice for planning, management, monitoring, and directed research guiding lion conservation;
- Aligning with regional and international laws, policies, guidelines, and strategies.

LiMF is first and foremost a forum for members to share their experiences and to discuss solutions to the unique challenges associated with lion management on small fenced areas. Subjects of discussion have included over-population, disease control, genetics and human-wildlife conflict.

LiMF members have published a collective peer-reviewed scientific paper outlining the issues surrounding lion management in South Africa and some possible solutions (Miller et al. 2013). A second collective publication on historical contraception of lionesses in currently under review. Members have also contributed scientific data to numerous other peer-reviewed publications over the years.

The Department of Environmental Affairs (DEA) in South Africa developed a Biodiversity Management Plan (BMP) for lions in South Africa (Funston & Levendal 2015). LiMF was involved in the development of the BMP and is involved in its implementation. As part of the BMP for lions, a managed metapopulation approach is being implemented across small reserves in South Africa.

More recently reintroductions have occurred in other African countries, most notably Zambia, Rwanda (Box 6.8.2) and Malawi (Briers-Louw 2017, Box 6.8.2). All of these reintroduction efforts were managed by African Parks and Zambia used lions from neighbouring populations while Rwanda and Malawi used lions from the South African small reserve network (Box 6.8.2).

Use of reintroduction, reinforcement and genetic rescue in future conservation efforts

Once found in an almost continuous population across the African continent, African lions are facing a shrinking and fragmenting habitat. While some populations are still large enough to persist on their own, natural movements between lion strongholds are becoming less common and those individuals that do venture between protected areas are highly persecuted (Riggio et al. 2013). Fencing is increasing (Packer et al. 2013) and has proven effective at protecting small populations (Bauer et al. 2015). Thus more and more populations are cut-off from neighbouring populations and are facing inbreeding threats and, in the extreme, local extinction. Björklund (2003) calculated that a minimum of 50 prides are required to prevent inbreeding in an isolated population. If connectivity cannot be restored between these isolated populations (see efforts in Chapter 6.4), any population smaller than this will likely require some human intervention to ensure long-term genetic sustainability. Ideally this would be through regular reinforcement events with suitable individuals, typically male lions to mimic nomadic males moving into a new area with occasional translocation of females to mimic less common lioness migration. In cases where a population is already experiencing inbreeding, a genetic rescue effort may be necessary. In cases where lions are extinct in an area, reintroduction is the only way to speed up the re-establishment of lion populations in the area.

While lions were not historically associated with metapopulation dynamics, this has changed over time with fragmentation of populations resulting in a metapopulation situation in the wild (Dolrenry et al. 2014). Approaching conservation planning within this context can be useful allowing humans to assisting with movement between populations where natural movements are reduced or no longer occur. The scale at which this is necessary will depend on the level of fragmentation and connectivity and may range from minimal interventions of one or two individuals as needed up to fully managed metapopulations. A managed metapopulation approach has been successfully applied to African wild dog (*Lycaon pictus*) (Mills et al. 1997, Gusset et al. 2008, 2010, Davies-Mostert et al. 2009, 2015) and cheetah (*Acinonyx jubatus*) (Lindsey et al. 2011, Buk et al. 2018) and is being implemented across the small reserves in South Africa for African lion through a Biodiversity Management Plan (BMP; Funston & Levendal 2015, Miller et al. 2015a).

Box 6.8.2 Lion reintroductions in Zambia, Malawi and Rwanda

Angela Gaylard

African Parks (AP) is a non-profit conservation organisation that takes on direct responsibility for the rehabilitation and long-term management of protected areas in partnership with governments and local communities. A key restoration activity is the re-establishment of historically occurring faunal species and their ecological roles. Moreover, some species play a significant role for promotion as tourism destinations, providing a catalyst for job creation and economic growth in the region. As apex predators, lions have been re-established in four of the protected areas managed by AP – Liuwa Plain National Park (Zambia), Majete Wildlife Reserve and Liwonde National Park (Malawi), and Akagera National Park (Rwanda).

The lion population in Liuwa Plain NP was all but eradicated until four lions were translocated from the nearby Greater Kafue area, onwards of 2009. The population has grown relatively slowly with three of the reintroduced animals succumbing to poaching or disease. Despite the reintroduction of an additional lion to enhance the genetics of the population, the dominant male is siring cubs with his mother and sister. In addition, although the park is unfenced, natural dispersal of new males into the park is unlikely, given the high levels of human disturbance in the corridors between parks with persistent lion populations. Although slow population growth is desired, active metapopulation management is now required to prevent further inbreeding.

Lions had been extirpated from Malawi decades ago. For the reintroduction into Majete WR in 2012, lions were sourced from South Africa, and the population has since grown to 17 animals. Since the park is relatively small (691 km^2), fenced, and surrounded by human settlements, active interventions are also required to manage the genetic integrity and growth of this population. Metapopulation management of the Majete population was therefore initiated in February 2018, through the removal of two male lions for reintroduction into Liwonde NP, and the supplementation of the population with five lions from South Africa. Seven lions from South Arica joined the two males brought from Majete WR to complete the reintroduction fof the species in Liwonde NP.

When regional sources of lions could not be found during 2015 and 2017 for reintroduction to Akagera NP due to their widespread extirpation, again lions from South Africa were used. In Order to maximize genetic heterozygosity and allelic richness the founder population was constructed of lions from multiple genetic sources in South Africa, comprising five unique genetic origins from three different protected areas.

The lessons learnt through AP's lion reintroductions can be summarized as follows:

- Ideally, lions should be sourced regionally to protect the genetic integrity of regional ecotypes. However, where regional lion populations are dwindling or have been extirpated, re-establishment of lion populations may necessitate the prioritization of conservation of the species above regional genetic integrity;
- Difficulty sourcing lions regionally can be alleviated through partnerships between managing authorities and the establishment of functional forums such as the Lion Management Forum (LiMF, South Africa);

- It may be necessary to reintroduce lions from further afield, comprising multiple, unrelated sources to maximize genetic heterozygosity and allelic richness – this requires knowledge of the lineages of source lion populations;
- After reintroduction, lion populations are able to grow rapidly in the absence of natural social regulating mechanisms;
- Strategic metapopulation management is therefore essential in order to mimic these social processes lost through fragmentation of protected areas, hard boundaries with human populations, and lack of functional dispersal corridors – such management requires individual identification, knowledge of the lineages of the reintroduced and growing lion populations in each park and the ability to locate particular individuals for targeted interventions.

Fig. 1. Parks under management of African Parks (adapted from African Parks 2018). Parks where lions were introduced are highlighted with blue symbols.

Specific points to consider for African lion reintroduction

Founders

(i) Captive or wild?

The IUCN guidelines suggest that either captive or wild individuals can be considered as a source of individuals for reintroductions. Currently there is no shortage of wild lions for reintroduction efforts for lions from eastern and southern Africa (*P. l. melanochita*) or any evidence of success in reintroducing captive lions into a wild environment (Hunter et al. 2013) and therefore wild individuals are preferred for reintroductions. There have, however, been some practical complications regarding sourcing the appropriate wild lions for reintroductions (Box 6.8.2).

(ii) Demographics

Depending on the ecological status of the proposed reintroduction site, several approaches are possible. Traditionally reintroduction efforts have introduced males and females together to form a 'ready-made' pride. This may be appropriate if there is a fully functional ecosystem already in place. However, it may be useful to stagger lion introduction to more closely mimic recolonisation of an area. In natural systems, young males disperse innately and more often than any other demographic, thus they are likely to colonise vacant habitats first, with females following more slowly. This process can be mimicked by introducing young males first, followed by young females (unrelated to the males).

Regardless of the introduction approach, initial reintroduction populations should mimic natural pride dynamics as much as possible within the constraints of available resources. Typically related females will form the basis of a pride with either a single unrelated male or a coalition of often related males (although unrelated individuals can be bonded in a boma prior to release if necessary).

Lions, especially in small fenced areas protected from persecution, reproduce at a rapid rate (Miller & Funston 2014; see below for reasons). Planners must take this into account when determining the number of founders for a reintroduction effort. A balance should be sought between providing enough individuals to ensure genetic diversity while not overwhelming the available prey resources within a few years. A simple R script (GrowLS) was developed to assist with predicting lion population growth over time with varying starting populations (Miller et al. 2015b). While this program was designed to simulate population control measures, it can equally be used in situations where this is not planned, providing some basic lion growth parameters are available to mimic the expected conditions.

In a managed metapopulation setup, existing populations can be used as a source of both females and males and 2–3 year old individuals are often available from reserves looking to control population growth and prevent inbreeding. Pedigree (including where translocated animals originated from) and/or genetic data should be used to ensure that founders are not closely related; likewise for any individuals chosen for reinforcement.

(iii) Genetics

Like all other species, individuals should be sourced from populations as close as possible to those that were historically present in the past. When this is not possible, the next closest population should be used (IUCN/SSC 2013). Recent evidence suggests that there are two subspecies of African lion: one found in India and West/Central Africa (*Panthera leo leo*) and one in East/Southern Africa (*Panthera leo melanochaita*) (Bauer et al. 2016). The African Lion Working Group (ALWG) has compiled some genetic recommendations for translocations of African lions which should be considered when planning a reintroduction, reinforcement or genetic remedy effort (African Lion Working Group 2016). Richard Frankham has published extensively on genetic management of fragmented populations including a recent book (Frankham et al. 2017) which is an invaluable resource.

The genetics of African lions had not been studied before the first reintroductions into South Africa and as a result, there has been a mixing of individuals from four different sources: Etosha NP in Namibia, Kruger NP in eastern South Africa, Kgalagadi Transfrontier Park (TP) in northwestern South Africa/southern Botswana and Greater Mapungubwe TP in South Africa/Botswana/Zimbabwe (Miller et al. 2014, 2015). The ALWG recommends that none of the managed wild lion populations in South Africa be used for reintroductions outside of the South African region (African Lion Working Group 2016), although lions from these populations were introduced into Rwanda and Malawi (see Box 6.8.2) when no other lions could be easily sourced.

Whatever the origin, the genetics of new populations should be monitored. Several techniques can be applied. Microsatellites exist and have been validated for use in African lion populations (Antunes et al. 2008, Bertola et al. 2011, Dubach et al. 2013, Miller et al. 2014) and Single Nucleotide Polymorphisms (SNPs) are available (Bertola 2015). Whichever method is used, a geneticist should be consulted to ensure that this analysis is performed correctly and the results interpreted accurately.

(iv) Disease and parasites

A complication when choosing individuals for translocation beyond the genetic component is disease and parasites. Several diseases are known to affect lions with varying levels of severity including, but not limited to: tuberculosis (TB), feline immunodeficiency virus (FiV), canine distemper (CDV), rabies, echinococcosis (tapeworm). African lions can live with TB and/or FiV and thus some consideration to the disease status of individuals considered for reintroduction efforts should be given. Other diseases are often fatal and for some, vaccinations are available. A wildlife veterinarian with lion experience should be consulted regarding vaccination/parasite medication prior to any translocations and the general IUCN Guidelines for Reintroductions should be followed (IUCN/SSC, 2013).

Tuberculosis TB – TB has been introduced into several lion populations, most notably Kruger NP, through infection of buffalo by domestic cattle. No lions should be moved from an area of known TB infection to an area without TB infection without appropriate testing of all individuals to confirm that they do not carry the disease.

Feline Immunodeficiency Virus FiV – African lions coevolved with FiV (Antunes et al. 2008) and early studies suggested that it has no effect on lion populations (Brown et al. 1994, Carpenter & O'Brien 1995, Hofmann-Lehmann et al. 1996, Packer et al. 1999). However, more recent evidence suggests that some wild populations may be adversely affected (Roelke et al. 2006, 2009). No evidence of an

interaction between FiV and TB in co-infected animals has been found in the Kruger NP (Maas et al. 2012).

Canine Distemper Virus CDV – The most famous outbreak of CDV was in the Serengeti NP population in 1994 where over 1,000 lions died representing a third of the population (Roelke-Parker et al. 1996). In this case, a drought had resulted in an increase of the tick-borne *Babesia* and was fatal when lions were co-infected with CDV (Munson et al. 2008). In smaller populations, CDV can be devastating. For example, Welgevonden Game Reserve, South Africa, had an outbreak in December 2015 which wiped out all but one of their lions. They were able to rebuild their population through translocations from other populations in the metapopulation network (pers. comm. A. Burger), thus emphasising the importance of managing these small populations collectively.

Long-term population management

In large open systems lions naturally regulate population size and the gene pool is large enough to prevent inbreeding. In smaller, closed systems normal social dynamics are compromised. For example, takeover opportunities are non-existent or limited and even if they are possible, there is a good chance that they would result in inbreeding due to a limited gene pool; space is limited and nomadic males cannot avoid interactions with existing pride males; competition between prides is reduced either due to only one pride being present or no competition for resources. Some of these systems can be mimicked through management interventions and should be considered and incorporated into any long term reintroduction plans.

(i) Growth phase

It has been shown on the small reserves in South Africa that these populations do not reach a natural equilibrium and can continue to grow up to the detriment of other species. Growth rates are accelerated by younger ages of first reproduction, shorter inter-birth interval and increased cub survival compared to lionesses in more open systems. Planning must take this into account both when deciding the number of founders to introduce and then for control of this growth to acceptable levels through contraception and the removal of 'excess' lions over time (Miller & Funston 2014). A simple R model (GrowLS) has been developed to allow managers and planners to explore the impact of contraception on growth rates of lion populations in small reserves (Miller et al. 2015b).

(ii) Genetic diversity and prevention of inbreeding

In open systems, genetic diversity is maintained through the lion social system whereby males regularly challenge for tenure over a pride. When (an) outside male(s) succeed(s) in taking over a pride, he/they will usually kill any young cubs, ensuring that future offspring carry his/their genes. In open systems, takeovers happen regularly and new males are usually unrelated to the existing pride females thus ensuring minimal inbreeding. Takeovers are rare events on many small reserves and even when they do happen, within a few generations all individuals on a reserve are often related. By mimicking processes such as takeovers (see below) and realistic growth rates (see above), within the context of a managed-metapopulation, genetic integrity should be maintained. Periodic monitoring of genetic measures, specifically relatedness, or mean kinship, values serve as a good indicator of a

population's genetic health as explained in more detail in Ralls et al. (2018).

(iii) Mimicking a takeover

Some reserves in South Africa have introduced new male lions with the hope that they will naturally take-over from existing pride males. However, this does not always work as was documented in Addo Elephant National Park (Tambling et al. 2013): In this case two males were introduced in the hopes that they would form a coalition and replace the existing, older solitary male. However, the introduced males did not stay together and one of them joined the existing pride male who then remained in charge of the pride (Tambling et al. 2013). African Parks also experienced problems with the introduction of a young male (Box 6.8.2). Using a larger coalition, which more closely mimics a natural takeover scenario, may be a solution to this problem. In cases where this is not possible due to size constraints, it may be necessary to remove the existing pride male(s) before/at the same time as introducing new ones to ensure a takeover. Timing is critical however, as it has been observed that if no new male takes over the pride, a male as young as 23 months old can successfully mate with a lioness and produce offspring (Miller & Funston 2014). Unless other techniques are developed, the best a manager can do is to ensure a minimum length of time when there are no unrelated adult males on the property and hope that lionesses will mate with unrelated males before they mate with younger, related males.

(iv) Genetic rescue

If genetic reinforcement has not been adequately applied to a population, genetic rescue may be necessary. The lion population in Hluhluwe-iMfolozi Park (HiP) in KwaZulu Natal, South Africa is an excellent example of a genetic rescue effort (paper in prep). In HiP the lion population was originally founded from a handful of lions which then resulted in a highly inbred population. Lions were sourced from two reserves in South Africa which had lions originating from Etosha NP. These lions successfully integrated into the existing population resulting in a successful genetic rescue effort (S. Miller, pers. obs). Frankham (2015) has provided revised guidelines for genetic rescue of small inbred populations.

Considerations for release of translocated individuals

(i) Release strategy

A soft release involving a temporary holding boma within the reserve should be used for all lion releases. This allows the lions to recover from the stress of the capture and transport as well as effects from the drugs used in the relocation. It also provides time for acclimatisation to their new surroundings and for bonding with new pride members if lions from different sources are introduced together. In the case of lions captured from unfenced areas, it allows them to learn to respect electric fences. Lions from different sources should be bonded in the same boma (no internal fencing needed). Individuals should, ideally, arrive and recover from sedation at the same time. If this is not possible, a sedated lion can be introduced into a boma with alert lions. An alert lion, however, should not be introduced into a boma under any circumstances. Extreme care must be taken to ensure that the lions in the boma do not form an association between people or vehicles and food. One successful approach to minimise human-lion contact is to add a screened "feeding camp" to the boma with a

gate that can be opened from outside the boma once the food has been placed inside. Details of the boma recommendations can be found in Box 1 of Miller et al. 2013.

(ii) Habitat requirements

Before reintroducing lions into an area the habitat and prey base must be secured. If restocking of herbivores is required, ideally these animals will be predator aware. If other carnivores are also being introduced, it is generally accepted that smaller carnivores should be introduced first, followed by larger ones. Again, lion-aware carnivores are preferred to naïve ones.

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6.9 Incentives for lion conservation and financial tools for co-existence

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Introduction

Lions have immense global value: they are one of the world's most charismatic and highly-valued species (Macdonald et al. 2017, Courchamp et al. 2018). They are the most common species used as a national animal (even in countries far beyond their global range), and their image is used internationally to promote everything from snacks to sports teams. More tangibly, they also generate significant economic revenue at national scales, as they are one of the most sought-after animals by both photographic tourists and trophy hunters (McNeely 2000, Lindsey et al. 2012). As long ago as the 1980s (when there were far more lions than today), the value of a single lion in Amboseli National Park in Kenya was estimated to exceed USD 120,000 (Thresher 1981). Introducing lions into South Africa's Pilanesberg National Park was thought to contribute around USD 9 million per year to the regional economy (McNeely 2000). Lions are also the highest-value species in the trophy hunting industry, which has been estimated to generate over USD 200 million annually in Africa (Lindsey et al. 2007, di Minin et al. 2016).

However, in marked contrast, live lions usually have very little, no, or even negative value for local Africans who live alongside them. Conversely, in some areas the value of dead lions is increasing through illegal trade in bones, skins, teeth and claws, for both international and domestic markets (Williams et al. 2017). Furthermore, the presence of lions can incur very significant costs in terms of attacks on livestock and humans, as well as through important indirect and opportunity costs (see Chapter 6.1). Although the economic costs of such losses tend to be less than through other factors such as disease (Frank et al. 2006, Dickman et al. 2014), they are particularly damaging as they tend to occur unpredictably, are not equally distributed, and a single attack can have devastating impacts on individuals, which makes it very hard for poor, pastoralist households to recover from (Lybbert et al. 2004). Although mechanisms exist in some areas to share the international value of lions (e.g. tourism revenue) with local stakeholders, these benefits are usually not equitably matched to the households who suffer most costs, and are usually insufficient to outweigh the multiple costs of lion presence. This leads to a situation where lions are locally extirpated, and this poor local cost-benefit ratio has been a major factor in the huge contraction of lion range over recent decades (Riggio et al. 2013, Bauer et al. 2016). It is one of the most pressing issues facing lion conservationists today, as more than half the remaining lion range is outside formally protected areas (Riggio et al. 2013), so they persist there on human-dominated land, often utilised by extremely poor people.

This is a classic example of a 'market failure', where an internationally-valued resource (here, the presence of live lions) is depleted because there are insufficient economic incentives to maintain it locally (Nelson 2009, Dickman et al. 2011). The challenge is how to effectively translate the international value of live lions down to a local scale, so that it not only offsets the costs imposed by them, but is also sufficient to incentivise long-term coexistence. Ideally, this has the added benefit of reducing poverty in rural communities, therefore helping to address the first Sustainable Development Goal (SDG). Depending on how benefits are used within the community, they can also contribute to

many of the other SDGs, such as reducing hunger, improving health and wellbeing, and reducing inequalities. One of the most challenging aspects of payment systems is ensuring they are at the correct level: they must be sufficient to outweigh local costs of lion presence, but also proportionate to the international level of conservation benefit/willingness to pay (Dickman et al. 2011). In addition to the costs of any payments, there will also be costs of developing the initiative, monitoring compliance etc, and those should also be considered. Another substantial challenge is ensuring that payments are equitable, and reach those households experiencing the costs of living with lions. Here, we provide a brief overview of some of the financial mechanisms which exist to try to incentivise coexistence, and highlight some of the most promising approaches for lion conservation.

However, it is also important to recognise that this is more than an economic issue, as lions have both positive and negative cultural value as well. For example, lions may be viewed particularly negatively if they are associated with sorcery (Israel 2009), or if they kill cattle in particular, which have cultural and social worth which exceeds its economic value (Spear & Waller 1993, Dickman 2009). Conversely, some people value lions more than might be expected if they view them as a totemic animal (E. Macdonald, pers. comm.), or they believe they have other important cultural value (Spear & Waller 1993). Therefore, while financial mechanisms can seem one of the simplest ways of encouraging tolerance of lions or maintaining lion friendly landscapes, it is vital to consider any such approach within the social and cultural context of the community concerned, or it is unlikely to succeed and may even exacerbate conflict (Israel 2009).

Overview of some potential financial mechanisms for lion conservation and co-existence

Here, we briefly examine some different financial approaches intended to improve lion conservation and coexistence, namely compensation and insurance, revenue-sharing and employment, community wildlife areas, conservation products, conservation performance payments and landscape-level business models such as Lion Carbon. An overview of the intended mechanisms, key operational considerations and likely benefits in terms of poverty and lion conservation are provided in Table 6.9.1.

(i) Compensation and insurance

Compensation is one of the most common mechanisms for trying to reduce human-lion conflict. Suspected depredations are reported, investigated, and if verified, a payment is made to the livestock keeper, with the aim of reducing anger towards the predator, and ideally reducing retaliatory killings. Sometimes there is an explicit conservation clause, with financial penalties if wildlife killings occur (Hazzah et al. 2014). Insurance initiatives use the same general model, but livestock-keepers pay premiums to receive coverage, and these schemes tend to be more community-driven. Insurance initiatives have been developed for other species, such as snow leopards (Mishra et al. 2003), and a Human/Animal Conflict Self-Insurance Scheme (HACSIS) has been developed in Namibia (Kasaona 2006). Initial examination suggested that peoples' livestock management practices did improve under HACSIS, but there were still high numbers of depredation incidents, and similar issues as with compensation regarding dissatisfaction over unpaid claims and low levels of payment (Kasaona 2006).

Compensation on Mbirikani Group Ranch in Kenya was linked to fewer lions being killed (Maclennan et al. 2009, Hazzah et al. 2014), so it can be successful, but these initiatives can be problematic, especially if not very well-managed (Johnson et al. 2018). Payments need to accurately track market value of livestock, and verifications must be accurate and rapid, which is challenging, especially in remote areas of Africa. Studies suggest that payments (especially given poor verification) rarely compensate for the full market value of lost livestock: in Botswana, compensation was set at 80% of livestock value, but ranchers only received 42% of market value due to penalties and lack of verification, so lion presence still incurred a substantial cost (Hemson et al. 2009). There is a need for substantial ongoing external investment (the level of which is hard to predict). Additionally, there is a risk of attempted fraud, particularly if the compensation rate is higher than the market value (e.g. during droughts), and the system may be biased against poor, illiterate livestock-keepers who are least able to follow the reporting regulations (Dickman et al. 2011). Furthermore, these schemes can create a perception that lions belong to someone else, rather than being a natural component in the landscape. There is a risk of 'moral hazard', where people are less inclined to protect their livestock in the presence of compensation or insurance payments (Nyhus et al. 2003, Bulte & Rondeau 2005), although this can be reduced if penalties exist for poor livestock husbandry and if verification is good. Ultimately, although compensation and insurance can reassure people that action is being taken to help them, and can reduce the direct costs of lion presence (and even lion killing in some cases), they do not generally outweigh the overall costs (including indirect ones) of lion presence, and do not give people a meaningful reason to actually want lions in the landscape.

(ii) Revenue-sharing and employment

Revenue-sharing – and other forms of engagement such as direct employment in conservation services – is probably the most common financial mechanism in Africa to encourage coexistence, especially around protected areas. The revenue may accrue through photographic tourism, trophy hunting, philanthropy or other activities, and can be substantial: in Uganda, revenue-sharing around 3 National Parks led to over USD 80,000 being invested in community development, with marked improvements in local attitudes towards conservation (Archabald & Naughton-Treves 2001). However, this revenue can be limited in scope, reaching certain 'gateway' locations close to a Park entrance gate, for example, and failing to reach more remote communities which may in fact suffer higher wildlife costs (Walpole & Goodwin 2000). Providing revenue to improve livelihoods is undoubtedly worthwhile, but people may associate the benefits with the Park, tourism department or NGO, without making a clear link to lion presence, especially if there are no associated penalties for wildlife killing. Around Uganda's Queen Elizabeth National Park, local peoples' support for lion conservation was mainly due to the Park's foreign currency revenue and the Uganda Wildlife Authority's Revenue Sharing Program (Moghari 2009). However, it was notable that despite such support, most people still felt that retaliatory killing of lions was 'justified' or 'acceptable'(Moghari 2009).

(iii) Conservancies and other community wildlife areas

Under these approaches, instead of external agencies providing some amount of revenue to local stakeholders (as in the section above), the stakeholders themselves (sometimes in joint venture partnerships with other organisations and/or investors) set aside and/or manage land for wildlife,

generate revenue for community development, or provide other services valued by the community e.g. increased security.

One classic example of this kind of arrangement is the CAMPFIRE (Communal Areas Management Programme for Indigenous Resources) model, where the CAMPFIRE Association works with local communities to help them better manage their land, and realise financial benefits from effective resource stewardship (mainly by selling safaris to both photographic tourists and foreign sport hunters). The Association aims to help people manage and profit from conserving healthy wildlife populations, enabling sustainable community development through the presence of wildlife. Over the first 12 years of the CAMPFIRE model (1989-2001), it generated over USD 20 million to participating communities, 89% of which came from sport hunting (Frost & Bond 2008). This led to substantial community development, and some reported positive impacts on wildlife populations, although there is limited data on this (Frost & Bond 2008). However, there was marked variability in revenue generation: 12 of the 37 districts who could market wildlife produced 97% of all CAMPFIRE revenues (Frost & Bond 2008). The CAMPFIRE model has been strongly affected by political upheaval in Zimbabwe and changes in international restrictions on trophy hunting, highlighting that financial mechanisms are often particularly subject to external impacts.

Collective land management and revenue-sharing has seemed beneficial in Kenya, where 'group ranches' manage their wildlife collectively. Between 1977 and 1994, wildlife numbers in Kenya dropped by 29–65% in areas where most of the revenue went to tourism industry and the government, but group ranches had stable wildlife numbers over the same period (Norton-Griffiths 1998), although later studies failed to find similar results. Communal conservancies in Namibia, where wildlife revenue is retained internally, have also been successful, with increasing populations of lions and other wildlife (Davis 2008). However, these approaches depend on the area being suitable for photo-tourism and/or trophy hunting. Another potential mechanism is the 'conservation easement' approach, where local communities enter into legal agreements with other stakeholders who manage land for conservation. An example of this is in Tarangire, Tanzania, where a consortium of tourism companies pay local villagers an annual lease fee to maintain plains as livestock pasture rather than converting it to settlement or farming, integrating wildlife conservation concerns with local land use planning.

However, land may have greater economic return under an alternative land use, such as farming, and communities may be restricted in land-use options and activities within these models, leading to additional opportunity costs (Gibson & Marks 1995, Redford et al. 2007). However, this approach has advantages of not being heavily reliant upon external funding, increasing community empowerment, and providing direct benefits from lion presence which may be sufficient to outweigh costs.

(iv) Conservation products

This approach involves developing a product, which is often certified and premium-priced, from a land-use with conservation practices aimed at benefiting the targeted species as well as local people. Examples from other species include 'cheetah-friendly beef', 'Jaguar-friendly coffee' and 'Snow Leopard Enterprises' where local women produce handicrafts from snow leopard areas. This approach has multiple community benefits, including empowering and skills-training local people, but again may not be the most profitable form of land use, so may have opportunity costs, especially if

the markets for such products are small. Yields tend to be lower under 'conservation-friendly' forms of farming, so if more land is required to be converted to farmland to provide the same returns then there is a risk of unintended negative consequences. It is also unclear how firm the linkage is between some of these products and conservation actions, and how well they equitably distribute the benefits according to people who suffer most costs of wildlife presence. Regarding lions, a 'Mara Beef' initiative has been developed, which is a 'direct to market' approach for pastoralists in southern Kenya, so they can make cattle production more profitable and increase food security. They also receive rangeland management and training, with the aim of improving pastoral livelihoods, restoring rangelands, preventing degradation, and supporting the conservation of lions and wider biodiversity. Mara Beef is still in its early stages, and has not been certified as 'wildlife-friendly' in the same way as many of the products above, and so far there are no data on the conservation impacts for lions, although the approach seems promising in terms of better rangeland management.

(v) Conservation performance payments

'Performance payments' for conserving wildlife have been used very successfully in Europe for species such as lynx and wolverines (Zabel & Holm-Muller 2008, Zabel & Engel 2010). The usual concept is that payments are made in return for clear conservation commitments (such as maintaining agreed land-use zones, not snaring or poisoning wildlife etc). They have been used successfully for land use planning and promoting lion friendly landscapes around communities inside one relatively small (580 km^2) concession inside Mozambique's Niassa National Reserve. Here, approximately 2,200 people receive community funds for keeping to agreed conservation contracts, from sightings of key species and through bed night levies, and receive penalties for actions such as killing lions or setting snares. In Namibia, every time lodges see a specified species (including lions), the government and international donors combine funds to make a payment to local communities. These 'wildlife credit' funds are used for conflict mitigation, offsetting indirect wildlife costs, wildlife monitoring and community development. A similar approach, based on villagers camera-trapping wildlife on their land, is operating through the Ruaha Carnivore Project in southern Tanzania (Fig. 6.9.1, Box 6.9.1).

These kinds of payments make a very clear, direct link between wildlife presence, conservation behaviour and benefit, and have proved effective at reducing risks to lion populations and managing land-use (C. Begg, pers. obs). However, unlike business-based models, they usually require continued external investment in some form, usually philanthropy unless some or all of revenue is directed into enterprises which then pay back into the fund. There is a risk of exacerbating local sensitivity to environmental fluctuations: for example, during a drought, not only would livestock numbers decline, but wildlife numbers and therefore payments may as well, multiplying the negative impacts on local people. However, the funds can be valuable in strengthening communities and therefore reducing the impact of such events. To avoid unintended consequences, such as increasing local vulnerability in times of drought, indicators of successful conservation need to be chosen with care, such as a reduction in the number of wildlife killing events, rather than merely changes in wildlife numbers. It is hard to provide sufficient community benefits to outweigh the household costs (or potential risks) of lion presence, but nevertheless, this remains a promising approach which is likely to deserve further attention.

Fig. 6.9.1. This camera-trap image generated 30,000 points for the village concerned (15,000 points per lion). For details see Box 6.9.1.

(vi) Landscape-level business models

Performance payments to local communities can be made more financially sustainable by linking them to markets for ecosystem services (MES) that are valued internationally e.g. carbon sequestration offsets and water mitigation banks. An example currently benefitting lions is a new Lion Carbon initiative in Luangwa valley, Zambia where for 30 years payments for forest and wildlife conservation commitments by local communities are generated through the sale of verified forest carbon offsets through an avoided deforestation mechanism known as REDD+ (Reducing Emissions from Deforestation and Degradation). Another REDD+ initiative is currently being implemented in the Chuyulu Hills area of Kenya: this is again a 30-year 'payment for ecosystem services' initiative, aimed at improving grazing and livestock management to reduce the degradation of rangelands, which represent key habitat for lions. This is the first REDD+ initiative in Kenya which is entirely owned and managed by the local community. In both cases, communities receive funds for avoided carbon dioxide emissions, and use those for projects which benefit both the community and the environment.

Markets for ecosystems services are still relatively unstable but increasing recognition of their financial and conservation value is a growing business opportunity for some sectors. If properly linked to local lion conservation commitments, as occurs within Lion Carbon, MES represent a direct and sustainable mechanism for transferring the international value of lions to those that bear the costs of living with them. Furthermore, initiatives such as the Chuyulu Hills REDD+ approach helps improve local governance, and both promote the good management of the wider landscape, including but not limited to lions. Business models that provide financial sustainability to lion conservation activities, give them the capacity to scale-up over large areas. The REDD+ project behind the Lion Carbon initiative is operational over 1 million hectares of important lion habitat and the predicted expansion is 10 million hectares in 10 years. Very few incentives for conservation have the potential for such scale.

Another emerging business approach (which could be used in collaboration with many of the approaches above) is impact investments, 'payment-by-results' or 'development impact bonds'. These are contracts between investors and the public sector, where the investor agrees to pay for improved social (and increasingly, conservation) outcomes, which then result in public sector savings. The investor provides up-front funding and if the project delivers the outcomes laid out in a contract, then the 'service provider' (e.g. a conservation organisation) would be paid, and the investor receives back their initial investment as well as a small return. This provides a mechanism for private investors to finance public projects, and as the returns on the investment are dependent only upon successful delivery of agreed metrics, the funding is not tied to specific actions, but can be used however as most needed to achieve those metrics. Furthermore, the contracts are often longer than the traditional short-term conservation grant models, which is important for delivering long-term goals. This is a more flexible, targeted and sustainable option than most of the traditional conservation models, and has recently been trialled for rhino conservation using 'Rhino Impact Bonds'. It could be another potential mechanism for generating up-front funding for lion conservation, and increasing the chances of sustainable, long-term funding of successful conservation initiatives. However, it does depend on having clearly measurable impacts, and the 'service provider' (which here would be lion conservation practitioners) risk non-payment of funds if the outcome is not achieved, even for reasons out of their control.

Ultimately, there is no single solution which will ensure the equitable, sustainable transfer of the global value of lions to a local level. However, there is a considerable range of approaches, both traditional and novel, which can help not only to offset the local costs of lions, but also to ensure that they are ultimately seen as a net benefit to the people most affected by their presence. This may take time, but each mechanism has shown success when used in appropriate ways, so there are promising tools available to reduce the costs of lion presence, improve the benefits associated with them, strengthen and empower local communities, and improve the chances of long-term coexistence with benefits for both people and lions.

Box 6.9.1 Community camera-trapping in Tanzania's Ruaha landscape

Amy Dickman

The Ruaha landscape in southern Tanzania is very important for large carnivores, particularly lions, as well as being highly significant for other wildlife species such as elephants. Wildlife presence provides regional and national benefits, for instance through tourism revenue from Ruaha National Park. However, relatively few benefits come to the village or household level, which is where the costs of wildlife presence are felt most acutely.

The Ruaha Carnivore Project (RCP) (part of Oxford University's WildCRU) was established in 2009, and has been working since then to research carnivore ecology and ease human-carnivore conflict in the landscape. In response to community needs, RCP has developed a variety of benefit initiatives, such as scholarship programmes, school feeding, and the provision of healthcare and educational supplies to local villages. These have had positive impacts on local peoples' lives, and improved relationships between villagers and conservation organisations. However, benefits were usually seen as due to the presence of the project, not directly because of wildlife presence. To address this, RCP developed a new initiative called 'community camera-trapping' (CCT), where the provision of additional community benefits is based specifically on wildlife presence.

The concept is discussed with the village and if they are interested, they choose two people to be 'CCT officers'. RCP equips each officer with camera-traps, batteries, a GPS unit, phone and a bicycle, and trains them in camera-trap placement. RCP then employs them to place camera-traps out on their village land, wherever they think is most appropriate (with some caveats, e.g. camera-traps must be spaced at least 1 km apart). Every month, for every individual wild animal camera-trapped, the village receives a certain number of points, with more threatened, larger and more conflict-causing species allocated more points. [Points are currently allocated as follows: smaller herbivore: (smaller than kudu) 1000; larger herbivores (kudu and larger) 2000; snakes 1000; primates 1500; smaller carnivores (smaller than wild dog) 5000; less threatened large carnivores (leopard and spotted hyaena) 10000; threatened large carnivores (cheetah and lion) 15000; endangered large carnivores (African wild dog) 20000; all other mammals (excluding rats and mice) 1000.]

Villages are organised into groups of 4, and every 3 months, USD 5000-worth of community benefits are distributed to each group, split according to which village has generated most points that quarter (so the 1st village gets USD 2000-worth, 2nd USD 1500 worth, 3rd USD 1000 worth and 4th USD 500-worth). Benefits are split equally between local priority areas of healthcare, education and veterinary health, with RCP working with each village to determine, purchase and distribute the relevant benefits. Benefits are distributed at large celebrations in each group's winning village each quarter, and the programme and images are regularly explained at community DVD nights across all villages. The points are then reset to zero and the competition begins again.

This programme now operates in 16 villages, and has reinforced the link between community development and wildlife presence, rather than merely NGO presence. It has resulted in people legally protecting their camera-traps, taking more conservation-friendly actions and has been recognised as a major driver of community development. It is not flawless – as with many approaches, it requires ongoing external investment, but the level is low for the scale of potential community and conservation benefits. In the future, the initiative may be adapted to include penalties (e.g. for wildlife killing) as well as rewards, but for now, it has proved a very valuable step in demonstrating to local communities that wildlife can be a major driver of development and livelihood improvement, and can help ensure that benefits are delivered to those communities living right alongside wildlife and risking its costs.

Table 6.9.1. Summary of some potential financial mechanisms to encourage lion conservation and coexistence

		Financial mechanisms						
		Compensation	**Insurance**	**Revenue-sharing**	**Conservancies/community conservation areas**	**Conservation products**	**Performance payments**	**Landscape models, e.g. REDD+**
Mechanisms	**Source of funds**	Usually established by conservation NGOs or governments	Usually collaboration between conservation NGOs and communities	Diverting funds from existing revenue streams	Usually collaboration between conservation NGOs and communities	Collaboration between producers, business and often conservation NGOs	Governments or conservation NGOs	Usually businesses
	Recipients of payments	Usually individuals	Usually individuals	Usually communities	Usually communities	Variable	Variable, but usually communities	Landowners - may be individual or collectives
	Motivations for coexistence	Reduced costs of lion presence, so reduced incentive for retaliatory killing	Reduced costs of lion presence, so reduced incentive for retaliatory killing	Increased local benefits linked to carnivore presence	New or additional revenue from lion presence, encouraging coexistence	Higher prices paid for products produced using lion-friendly approaches	Increased local benefits paid as a direct result of carnivore presence	Receive payments for conserving land
Operational issues	**Governance required**	Medium - verification, payments	Medium - premiums, verification, payments	High - need effective structures to disburse funds to affected people	Medium - land use zoning and management	High - product development, verification, payments	High - need effective structures to disburse funds to affected people	High - needs landscape monitoring, payments disbursed
	Potential for fraud	Low - may try to claim for other losses, but unlikely to be verified	Low - may try to claim for other losses, but unlikely to be verified, especially in community settings	Medium - potential for corrupt disbursement of funds	Medium - potential for corrupt disbursement of funds	Low if well-structured and verified	Medium - potential for corrupt disbursement of funds	Low if well-structured and verified
	Likelihood of being sufficient	Low - unlikely to offset all costs of lion presence, and may be hard to verify even true depredation	Low - unlikely to offset all costs of lion presence, and may be hard to verify even true depredation	Low - revenue unlikely to be sufficient to outweigh all costs	Medium - depends on relative costs and benefits	Medium - may be sufficient at the scale of the producer	Medium - depends on relative costs and benefits	Medium - depends on relative costs and benefits

	Amount of external funding required	High and difficult to plan	Medium - initial setup, then depends on premiums	Low once business operational	Medium, mainly needed for initial setup	Low once business operational	High	Low once business operational
	Sustainability	Low - once initiated, must continue long-term	Medium - depends on willingness of the community to keep paying premiums	Medium - can be relatively sustainable if revenue comes from a good business	High if business model is good	High if business model is good	Low unless payments are linked to a source of revenue generation	High as long as carbon market is good
	Proven concept for lions?	Medium - seems to have worked in Amboseli but has had many problems elsewhere	Low - some trials but low buy-in so far amongst poor farmers	Medium - has been used around many Parks, but often revenue is quite low and has limited reach	High - has worked particularly well in Namibia for lions	Medium - examples for other predators (e.g. cheetah-friendly beef) but not proven for lions as yet	High - has worked well in Mozambique, some success in Tanzania	Medium - initiatives are starting but not proven as yet
Ultimate benefits	**Potential for poverty alleviation**	Low - does not provide additional money for participants	Low - does not provide additional money for participants, and involves cost of premiums	Medium - provides revenue, but may restrict land use options	Medium - provides revenue, but may restrict land use options	High, depending on the market and the skills training and empowerment of communities	High, as long as payments are sufficient & ongoing	High
	Potential for lion conservation	Low - just reduces the direct costs, so does not provide a reason to conserve lions, unless there are penalties for killing lions	Low - just reduces the direct costs, so does not provide a reason to conserve lions, unless there are penalties for killing lions	Medium - provides conservation revenue, but not linked to direct lion conservation actions	High, but often depends on the quality of the area for tourism and/or trophy hunting	High if the business is well-managed and revenue are high enough to offset costs	High - as long as recipients are rewarded directly for metrics likely to have direct lion conservaton impacts	High, especially in landscapes with poor potential for other wildlife land-uses
Examples of use		https://biglife.org/wildlife-protection/predator-compensation	http://pubs.iied.org/G03733/	http://www.uws.or.ug/wp-content/uploads/QEPA%20RS%20brief.pdf	http://www.met.gov.na/services/conservancies/193/	https://qcat.wocat.net/en/summary/4020/?as=html	http://www.niassalion.org/conservation-benefits.php	https://www.lionlandscapes.org/lion-carbon

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The School for Field Studies

The School for Field Studies (SFS) offers a variety of semester courses and summer sessions in many different countries, incl. a semester course on Wildlife Management Studies, as well as summer sessions in the Fundamentals of Wildlife Management and Carnivores of the African Plains, respectively, all of them in Tanzania (SFS 2018a, b, c). A semester course takes 15 weeks, a summer session 4 weeks (SFS 2018a, b, c). Applicants for the semester course must be at least 18 years of age and must have completed at least one semester of college-level ecology, biology or environmental studies/sciences (SFS 2018a). The costs for a semester course are around USD 23,000, for a summer session around USD 7,500 (SFS 2018a, b, c). Students of SFS can apply at SFS for financial aid, and the website of SFS lists further opportunities for scholarships & loans, although some of them are exclusively for U.S. students (SFS 2018d).

Southern African Wildlife College (wildlifecollege.org.za)

The main campus of the Southern African Wildlife College (SAWC) is located near Kruger National Park's Orpen Gate, South Africa. It covers various subjects within Natural Resource Management, Wildlife Guardianship, Community Development and Youth Access, and Sustainable Use & Field Guiding. Courses are offered on different levels:

- *Higher Education and Training*. The SAWC offers 2 programmes in higher education: one for the Advanced Certificate in Nature Conservation: Transfrontier Conservation Management, and one for the Higher Certificate in Nature Conservation: Implementation and Leadership, respectively. Both take 1 academic year and are "designed for those involved in operational positions within the nature conservation environment who will be moving into entry-level managerial or supervisory positions in their organisations".
- *Occupational Qualifications*. The SAWC offer 5 Skills Programmes, taking between 35–75 days and mainly aimed at Field Rangers; 2 National Certificates, taking 40-52 weeks and mainly aimed at protected area staff; and 1 Further Education and Training Certificate in professional hunting taking 24 months.
- *Short Courses*. The SAWC offers 42 different short courses in the subjects of SMART, computer skills, sustainable utilisation and guiding, law enforcement, people and conservation, administration for conservation, research and monitoring and wildlife area management. Short courses usually take 4–10 days.
- *Skilled Practitioner Classes*. The SAWC offers Skilled Practictioner Classes on 39 different subjects. These classes mostly consist of presentations that take about 90 minutes. Subjects include e.g. behaviour and ageing of lions or wildlife damage control.
- *Youth Access Courses*. The Youth Access Course is aimed at school leavers interested in a career in conservation. The course takes 6 months (SAWC 2018).

For more details on the entry requirements and course fees we refer to the website and the Prospectus 2018 (SAWC 2018).

Universities

In Senegal, programmes in protected area management are offered by the *Université Alioune Diop de Bambey* and the *Université de Thiès* (A. Fall, pers. comm.). Both, the *École Doctorale – Sciences Agronomiques et de l'Eau* of the *Université de Parakou*, and the *Université d'Abomey-Calavi* are located in Benin and offer programmes the management of natural resources. The EDSAE additionally offers a masters and a PhD programme, respectively, in biodiversity monitoring and conservation. The *Université de Dschang*, Cameroon, offers a 3-year programme in animal biology. The University of Cape Coast is located in Ghana and offers a bachelor programme in entomology and wildlife, as well as a master and a PhD programme in wildlife management. The University of Nairobi, Kenya, offers a bachelor programme in environmental conservation and natural resource management, as well as a master programme in biology of conservation. The Namibia University of Science and Technology offers a bachelor and a master programme of natural resource management (nature conservation) as well as a PhD programme in natural resource sciences. The University of Namibia offers a bachelor programme in wildlife management and ecotourism, with plans to introduce a master and a PhD programme in wildlife management. Both, the Tshwane University of Technology and the University of South Africa (UNISA) are located in South Africa and offer an education in nature conservation on different levels – from a national diploma to a doctoral degree. For information on the requirements of admission, length of the programmes, fees, financial aid etc. we refer you to the websites of the universities.

IUCN Program on African Protected Areas & Conservation (papaco.org)

The IUCN Program on African Protected Areas & Conservation (IUCN PAPACO) offers in collaboration with the *École Polytechnique Fédéral de Lausanne*, Switzerland, free Massive Open Online Courses (MOOCs) in English and French in four subjects: protected areas management in Africa, ecological monitoring, law enforcement and species conservation. Participants can go through the courses at their own pace, but it is estimated that it takes about 2 months to complete one of the courses.

Wildlife Campus (www.wildlifecampus.com)

Wildlife Campus is an online virtual campus endorsed by the Field Guides Association of Southern Africa (FGASA). Amongst others, the Wildlife Campus offers theoretical courses on wildlife management, anti-poaching, animal tracks and signs of Africa, or a behaviour guide to African carnivores, but no practical lessons. Complete courses cost ZAR 600–7,000, but can also be bought in individual components costing ZAR 55–125. Upon registration, one component of every course is made available for free. There are no pre-conditions for starting a course, and students may start at any time of the year and work through the material at their own speed. Upon passing the test, students receive a certificate.

African Leadership University – School of Wildlife Conservation (www.alueducation.com)

The African Leadership University – School of Wildlife Conservation (ALU SoWC) is situated at the ALU campus in Kigali, Rwanda. It offers an undergraduate degree programme in global challenges. The programme takes a total of 3 years, with 8 months per year on campus, and 4 months of internship. There is also an MBA for Conservation leaders on offer, which takes 20 months (mostly interactive, online learning, interspersed with week-long in-classroom "intensive" sessions) and "combines world-class business education with cutting-edge training in leadership and pressing conservation issues". The ALU SoWC also plans to launch a number of short courses of up to one week to be held across Africa, e.g. in Dar Es Salaam, Tanzania; Nairobi, Kenya; Lusaka, Zambia; Maputo, Mozambique; Kruger National Park, South Africa; Port Elizabeth, South Africa; or Windhoek, Namibia (ALU SoWC 2018). The estimated costs of attendance for the undergraduate programme in Kigali amount to USD 7,260–13,000 per 8 months on campus (ALU 2018a). The MBA programme tuition costs USD 30,000 for the 20 months excl. travel costs to attend the "intensive" sessions in Kigali, Rwanda (ALU 2018b). Students at the ALU can apply for financial aid (ALU 2018b, c).

International Ranger Federation (www.internationalrangers.org)

The website of the International Ranger Federation (IRF) contains the Ranger Toolkit – "a collection of documents and links to websites of relevance to rangers and the work that they do" incl. e.g. anti-poaching training guidelines in English and French.

PAMS Foundation (pamsfoundation.org)

The PAMS foundation offers amongst others support for rangers and village game scouts by providing training as well as basic equipment and resources for patrolling.

Game Rangers' Association of Africa (cf. Chapter 9.3; www.gameranger.org)

The Game Rangers' Association of Africa runs a variety of projects to support rangers in Africa by providing training and equipment. The Safe Ranger Project provides rangers with training and equipment for first aid in remote areas. The GRAA offers an advanced field ranger course, a protected area security operations planning course, and a counter insurgency tracking training course (GRAA 2018). The GRAA also administers a ranger training bursary fund "to financially assist members who wish to enter, or who already attend a GRAA approved educational establishment, to study towards or further a career in conservation and/or protected area management" (GRAA 2018).

Bhejane Nature Training (www.bhejanenaturetraining.com)

Bhejane Nature Training is located in northern KwaZulu Natal, South Africa. It offers a field ranger and monitoring assistant course taking 4 weeks to complete, costing ZAR 22,500.

7 Capacity development in conservation and management

7.1 Existing training opportunities in Africa

Roland Bürki

Having well-trained people is as vital in nature conservation and management as in any other field. While at its basis, training mainly serves the improvement of skills and knowledge, there are more subtle purposes as well: training courses are most often not performed exclusively for the staff of a single institution, but brings together people from a variety of places, allowing them to also increase their network and the exchange of experiences (cf. chapter 9.3). Moreover, regular training allows participants to learn about new approaches and developments, enabling them to adapt to new challenges. Last but not least, training may also keep up the motivation and enthusiasm of participants. Especially in the challenging work environment of nature conservation, training sessions can help reminding about the significance and importance of their work and make them feel appreciated (Kopylova & Danilina 2011).

Below we have compiled a number of training opportunities in Africa or online. The selection is by no means exhaustive or exclusive, nor is it a recommendation compared to institutions not listed below. With our selection, we have attempted to capture the broadness of available opportunities on offer both for academics as well as for field personnel. We would also like to refer you to publication no. 17 in the IUCN Best Practice Protected area Guidelines Series "Protected Area Staff Training: Guidelines for Planning and Management" by Kopylova & Danilina (2011). For overview of Central Africa, there is also the *Réseau des Institutions de Formation Forestière et Environnementale de l'Afrique Centrale* (RIFFEAC), a grouping of 23 Central African educational institutions, offering courses and programmes regarding the sustainable use of environmental resources.

École de faune de Garoua, Cameroon (www.ecoledefaune.org)

The *École de Faune de Garoua* (EFG), Cameroon, describes itself as the only institution in french-speaking Africa for the education in animal conservation and protected area management. It was established in 1970 and has since then trained more than 2,000 people from 22 African countries, which now work as directors of protected areas, conservation project leader, heads of anti-poaching units, or as CITES officers (EFG 2018a). The formation consists of four semesters of courses plus a research internship during the summer, with shorter courses for rangers also on offer (USFWS 2014). Students are housed in dormitories and costs for the education amount to about XAF 7,000,000 for the two years (EFG 2018b, c). Various organisations offer financial support for students of the EFG (EFG 2018d).

African Bush Training (www.africanbushtraining.com)

African Bush Training has camps in South Africa and Botswana. ABT offers a wilderness protection course, taking 21 days to domplete, costing ZAR 23,100. The course is aimed at career orientated individuals, school-leavers and gap-year students.

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7.2 Diploma in International Wildlife Conservation Practices

Egil Dröge

Conservation at the front-line requires committed, talented field biologists whose practical skills and ingenuity are well-founded on solid, high level, science. This foundation of theory and practice underpins the need to tirelessly monitor populations, work with local communities or lead anti-poaching patrols. Passion is necessary but not sufficient – too often talent goes untapped due to inadequate theoretical foundations and insufficient training. In 2008, WildCRU started a Diploma in International Wildlife Conservation Practices aimed at young, practical conservationists (often working for local NGOs, international NGOs, in studies linked to universities or working in protected area management within government wildlife services) and from developing countries.

To enrol, applicants have to go through a competitive selection procedure. The program involves 7 months of intensive, residential tuition at WildCRU and over the last 11 years trained over 75 students from 39 different countries. The course is made possible by a donation from the Recanati-Kaplan foundation which covers all course related costs (tuition, visa and travel costs) and students receive a living stipend and are provided with housing on site at WildCRU. In addition, the course benefits from our collaborations with the University of Oxford's Department for Continuing Education (DCE), and Lady Margaret Hall college. The course is provided in English, but because of the diverse background of students, the students are only required to meet the standards which provides them with an English visa.

The aim is that once graduated they will build on their role as a field biologist and conservation practitioner, working within a national or regional wildlife management and protected area systems organisation, for NGOs or as independent practitioner. In addition, their knowledge and expertise will benefit their colleagues through informal peer-learning, skills transfer and the encouragement of critical thinking and debate.

We have received and trained 25 students from 10 different African lion range states. Many of those students were involved with lion management or research before they enrolled in the Diploma, and most of them went back to their respective jobs or projects with their newly gained skills or obtained other management positions affecting lion management (Box 7.2.1).

The Diploma teaches many sides of conservation and provides the students with a solid background in statistics and GIS and focuses on various techniques to monitor, manage and detect trends, in populations and biodiversity as well as equip them with knowledge about human-wildlife conflict (HWC) mitigation practices. Amongst others, techniques taught are distance sampling, occupancy modelling, spatial explicit capture-recapture (SECR) and population viability analysis. The whole process of research and monitoring is addressed during the course, from study design to collecting the data, entering the data, preparing the data for analysis, doing the analyses and interpreting the results of the analyses and presenting them in various ways. This is done with a mix of lectures, labs in the field, labs in class, discussions and workshops and taught by various world-class experts. Various free software packages like R, QGIS, PRESENCE, DISTANCE and Vortex are used so students will be able to use those programs even after finishing the Diploma. Multiple other monitoring and management techniques are discussed in class too. Some management approaches discussed include fencing of PAs, hunting, vaccinations of wildlife and domestic animals, contraceptives, livestock prac-

tices, relocations and reintroductions. A dedicated reintroduction workshop is organized where students explore all pros and cons which need to be considered, according to the IUCN guidelines for such undertakings. These are compared to a theoretical scenario and also actual reintroductions are reviewed and tested to the IUCN guidelines. Students are assessed throughout the Diploma with 5 different assignments and an independent project which needs to be completed in two phases and which culminates in a report in the form of a scientific paper and a presentation at a WildCRU seminar.

Emphasis in the Diploma is placed on the human dimensions of conservation, especially on human-wildlife conflict. Several large projects led by WildCRU researchers, for example the Hwange Lion Project in Zimbabwe, the Ruaha Carnivore Project in Tanzania, Living Landscapes in Kenya and the Ethiopian Wolf Conservation Programme in Ethiopia deal with various types of HWC with carnivores. This huge amount of experience within WildCRU is utilized in the Diploma to teach the students about HWC and approaches used to mitigate in these conflicts. After lectures and in-class discussions, it culminates in a 3-day workshop. A hypothetic HWC situation is set out in detail, along with a budget, a time frame and the costs of some common project expenses. Students then have to present a detailed project proposal, including a timeline and a budget and with measurable achievements at the end of the workshop.

At the end of the course the students have a comprehensive knowledge of globally occurring terrestrial conservation problems with a focus on large carnivores, the most widely-adopted solutions to these problems, and barriers to their effectiveness. They have gained the skills to apply methods of biodiversity and population monitoring, are able to select appropriate field techniques depending on the information needed, and have the technical expertise to plan, implement and draw conclusions from their field work. They are also able to get their message across to a variety of audiences, be they scientists, government staff, donors or the general public.

Box 7.2.1 Account of an alumnus

Martial Kiki

Born in Benin, one of the countries with the largest population of lion (*Panthera leo*) in West Africa, I have been fortunate enough to attend the WildCRU Diploma in International Wildlife Conservation Practice at the University of Oxford. Before the Diploma I had general knowledge on wildlife conservation and research. However, I was not skilled and confident enough to conduct both research and conservation work on my own. I learnt a tremendous amount of practical skills in conservation during my time in Oxford which has significantly improved my knowledge and skills in wildlife conservation and research but was also a big opener of my awareness to the global world as of how I could contribute to the development challenges of my country and the wider Africa. Thanks to the Diploma, I successfully conducted research on "The status and conservation of the Critically Endangered lion (*Panthera leo*) population and other carnivores in Nigeria" with wildlife practitioners from WCS (Wildlife Conservation Society); using different techniques to survey large carnivores that I learnt from WildCRU and also gave training to rangers and students working in the protected areas. I also led a Lion Guards program in Benin. Through this program funded by the National Geographic Society's Big Cats Initiative, I carried out the first large scale camera trapping survey in W NP which is now helping us to learn more about the interactions between lions, their prey and illegal human activities in this landscape. We have also conducted the first successful environmental education to students in this area to increase their awareness and that of the local communities about lion conservation. The WildCRU Diploma also allowed me after my return to train other students in Benin, Burkina Faso and Nigeria with some of them pursuing their academic goal in conservation science at Master level and other serving at various job positions with organizations such as ZSL, African Parks and GIZ in Benin, Niger and Burkina Faso. As regard to myself, the Diploma allowed me to demonstrate sufficient academic merit to start a PhD degree at the University of Florida which will help me build on my previous knowledge to successfully protect the last lions of West Africa.

7.3 Establishing trained and effective National Coordinators

Sarah Durant

Regional strategies and national conservation action plans (NAPs) need to be far reaching, if they are to be able to halt the decline of lions. Hence, they must encompass multiple aspects of lion conservation, ranging from mitigating human-lion conflict and delivering benefits from lions for local communities, to large scale planning of movement corridors and transboundary conservation. This means that the implementation of NAPs requires good coordination, to ensure that different departments, and sometimes different ministries, deliver on the activities outlined in the plans. It is critically important that a broad range of stakeholders are actively engaged with the national conservation action planning process to ensure ownership and to secure the commitment required to see the plans through to implementation.

A model which has proven effective in implementing NAPs is that used by the Range Wide Conservation Programme for Cheetah and African Wild Dogs (IUCN/SSC 2007a, b, 2012, 2015). Here, once the NAP is developed by the government and relevant stakeholders, the national wildlife authority agrees to appoint a National Coordinator. The Coordinator is a single individual charged with coordinating the implementation of the plan. Such an individual should, ideally, be based within the most relevant wildlife department within the country concerned, and should ensure that coordination is mainstreamed within, and between, relevant departments. The National Coordinator is not, however, responsible for implementing specific activities themselves, although they may also choose to do some of this. Instead, they coordinate NAP implementation by ensuring that relevant government departments, NGOs, and individuals move ahead in implementing the activities laid out in the plan. The national wildlife authority, after seeking the necessary agreements, should select and publicly assign the National Coordinator role to a suitable individual among their employees. When selecting a National Coordinator, consideration should be given not only to the conservation management knowledge of the candidate, but also to the personal skills that they will need to enable them to work productively with a broad range of stakeholders. A significant portion of the time of the Coordinator should be allocated to their coordination role, to ensure they can be effective in this role. The same individual should be kept in place as Coordinator for a minimum of three years and, ideally, a National Coordinator deputy or assistant should also be appointed to maintain the role through staff changes.

A National Coordinator should, ideally, have prior experience in large carnivore conservation, however they may also need training and mentoring to help them develop in their role. As government employees, who need to address a diverse array of wildlife management responsibilities, Coordinators are unlikely to be lion ‘experts’, and thus they will benefit from targeted training to give them the skills and knowledge they need for coordinating lion conservation activities. An example of how this can be achieved is provided by the training and mentoring programme carried out by the Range Wide Conservation Programme for Cheetah and African Wild Dogs, with coursework support from the Tropical Biology Association (Box 7.3.1). In this programme, a series of short targeted courses were provided to a cohort of National Coordinators for the National Conservation Action Plans for Cheetah and African Wild Dogs. Training courses were backed up with long term mentoring support from three regional coordinators (southern Africa; eastern Africa; and western, central and northern Africa), and a small budget to allow Coordinators to implement key activities within their National

Conservation Action Plans, to help develop skills in project development, management and communication. The result of such a training and mentoring programme should be a cadre of coordinators with the knowledge and the skills they need to coordinate the implementation of their action plans, and to engage the support of a wide network of stakeholders.

In order to ensure implementation of NAPs does not lose momentum over time, it is vital to establish a system of reporting back on progress, including regular meetings. Ideally, these meetings will be at a regional or continental level, that also provide opportunities for peer-to-peer learning where coordinators can learn from each other. Such meetings can be combined with training courses, or can be organised separately, and should happen at least once every two years, ideally every year. National Coordinators should report back on the activities undertaken in their countries in line with their NAP, identify challenges to implementation and provide feedback on lessons learned. National Coordinators will need to liaise with relevant stakeholders, to develop their reports on progress, since this progress is achieved jointly together with multiple stakeholders. An NAP is expected to last for a minimum term of five years. Thus, as well as the regular meetings described above, a full mid-term review should be undertaken two to three years into the NAP, including a report back on progress on each activity within the NAP. After five years, another review should be undertaken to determine whether the NAP can be renewed for another five years, or whether it needs to be updated.

In conclusion, the NAP should be the start of a conservation process – not the end result. The implementation of a NAP does not happen automatically, but requires some thought and planning, including support to governments, and their selected Coordinators, along their NAP implementation journey. While the development of a NAP is likely to need external support, the process should be designed in a way that fully engages all relevant stakeholders and ensures that NAPs are owned by national governments and stakeholders. Formal and explicit governmental support for the NAP is vital to ensure the process of implementation moves forward effectively. As a first step, governments should establish a National Coordinator who can be tasked with coordinating the implementation of the NAP. The international community, through the IUCN Cat SG, should help to address the training needs to support the Coordinator in fulfilling their role, including ongoing mentoring, as they start to face the challenges in conserving their lion populations. Regular meetings, to allow reporting on progress in implementing the NAP, are essential to maintain momentum over the 5-10-year cycle of NAPs. This will require long term commitment from stakeholders and donors.

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Box 7.3.1 Training for National Lion Coordinators

Sarah Durant, Nick Mitchell and Rosemary Groom

This training programme is adapted from one used for the training of National Coordinators for Cheetah and African Wild Dogs (Fig. 1), conducted by the Range Wide Conservation Program for Cheetah and African Wild Dog, with the support of the Tropical Biology Association.

A cohort of National Coordinators from multiple countries will vary in their experience in lion conservation and management and are likely to have a wide diversity of knowledge and skills. Thus, a training programme designed to provide Coordinators with the skills they need for lion conservation must be sufficiently flexible to accommodate this range of experience.

Fig. 1. Participants of a two-week long training course for a cohort of ten National Cheetah (or Carnivore) Coordinators (NCCs) from ten cheetah range states across Africa.

A cohort of National Coordinators from multiple countries will vary in their experience in lion conservation and management and are likely to have a wide diversity of knowledge and skills. Thus, a training programme designed to provide Coordinators with the skills they need for lion conservation must be sufficiently flexible to accommodate this range of experience. National Coordinators are government employees and hence have substantial constraints on their time and schedules, thus training is best conducted over several short training sessions, rather than a single long course. This also provides for periods of consolidation and for applying new knowledge, and then for reporting back to colleagues and peers on experiences associated with implementing NAPs. Each course should provide opportunities for feedback on the training from Coordinators to ensure each subsequent course can be carefully tailored according to their needs.

Within each training course, formal lectures should be interspersed with facilitated discussions, role plays, practical exercises and field visits. Local lion research and conservation organisations should be engaged in the training courses to provide opportunities to learn from on-the-ground lion conservation projects, including visits to communities impacted by lions and the observation of lions in the wild. Thus, the location for these courses should be selected in terms of access to active lion conservation and research projects.

Within each course, the Coordinators should develop workplans and implementation timetables to move their NAPs forward. Thus, enough time should be scheduled for this activity, when they should also be provided with one-on-one mentoring support from a regional coordinator or trainer.

Based on the experience of the Range Wide Conservation Program for Cheetah and African Wild Dog, who have provided similar training to a cadre of National Cheetah and African Wild Dog Coordinators, the curriculum should include the following topics:

Ecology, Science and Research

- Lion ecology and habitat needs
- Lion survey and monitoring techniques
- Database management and data analysis

Implementing Conservation Action Plans

- Managing the implementation of lion conservation action plans
- Developing annual work plans for each country
- Fundraising for conservation

Coexistence and livelihoods

- Human-lion conflict and coexistence
- Enhancing livelihoods of local communities

Communication and Collaboration

- Education and awareness raising in schools, communities and governments
- Working with NGOs for effective lion conservation

Trade

- Understanding the legal and illegal trade in lions
- How to engage with CITES and CMS

A total of 3-4 weeks is needed to cover all this course work. This could be conducted as a single, month-long course or, preferably, broken down into two or three courses of 1-2 weeks duration, which are likely to be easier to fit into busy government schedules.

7.4. Training for handling poisoning incidences and poaching evidence

Matthew Becker, André Botha, Kelly Marnewick and Lizanne Roxburgh

Wildlife poisoning in general, and the poisoning of lions in particular, is a rapidly emerging threat across Africa, with serious ecological and human impacts. Poisoning is typically associated with 1) retaliatory killings arising from human-wildlife conflict, 2) as a means of reducing detection of poaching (by killing scavengers), or 3) as part of an increasing network of wildlife trafficking in animal parts and skins. Here we present an overview of poisoning, its impacts, drivers, and means of addressing incidences through training programmes.

Background to poisoning

The poisoning of wildlife has had a substantial negative impact on many species; for example five of Africa's vulture species are listed as critically endangered due to poisoning (Botha et al. 2017). The impacts of a poisoning incident can be far reaching, not only involving the targeted species but also other mammalian and avian scavengers that eat either the poison, or succumb to secondary poisoning though eating other poisoned animals.

The scale of these poisonings can be substantial, and there have been several incidents in Southern and Eastern Africa in the last 10 years which have resulted in the loss of more than 100 animals, across a range of species per incident. The most extreme example of this happened in the Zambezi region of Namibia in June 2013 when between 400-600 vultures and an undetermined number of mammalian scavengers were killed after feeding on a single elephant carcass that was deliberately poisoned after being poached for its ivory (Ogada et al. 2016).

Poison is widely available throughout Africa and generally its use for killing carnivores is illegal, but very hard to regulate. A wide variety of poisons are used and there appears to be some regional preference for certain poisons e.g. in East Africa carbamates like, carbofuran and carbosulphate and a range of organophosphates are used, while in Southern Africa aldicarb, strychnine and organophosphates are commonly used.

Poisons and their unregulated use also pose a threat to human health both through consumption of poisoned animals and through direct handling of the poisons. Very little is known about the impacts of consuming parts from poisoned lions (e.g. fat and bones) and research is needed in this area. It is documented that people can suffer negative health effects from consumption of poisoned vultures and other wildlife (Richards et al. 2017). There is also a substantial risk to human health when handling and working with pesticides and other chemicals without adequate protective equipment and clothing.

As a top predator declining across its range, the African lion has become increasingly impacted by poisoning. Multiple incidences of poisoning mortality have been documented, perhaps most notably by the eradication of the well-known Marsh Pride in the Maasai Mara Game Reserve in 2015. Poisoning is one of the methods used to kill lions in retaliation for livestock predation (Bauer & De Iongh 2005) and has also been documented areas across including: Botswana (Snyman et al. 2015), Tanza-

nia (A. Dickman, pers. Comm..), and Kenya (Hazzah et al. 2014). In a recent trend, lions are being poisoned and snared for their body parts for trade. In the Limpopo National Park (Everett & Kokes, submitted) and Niassa National Reserve (C. Begg, unpubl. data), Mozambique, this poaching has been linked to organised crime. In South Africa captive lions are being targeted for their parts (Marnewick unpublished).

Lions are an excellent flagship species that can be used in addressing the ecological impacts of poisoning. As such, it is important that the poisoning of lions is addressed both in terms of the impact on lion populations, and to prevent the potential catastrophic impacts that secondary poisoning can have on scavengers.

A poisoned lion with parts harvested (Photo A. Botha).

Monitoring and quantifying poisoning impacts on lions

Poisoning incidents involving lions are not reported in any standardised way or to any centralised database. This makes trends and impacts difficult to quantify. However, the African Wildlife Poisoning Database (www.africanwildlifepoisoning.org) was established as a joint initiative of the Endangered Wildlife Trust (EWT) and the Peregrine Fund Wildlife, and poisoning incident data can be submitted to wildlifepoisoning@ewt.org.za for inclusion in the database. The database has been for-

mally maintained since 2017, although records date back to 1961. The database was established because poisoning is the main threat to critically endangered African vultures and has severely impacted populations of many other species, including lions, hyenas, Tawny Eagles, Bateleurs and jackals. The database consists of 451 poisoning incident records resulting in 14,992 mortalities for a variety of species. Lion poisonings are displayed in Table 7.4.1.

Additionally, the EWT has been recording the deliberate poisoning of captive lions in South Africa using open sources and direct reports (K. Marnewick, unpubl. data) since 2016. South African has a captive lion population of approximately 8,000 (van der Vyfer, pers. comm. June 2018) however some estimates are as high as 12,000. These lions are kept in captive conditions and are habituated to humans, making them particularly vulnerable to being targeted for poisoning. The EWT has recorded 23 incidents involving 68 lions being killed, all of which were poisoned. The type of poison used is not known. The body parts taken included: feet (15 incidents), front of the face (14 incidents), the mouth/jaw (five incidents), head and skin (four incidents each) and tails (two incidents).

Not much is known about the demand and trade routes for these parts, however, lion parts are commonly found in muthi markets in South Africa and have also been seized with other wildlife contraband like rhino horn destined for the East. Thus we suspect that there are both national (African) and international (Eastern) demand for lion products.

Reducing the impact of poisoning

Although the intentional killing of wildlife by means of poisoning is very difficult to prevent, the impact of individual poisoning events in terms of the losses of wildlife can be reduced through rapid response and immediate action to prevent further losses and contamination of the environment (Box 7.4.1; Murn & Botha 2018). At the same time as securing and stabilising a poisoning site, it is essential to collect appropriate evidence for possible prosecution should the perpetrators of such acts be apprehended. Both effective poison site management and the collection of samples from such incidents require particular knowledge, skills and equipment. It is also imperative that due consideration and training to ensure the safety of the individuals involved is ingrained in this process. In the case of reducing targeting killing of lions, it is imperative that this is done as part of a holistic approach to dealing with human-lion conflict.

Training for poison management

The EWT-Vultures for Africa Programme, in partnership with The Hawk Conservancy Trust, offer poising intervention training to rangers, law enforcement officials and other interested parties across Southern and East Africa. Since 2015 training has been provided to 1500 people in nine countries across the lion's range in Africa. Apart from reactive capability, knowledge of the drivers, methods and substances used in wildlife poisoning events also enable conservation and law enforcement staff on the ground to proactively be on the look-out for substances and possible perpetrators and, through effective legal intervention, prevent incidents where wildlife is poisoned.

Box 7.4.1 Poison intervention training: a case study of Zambian lions

Matthew Becker

Treating poisoned lions from South Luangwa's Big Pride in Zambia. Photo M. Becker

Luangwa Valley, Zambia, is one of ten remaining lion strongholds on the continent (Riggio et al. 2012). While poisoning had not been occurring at a high level in this area, there were increasing incidents from elephant poaching and conflict, as well as from poisoning of birds such as crowned cranes for consumption. Consequently members of the Zambia Department of National Parks and Wildlife (DNPW) as well as multiple non-governmental conservation organizations, underwent the intensive poisons training described above in July, 2016. Several weeks after this training, fourteen lions of the South Luangwa National Park's iconic Big Pride were found feeding on a carbofuran-poisoned elephant, with one lion already dead and multiple animals displaying advanced signs of poisoning. Utilizing the poisons response skills, the newly-trained department and NGO team undertook a week-long effort to dart and treat all poisoned lions, prevent further consumption of the elephant, and destroy both the elephant carcass and all contaminated faeces and vomit from the lions. This effort was successful and no additional lions succumbed to poisoning (additional lions attempted to visit the carcass in the night--including the famous male lions, Ginger and Garlic--but were prevented), and no vultures, hyenas or other scavengers were poisoned. The success of this operation was entirely due to the poisons response training enabling the team to safely and effectively respond to the incident. Without this training most, if not all, of the lions would have succumbed to poisoning, as would have an untold number of avian and mammalian scavengers. Similarly, given the human health risks posed by the poisoned carcass, the safety of the team could have been seriously jeopardized had the situation been improperly handled. Poisons response training has since been conducted across most of the ecosystems where lions occur in Zambia, but more is required to ensure an effective response to future poisoning incidences.

Table 7.4.1. Records of lion poisoning incidents from the African Wildlife Poisoning Database (www.africanwildlifepoisoning.org)

Country	Year	Sum of Mortality
Kenya	2002	25
Kenya	2003	17
Kenya	2004	30
Kenya	2005	11
Kenya	2006	10
Kenya	2007	21
Kenya	2008	12
Kenya	2009	9
Kenya	2010	5
Kenya	2011	5
Kenya	2012	4
Kenya	2014	2
Kenya	2015	13
Kenya	2016	4
Kenya	2017	2
Tanzania	2016	1
Tanzania	2018	21
Uganda	2010	6
Uganda	2018	11
South Africa	1986	1
South Africa	2015	5
South Africa	2016	4
South Africa	2017	6
Namibia	1980	7
Namibia	2016	3
Mozambique	2014	6
Mozambique	2015	1
Mozambique	2016	2
Zimbabwe	2016	1
Zambia	2016	1
Grand Total		246

Training covers both theoretical and practical aspects and is conducted on-site. The specific aspects are displayed in Table 7.4.2 as per the standard protocols which have been drafted by the EWT and its partners over more than 25 years of addressing poisoning incidents in southern Africa. In addition to training poisoning response kits are distributed. These kits contain the basic equipment needed to manage and conduct investigations at wildlife poisoning scenes.

Table 7.4.2. Outline of the theoretical and practical aspects of the poison intervention training

An overview of wildlife poisoning and its impact on species
Signs and symptoms of wildlife poisoning
Information on chemicals commonly used
Safety of staff and basic equipment required
Scene investigation and collection of samples
Assessment of mortalities (Species, age, sex, etc)
Legal process and relevant legislation
Emergency treatment and evacuation of live specimens from the scene
Sterilization of the scene to prevent further poisoning
Data capture and dissemination
Poisoning Intervention Planning (SOP's)

Greater emphasis is currently being placed on the training of trainers in countries where wildlife poisoning has been identified as a significant problem and good results have been achieved. An example of this is a training workshop held in the Maasai Mara Game Reserve, Kenya in November 2016 that was attended by representative from a range of organisations, which included lion research and conservation projects. More than 400 individuals have subsequently been trained during 33 interventions by teams of trainers that attended this training, and initial feedback indicates that the improved awareness and preparedness to respond to poisoning incidents have contributed to a significant reduction in the number of recorded poisoning events in the Maasai Mara (M. Virani, pers. comm.). A project aimed at training trainers in six SADC countries in this regard will aim to achieve the same objective in the region over the next two years.

Conclusion

With burgeoning human and livestock populations, and an increasing illegal trade in wildlife parts, the threat and impact of poisoning is likely to only increase in Africa. As the continent's top predator and an iconic species of significant economic value, lions have the potential to serve as a flagship species to garner support and resources to address this serious threat to ecosystems and people. The drivers and impacts of poisoning are still poorly understood and in need of continued investigation to help guide, inform and evaluate conservation efforts to address it. However poisons response training commensurate with these efforts has clear benefits in combatting the impacts of poisoning on lions, people, and ecosystems, and should be implemented across lion ranges in Africa.

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7.5 Law enforcement and site based intelligence training

Nick Beale and Mark Booton

Law enforcement and intelligence training span a broad spectrum of different skills and disciplines. From the more military-directed skills such as weapons training through to more policing-focused skills such as interview training and community engagement techniques, the types of different training which can be delivered under the law enforcement and intelligence banner are extremely diverse and varied. Regardless of the actual type of training which is on offer, the three most important questions to ask when planning a site-based law enforcement and intelligence training programme are: Who needs it? Why do they need it? And who is going to deliver it? Training can be delivered to groups or individuals. Sometimes it may be best to train a few key individuals before training the main group. For example, training patrol managers in planning and leadership before training rangers in patrolling tactics.

An Overarching Strategy

The planning and delivery of site-based law enforcement and intelligence training should form part of a broader strategic plan for protected area management. This strategic plan serves to direct resources towards the primary threats facing big cats in any given Protected Area (PA). Coordinating the delivery of training under a broader strategic plan ensures these investments are delivered to the right people at the right time, and avoids the trap of delivering training in a vacuum. An effective way of ensuring that this happens is by using a proven business and decision making model that's been adapted for the conservation context. For example, some conservation organisations involved in countering wildlife crime use a system based on the British Police National Intelligence Model to help shape strategic thinking. Under this model, investing in 'human assets' is a key part of increasing capacity.

Having proper site-based systems in place ensures all site staff, including from partner organisations, work to consistent standards and procedures across a whole site. In a law enforcement and intelligence capacity this means adopting a system which supports the Intelligence Cycle, a proven systematic approach to the planning, collection, processing, analysis and dissemination of information. By having this cycle as a focus, information can be used more effectively and patrols tasked and directed more efficiently, increasing the chances of countering or deterring poaching activity.

Who needs law enforcement and intelligence training?

Managers and decision-makers assessing whether to invest resources in training staff in law enforcement and intelligence skills, first need to have a good understanding of what this training includes and more importantly who needs to receive it. The best way to start this process is to assess the skills of existing staff (see below). By having this as the initial focus, managers are able to avoid prioritising training simply because it is offered and can instead focus on what is most needed. All training needs to address two key criteria: to ensure the safety of staff whilst they carry out their normal job-related duties and to enable them to do their jobs more effectively. Training should also allow for future changes in job requirements due to emerging threats or risks.

Law enforcement and intelligence training is therefore not just about the upskilling of frontline staff, namely the rangers. Whilst this obviously forms a vital part, to have an effective law enforcement and intelligence capability on site, key people who have been identified or recruited to provide the support to frontline staff will also need to develop their skills. These skills include tasking and leading ranger teams and collecting and analysing information. Any plan for the delivery of law enforcement and intelligence training therefore should include plans to train patrol managers and planners, analysists, community engagers, technicians as well as the rangers themselves.

Conducting a training needs analysis

Before training is delivered, a training needs analysis (TNA) should take place. Knowledge of the site or protected area and its staff will provide some answers to key questions. Whilst the process need not be formal, conducting a site based TNA is more effective if you use a proven systematic approach such as the 'Three Level Analysis' model by McGhee and Thayer (1961), where training needs are identified by looking at the organisational, operational and individual level. By using this approach, it helps synergise the delivery of training into the overall strategic plan for a site and avoids the common pitfall of first jumping into delivering training to rangers at an individual level. Often law enforcement and intelligence training will be requested directly by a PA's management to a foreign NGO or training provider. A person in charge of the management of a PA may well have already identified areas where they feel their staff need to be trained.

Course content and design

When planning law enforcement training for rangers, it is important to consider how the course is structured and the basic standards you want the majority of the course to achieve; i.e. What are the core competencies for a ranger to do his or her job effectively and safely? For more guidance on this see the 'Anti-Poaching Training Guidelines' (available in English and French) produced by the International Ranger Federation (IRF). Any training programme needs to take into account the aspirational level which needs to be reached by the participants in any particular subject area: foundation, practitioner or expert.

To take account of diverse site and staff skills requirements, training programmes are best designed with a modular approach. There are some training modules such as patrolling, navigation and first aid (Fig. 7.5.1) which are classed as core skills, and are more often than not always included in the delivery of foundation level ranger training. More advanced skills are normally taught as part of follow-on courses, once the basic skills have been mastered. What is taught and to what level will always link back to the findings from the TNA. Having a generic course which is always delivered to different groups of rangers in different sites is rarely possible. Sites will always have their own specific sets of training requirements based on what is happening in their sites and the threats and challenges faced.

Fig. 7.5.1. First aid training in Pendjari, Benin. Photo Vincent Lapeyre.

An example of some of the different law enforcement skills that can be taught to ranger teams are as follows:

- Patrol and or operational tasking, planning, briefing and de-briefing
- Field craft and basic patrol skills, including camouflage and concealment, tactical movement, obstacle crossing (Fig. 7.5.2)
- Navigation
- Tracking
- Arrest techniques
- Evidential procedures and crime scene management
- Search
- PoacherCam deployment training
- Safe weapons handling

Key individuals or smaller staff groups within a site could be trained in:

- Management and leadership
- Interviewing skills
- Analysis training
- SMART data entry and profiles training
- Image management and technical asset training.

Fig. 7.5.2. Patrolling tactics training in Pendjari, Benin. Photo Audrey Ipavec.

This is by no means an exhaustive list. As mentioned earlier, the key to designing an effective protection strategy is identifying what skills staff need to do their jobs more efficiently and safely, and also what do they need to get better at capturing and deterring the poachers. Once this is identified, professionals can be brought in to address the particular training need as necessary. Where trainers from within teams are used, they should have the relevant operational experience and ideally be experienced instructors. NGOs delivering law enforcement and intelligence training should consider how they can impart the required knowledge and skills to park-based staff so that, over time, they can be in a position to conduct their own site-based training programmes.

A sustainable approach to skills development

It is important to consider that training forms part of an ongoing cycle to allow people reach their potential, and time must be allowed for selection, basic and continuation training. Team structure should allow for experienced mentors to mentor new, less experienced recruits. All training should be followed by a period of consolidation, mentoring and coaching. Further training (including in the consolidation phase) should be guided by operational requirements, specific to the team's area of work. Trainers and senior staff within the team should devise and lead such further training, and should be supported by management. This approach ensures sustainability over the longer term.

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8 Public awareness and education programmes

Roland Bürki

"Public awareness brings the issues relating to biodiversity to the attention of key groups who have the power to influence outcomes. Awareness is an agenda setting and marketing exercise helping people to know what and why this is an important issue, the aspirations for the targets, and what is and can be done to achieve these" (Hesselink et al. 2007). In other words, public awareness is a question of communication. According to a Quick guide on communication, education and public awareness programmes for protected area practitioners by the Convention on Biological Diversity and Rare (Ervin et al. 2010), an effective communications program consists of 7 steps:

1) Understanding the societal and conservation context
2) Changing knowledge and attitudes
3) Changing social norms, values, perceptions and conversations
4) Removing barriers and creating incentives
5) Motivating positive actions
6) Sustaining behaviour change over time
7) Assessing and monitoring the impacts of behaviour change.

Crucially, for a public awareness campaign to be successful its target audience needs to be clearly identified and the message fitted and adapted accordingly (e.g. in Waza NP, see Box 8.1; Hesselink et al. 2007, Ervin et al. 2010). Below, we list some examples of public awareness publications. For this chapter, we distinguish between technical awareness publications (usually aimed at practitioners or managers), educational publications for children or adults, and general public awareness publications.

This chapter provides a short and exemplary selection of materials and publications. Many organisations involved in lion conservation provide educational brochures or awareness raising material. Further documents or links to websites can be found on the Lion Web Portal maintained by CMS (Chapter 9.2).

Technical publications

Manuel de gestion des aires protégées d'Afrique francophone

This manual by Triplet (2009) is aimed at protected area managers and staff from French-speaking Africa. It covers in much detail a wide variety of subjects, ranging from personnel, management plans and indicators, involvement of local communities, communication, visitors and necessary structures, species monitoring and management, to financing.

Box 8.1 Information, Education and Communication in West and Central Africa

Hans Bauer, Aristide C. Tehou, Etotépé A. Sogbohossou and Hans de Iongh

Information, Education and Communication (IEC) is an essential part of community engagement, especially in areas with lion-livestock conflict (Gebresenbet et al. 2018). We present cases from Pendjari and W NP in Benin, Northern Guinea and Waza NP and Benoue NP in Cameroon (full report in Bauer et al. 2010). Activities were technically supported by the West and Central African Lion Conservation Network (ROCAL), but implemented in partnership with respective national conservation authorities.

In Benin, improved livestock enclosures were combined with the creation of fodder plantations and the use of manure and compost for organic cotton. Mitigation was successful and broadcasted over local radio. More recently, we organised bush-camps for a total of 100 school children and provided French versions of the Niassa human lion conflict toolkit. A survey showed that respondents didn't like lions in their proverbial backyards, but they agreed that lions should continue to exist in the area and were prepared to tolerate some depredation. Even though adoption of mitigation measures was not widespread, people responded that they would invest more resources if depredation became intolerable, especially by disturbance, analogous to routinely practised elephant deterrent methods.

In Cameroon, two different sites were involved; Benoue NP and Waza NP. In the Benoue area, we organised several children's bush-camps. In Waza NP, we worked on improved enclosures, but the area is quite remote and there is no easy access to imported materials such as barbed wire or cement. In view of post-project sustainability we opted for not introducing foreign technology and for intervening through local elites. Six villages in the buffer zone were selected and 75% of the pastoralists in these villages participated in upgrading their enclosures to standards of 'best local practice', using a sufficiently thick layer of thorny shrubs and/or earth walls and with a safe gate (either made of wood or using a complete Acacia seyal (Delile) crown as a 'gate-plug'). The improved enclosures around Waza NP in Cameroon and Pendjari NP in Benin led to a significant decrease in depredation.

The only mitigation measure that is widely practised throughout the region, and maybe throughout rural Africa, but which has received little attention from human wildlife conflict specialists, is the use of religious, traditional and spiritual practices ('magic'). Every single individual we met invested important sums of money in magical protection, e.g. by paying for prayers by a professional 'marabout', or purchasing amulets. The effectiveness of these measures is irrelevant here – they should receive far more attention as starting point for community discussions. In Guinea, religious leaders were invited to prepare statements and sermons on nature in general and carnivore conservation in particular, using relevant Sourats (verses in the Koran). These materials were distributed to and used by several mosques and community radio stations. Due to insecurity, we were unable to monitor the impacts of this approach.

La boîte à outils

Cirad and Awely (no date a, b, c) produced together a toolbox for human-wildlife conflicts, ranging from rodents to large herbivores and large carnivores. Two brochures address the conflicts, the Fauna Booklet and the Conflicts Booklet, the third brochure, the Solutions Booklet, presents the possible mitigation measures, within the categories 'prevent', 'keep out', 'repel' and 'remove'.

Fig. 8.1. Example page from the Fauna Booklet by Cirad and Awely.

Le guépard & les principaux carnivores du complexe WAP
Large carnivore identification: a basic guide

These publications by Berzins & Kriloff (2008) and Dickman & Msigwa (2007), respectively, are aimed at the eco-wardens of the WAP complex, and at rangers in Tanzania. They present the different carnivores occurring in the areas with their distinctive features including spoors and scats for correct identification of the species. The guide for WAP also includes e.g. dentition, whereas the guide for Tanzania includes e.g. identification of a kill by the various species.

A hunter's guide to aging lions in Eastern and Southern Africa

The guide by Whitman & Packer (2007) is available in a printed version from Safari Press. An online guide and training tool is provided by Aging the African Lion. The website offers also pocket guides, which differentiate between lions from Southern and high-lying Africa (Hwange, Serengeti) and lions from West-Central and Eastern low-lying Africa (Niassa, Selous).

Human-lion conflict toolkit

The human-lion conflict toolkit by Begg & Kushnir (2010) can be found in three versions, English, French and Portuguese on the website of the Niassa Carnivore Project. It is a living document that is

updated with new tools as they emerge and prove to be effective. The toolkit covers the protection of livestock, the reduction of bush pigs and warthogs in folds to prevent attracting lions into fields, and the protection of people at home, as well as the development of educational programmes (e.g. on safe behaviour) or community monitoring systems. It provides an overview of available solutions and contact details to projects experienced in the implementation of the tools (see also Chapter 6.1).

Educational publications

Programme casquettes vertes en RD Congo

Caps Programmes in Zambia

The France-based international organisation Awely has published two similar brochures for the Democratic Republic of Congo (Awely 2011) and Zambia (Awely 2015), respectively, aimed at the local communities. In the DRC, Awely has a 'green caps programme', which consists of actions to improve the situation of an emblematic endangered species – in this case, the bonobo. Apart from bonobo-specific matters, the brochure teaches about biodiversity, the consequences of bushmeat hunting and sustainable alternatives. In Zambia, Awely has a 'red caps programme', which consists of actions to resolve human-wildlife conflicts – in this case, concerning the elephant. Apart from elephant-specific actions, the brochure teaches about living with wildlife in Africa, the balance of the ecosystem, and other wildlife in Zambia. Both publications are fully bilingual in French and Lingala, and in English and Chinyanja, respectively.

General publications

Public service announcements by WildAid

WildAid performs public service announcements, e.g. against poaching and against the buying and use of products from endangered species. Their public service announcements come in the form of short videos, documentaries, billboards and print ads on television, radio, social media in airports, subways, bus and train stations, hospitals banks and shopping centres, not only in the Range States, but also in consumer states: "When the buying stops, the killing can too" (WildAid 2018a). WildAid uses a series of ambassadors – famous and usually idolised people from e.g. popular culture and sport from the respective countries – to get their conservation message across. A recent campaign for World Lion Day ("Give lions some space!") featured Po as an ambassador – the title character of the animated movies 'Kung Fu Panda' (WildAid 2018b).

Fact sheet Lion Panthera leo

Fact sheets are a very simple and basic way of raising public awareness for a species or to a certain conservation issue. An example of such a fact sheet for the lion was produced by Panthera. It covers the IUCN Red List status, distribution and population size and compares them with the historic situation, explains the most important threats to the species and the conservation actions proposed by the organisation.

Beyond Cecil: Africa's lions in crisis

This joint report by Panthera, WildAid and WildCRU (Funston et al. 2016) was published in response to the public reaction to the case of 'Cecil'. It is aimed at the general public and uses the international media publicity of this individual lion to raise awareness on the status of all lions. Similar to the fact sheet mentioned above it presents the status of the lion, the threats to the species and proposes solutions, but more in detail. The report is available in English and Swahili.

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9. Sharing data and information

9.1. The African Lion Database (ALD)

Samantha Page-Nicholson and Peter Lindsey

In recent decades, there has been increasing concern over the fate of the lion (*Panthera leo*) on the African continent. Bauer et al. (2015) inferred a decline of almost 43% over three lion generations. However, comprehensive robust data supporting the claims of significant population declines are lacking and are not uniform across Range States. There is significant difficulty in compiling and consequently interpreting lion numbers; the 2015 Red List Assessment, for example, did not use total lion numbers for the assessment but rather inferred a decline based on time trend analysis of census data from selected reference areas (Bauer et al. 2015). In addition, knowledge of the status and trends in lion populations is generally quite poor and the collective ability of governments and the conservation community to identify priorities, or to assess the impacts of conservation interventions is very limited. This can be largely attributed to the lack of a single, shared repository of data regarding the species' abundance, status, trends and fine-scale distribution in each of the Range States. Current information tends to be siloed and therefore only of limited conservation value. Further, large areas of the species' distribution have not been surveyed and are therefore excluded from range maps. Conservation decisions should be informed by the most up-to-date and reliable information available on both population numbers and distribution. A range-wide African Lion Database (ALD) would provide a solution to the current shortcomings.

At the CITES CoP17 in 2016 in Johannesburg, South Africa, the CITES Secretariat was given the specific mandate to "develop an inventory of African Lion populations across its range, taking due consideration of existing inventories developed by African Lion range States" and to "support the development of relevant databases by African Lion Range States" (Dec. 17.241 b and c). These decisions were also adopted and directed at the CMS Secretariat by the 12th CoP of CMS in 2017 in Manila, Philippines (CMS Dec. 12.67 ii and iii).

The concept of a species-specific population database is not a novel one. The African Elephant (*Loxodonta africana*) database (AED) was initiated by Iain Douglas-Hamilton in 1986 (Barnes et al. 1999) to provide a comprehensive assessment of elephant numbers and distribution across Africa (Barnes et al. 1999; Thouless et al. 2016). The AED is today a digital information system that stores population estimates and associated geographic information about the species (Barnes et al. 1999). This database provides reliable figures and data to demonstrate that the elephant population is in fact declining (Thouless et al. 2016).

Using the idea of the AED, and as a collaborative effort between government, researchers and non-governmental organisations (NGOs), we aim to establish the ALD with the long-term intention of expanding it into a broader multi-species database for large carnivores (potentially including Cheetah *Acinonyx jubatus*, Snow Leopard *Panthera uncia*¸ African Wild Dog *Lycaon pictus*, or Leopard *Panthera pardus*, the focal species of the joint CITES-CMS African Carnivore Initiative (Chapter 1, 4.1)).

The vision is to establish a database as an instrument for lion conservation and management by facilitating the sharing of information between stakeholders. The goal is to create a database that will be

used to compile, analyse and store data on lion distribution, abundance and population trends. This database will be used to assist the continuous assessment of the status of lion populations; inform range countries and national and international institutions about the status of lions; disclose the reliability of information and gaps in knowledge, and continuously help improving the monitoring of lions, and conservation planning and resourcing for the species.

The ALD aims to create the most authoritative and up-to-date compilation of data on the numbers and distribution of lions at national, regional and continental levels across Africa. Broadly, the ALD will focus on the collection of data on two key conservation aspects. The first is population data that will include data from all protected areas and those populations occurring outside of protected areas. Secondly, the database will collate data on the distribution of lions across the continent. This will incorporate ad hoc sightings outside protected areas (point data) and protected areas with lions (polygon data). This will provide the most up to date, and potentially most accurate, range map on their distribution. Similar to the AED, this database will be a dynamic one, with continuous updates that will form a fundamental component of the database management. The ALD will contain both spatial and non-spatial attribute data, which will be managed using GIS-software (ESRI, GIS) and a relational Database Management System (DBMS). The database will collate data across all Range States in Africa (Bauer et al. 2015).

The specific project objectives for the next two years include:

1) Build partnerships with lion conservation organisations, lion researchers, and the relevant Range States for the creation and maintenance of the lion database.
2) Identify the needs, possibilities, and datasets available for the lion database.
3) Identify the willingness of researchers and institutions to share data.
4) Assess the conceptual integration of the ALD into IUCN processes (Red List/Species Information Service and Strategic Planning for Species Conservation).
5) Assess the technical feasibility and financial consequences of integrating a lion/felid database into a multi-species database.

In order for the ALD to be successful, it requires support from all lion Range States as well as overseeing parties. While the ALD will be institutionally 'owned' by the IUCN SSC Cat Specialist Group, on behalf of the wider conservation community, it is the long-term goal that the data can be viewed on an online-system where organisations can access elements of the data. The database coordinator (Sam Page-Nicholson) is based at the Endangered Wildlife Trust (South Africa). An oversight committee, comprising key individuals involved in lion research and management, will be established to assist the coordinator with establishing the database and will provide technical expertise. Cooperation and support of Range States and lion researchers is tantamount to the success of the ALD. The ALD would require the sharing of data of global lion researchers and institutions. It is therefore important to note that data-ownership of such contributors will be respected and credited.

The ALD requires a collaborative effort and partnerships between park management authorities, scientific institutions, non-governmental organizations, local communities and the private sector are pivotal in the success of the ALD and ensuring its perpetuity in lion conservation. The ALD has significant potential to aid in lion conservation and be used as an effective tool to aid in decision-making processes. The current funded period of the project is only between October 2018 and September 2020. During this period, it is aimed that the specific project objectives mentioned above will be

achieved and that this initial phase of the project will lay a strong foundation for the multi-species database.

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9.2 The Lion Web Portal

Yelizaveta Protas

The Lion Web Portal is produced jointly by CITES, CMS, and the IUCN SSC Cat Specialist Group. The target audience is wildlife managers and all users in lion Range States, for whom a collection of lion policies, scientific studies, action plans, database, management tools, and other information would prove useful information to guide and inform their work. The creation of the portal is called for in CITES Decision 17.241 j (*create a portal on the CITES website to permit, amongst other things, the posting and sharing of information and voluntary guidance on the making of non-detriment findings for African lion*) and CMS Decision 12.67 a, item ix (*Consult with the CITES Secretariat on developing a joint web portal to permit, amongst other things, the posting and sharing of information regarding conservation and management of African Lions*). The Lion Web Portal will also support other provisions in Decision 17.241 and Decision 12.67 by hosting the results of implementing those provisions, and creating a common portal of collaboration across the lion Range States.

Much information and referenced source material of the *Guidelines for the Conservation of Lions in Africa* shall be made available on the Lion Web Portal. The following information will be included with the understanding that this is meant to be a dynamic and growing web page that can be amended as more information becomes available.

The needs of the end users (lion Range State wildlife managers and policy makers) should guide the information that is added to the web portal, which will be not only targeted to their needs, but also continuously supplemented through their own materials and products as they become available. The Portal will also provide a way to filter each document and piece of information by country, enabling a manager from a particular country to find documents relevant to their own country. The broad subdivision of information contained on this web portal will be as follows:

1. Introduction
2. Lion Conservation Planning
3. Status of the Lion
4. Lion Management
5. Legal and Illegal Trade in Lion Specimens
6. Community Conservation
7. Lion Projects

A compilation of Regional Conservation Strategies and National Action Plans (Chapter 3.1, 3.2) will be made available and updated as countries or regions create or revise such plans. Up to date information about the Status of the African Lion will be provided and linked to the most recent IUCN Red List Assessment. This will also contain an explanation of and link to the Lion Database (Chapter 9.3). This section will be of special use to new wildlife managers who need a broad overview of current lion conservation status, but nonetheless providing links to more detailed information where they can delve deeper when needed.

Up to date information about various aspects of lion management will be provided for on topics such as:

- Human-lion conflict mitigation, including some tools for managers tasked with dealing with lion conflicts and helping with making decisions on when to remove a lion;
- Awareness raising and educational materials in English, French, and Portuguese;
- Dog use, the SMART tool, and other current techniques that managers can chose from, and try to adapt to their sites;
- Protected Areas and transboundary lion conservation, including relevant habitat protection measures, connectivity, movements between and outside of Protected Areas, anti-poaching measures, large-scale transboundary approach, etc.;
- Links and descriptions of law enforcement courses and other useful information that can be adapted by managers in their respective countries will be presented, and well as links to Interpol and whatever tools and knowledge they have in relation to lions and other big cats.

Trade issues as related to lions will provide information on topics such as:

- Basic instructions to managers for how to set quotas, best practices to manage hunting;
- Non-detriment findings information with description and information re: voluntary guidance on the making of NDFs, and possibly examples of NDFs from countries, which choose to make them public. Results from workshops and discussions around this topic, and any literature that could aid in making NDFs;
- In addition, there will be provided an overview of legal and illegal trade in lions, including lion bones and other parts and derivatives: This information will be continuously renewed, in co-operation with those organisations that are involved in trade and wildlife crime, such as TRAFFIC.

Information for interacting with communities, gleaned from the experience of groups such as IUCN Sustainable Use and Livelihoods Specialist Group will be given in the form of case studies, lessons learned, best practices, and analysis. Such might include descriptions of ongoing community work, insurance schemes, and bolstered by examples that have worked in the past. Finally, a compilation of current practitioners, projects, ongoing studies, and important ongoing activities all over the range of the African lion will provide a practical look at collaboration and what is already being done.

We would also like to encourage a transparency about funding and funding opportunities available for lion projects, and information on funding will be placed here, alongside the information on existing projects.

Viewed in the context of the African Carnivores Initiative, the Lion Web Portal may also provide a template for creating similar web portals for the other 3 species of the ACI, namely the cheetah, leopard, and African wild dog.

9.3 Networks

Roland Bürki

"Networking provides informal and formal ways to know what is going on, who is doing what and when" (Hesselink et al. 2007). As such, networking can be performed in a huge variety of forms. The most basic purpose of exchanging information on activities (Hesselink et al. 2007 above) can be altered or enhanced, too. It may be complemented or replaced e.g. by an exchange of experience and/or data, a sharing of resources, and/or the development of common rules, standards etc. Below, we have compiled a few examples of networks in a very broad sense, where the co-operation has been more or less formalised.

Southern African Development Community (SADC; www.sadc.int)

The Southern African Development Co-ordination Conference (SADCC) was established in 1980, before it was transformed into the Southern African Development Community (SADC) by signing of the SADC Treaty on 17 August 1992. Among the Objectives of SADC in the Treaty is to "achieve sustainable utilization of natural resources and effective protection of the environment" (SADC 1992). SADC consists of the African mainland countries south of and including the Democratic Republic of the Congo and Tanzania, plus the island States of Comoros, Madagascar, Mauritius and Seychelles (SADC 2018a). The member States have signed in 1999 a common Protocol on Wildlife Conservation and Law Enforcement to establish "common approaches to the conservation and sustainable use of wildlife resources and to assist with the effective enforcement of laws governing those resources". It is implemented institutionally by means of a "a) Wildlife Sector Technical Coordinating Unit; b) Committee of Ministers responsible for Food, Agriculture and Natural Resources; c) Committee of Senior Officials; and d) Technical Committee" (SADC 1999). The Wildlife Technical Coordinating Unit is part of the Secretariat of the Treaty (SADC 2018b). Other regional African treaties include the Eastern African Community EAC, the Intergovernmental Authority on Development IGAD, the Economic Community of West African States ECOWAS and the *Union Economique et Monétaire Ouest Africaine* UEMOA. Although they mention cooperation or support in environmental sectors in the respective treaties, they have no separate specific protocol on wildlife conservation or similar.

Organisation for the Conservation of Wildlife in Africa (OCFSA)

The Organisation for the Conservation of Wildlife in Africa (*L'organisation pour la Conservation de la Faune Sauvage en Afrique* OCFSA) was founded in 1983 in Khartoum, Sudan. After some issues and years of inactivity, an extraordinary session of the ministerial conference on 17 June 2015 initiated a revival of the OCFSA (COMIFAC 2018). OCFSA has six member states, namely Cameroon, Chad, the Republic of the Congo, Central African Republic, Gabon, and Sudan. It is planned to enlarge the organization to include the same members as the Central African Forests Commission founded in February 2005 (*Commission des Forêts d'Afrique Centrale* COMIFAC; COMIFAC 2018).

CITES Task Force on African Lion

[The CITES Task Force, its terms of reference and modus operandi should be a subject for the Range State meeting in Bonn (see below). As such, the paragraph about this group will be fully reworked after the meeting.]

The 17th CITES Conference of the Parties (CoP17) in Johannesburg, South Africa, adopted Decision 17.243 directed to the Standing Committee to create a CITES Task Force on lions (Decision 17.243c) and to define its terms of reference and modus operandi (Decision 17.243d) as well as to consider the creation of a multi-donor trust fund for the work of the Task Force and to support the effective implementation of conservation and management plans and strategies for African lions (Decision 17.243e). At its 69th meeting in Geneva, Switzerland, the Standing Committee formed an intersessional working group chaired by Niger and consisting of lion range States, consumer states for lion parts and derivatives, IGOs and NGOs (CITES 2017). The intersessional group recommends to the 70th meeting of the Standing Committee in Rosa Khutor, Sochi, Russia, to "mandate the Secretariat to provide support with the implementation of item d) of the Working Group mandate [i.e. consider and provide term of reference and *modus operandi* for the CITES Task Force on African lions] by making recommendations for consideration during the upcoming Meeting of Range States for the Joint CMS-CITES African Carnivores Initiative to guide the development of terms of reference and modus operandi for the CITES Task Force on African lions as directed in Decision 17.243, paragraphs c) and d)" (CITES 2018).

Kavango Zambezi (KAZA) Carnivore Conservation Coalition

See Box 9.3.1.

Lion Management Forum in and for South Africa (limf.co.za/)

See Box 6.8.2 in Chapter 6.8.

Large Carnivore Task Force at the Kenya Wildlife Service

See Box 9.3.2.

IUCN/SSC Cat Specialist Group (www.catsg.org)

The Cat Specialist Group (IUCN/SSC Cat SG) is part of the Species Survival Commission (SSC) of the International Union for Conservation of Nature (IUCN). The IUCN SSC joins more than 7'500 volunteer experts in a science-based network who's aim is that "the species extinction crisis and massive loss of biodiversity are universally adopted as a shared responsibility and addressed by all sectors of society taking positive conservation action and avoiding negative impacts worldwide" (IUCN/SSC 2016). Most members of the IUCN SSC are part of one of its Specialist Groups. The IUCN/SSC Cat SG contains 194 members from 62 countries. Members of the Specialist Groups, and as such of SSC, are invited by the Chairs of the Specialist Group and reviewed every 4 years after (re-)election of the

Chairs at the World Conservation Congress (IUCN/SSC 2017). Both, the IUCN/SSC and the IUCN/SSC Cat SG have Terms of Reference for their members (IUCN/SSC 2016, IUCN/SSC Cat SG 2018).

ALWG (www.africanliongroup.org)

See Box 9.3.3.

ROCAL (www.rocal-lion.org)

The West and Central African Lion Conservation Network (*Réseau Ouest et Centre Africain pour la Conservation du Lion* ROCAL) aims to ensure the conservation and sustainable management of the lion in West and Central Africa. Its individual members must be associated with a wildlife conservation institution, and must have worked on large carnivores in West and/or Central Africa (ROCAL 2018).

Box 9.3.1. A Collaborative and Consensus Driven Approach to Conserving Lions at Scale across the KAZA TFCA

Kim Young-Overton

KAZA is Africa's largest conservation landscape and the world's largest trans-frontier conservation area. At 520,000 km^2 it is a bold partnership among five southern African countries to conserve biodiversity at scale, and to market this biodiversity using nature-based tourism as the engine for rural economic growth and development.

Being home to 15% of the world's lion population and encompassing 36 protected areas, KAZA is an extremely important conservation landscape for conservation of African lions. Not only is conserving KAZA's lion populations important for the persistence of the species *per se*, but the opportunity to conserve the natural dispersal and movement patterns of lions among protected areas and across large landscapes is paramount for the conservation of the ecology of the species (see Cushman et al. 2018).

The KAZA Carnivore Conservation Coalition (KCC)

To overcome the challenges of scale and realise the opportunity that KAZA provides, conservation practitioners, government officials, researchers and advisors formed the KAZA Carnivore Conservation Coalition or KCC. KCC members are committed to working collaboratively and collectively at the KAZA-wide scale to develop and implement both a strategic and unified program of outcome-focussed conservation and development activities to secure KAZA's large carnivore populations. The Coalition is now a formal part of the KAZA structures. It is led by a Steering Committee and comprises five focal working groups dedicated to key areas where carnivore and human needs are both greatest and aligned. Focal working groups form the engine rooms of the Coalition and include more than 177 participants from over 100 organisations across the five KAZA partner countries.

Box 9.3.2 The Large Carnivore Task Force at the Kenya Wildlife Service

Patrick Omondi, Stephanie M. Dloniak, Shadrack Ngene and Bernard Kuloba

The Kenya Wildlife Service (KWS) created The Large Carnivore Task Force in 2006 in response to declining numbers of large carnivores and high rates of conflict between carnivores and people in Kenya. The task force was formed in recognition of the need to bring multiple stakeholders with relevant expertise and experience together, to collaborate towards successful conservation of the large carnivores that are of great importance for both Kenya's national heritage and its safari tourism industry. The main functions of the group have been outlined within its terms of reference. These functions include:

1) Advising KWS management on large carnivore conservation matters, including priorities for critical conservation actions, in a structured and participatory way
2) Integrating species conservation with the review of research activities and advice on appropriate research and monitoring programmes
3) Providing relevant information for the development of policy options for the conservation and management of large carnivores
4) Steering the formulation and implementation of large carnivore recovery and action plans that will ensure the long-term survival of healthy populations of species and their habitats
5) Collaboratively mobilizing resources to formulate and implement large carnivore recovery, action plans and management guidelines
6) Enhancing capacity building for carnivore conservation by involving Kenyans at scientific and site levels
7) Raising the profile of carnivore species through better awareness approaches to minimise conflict and enhance positive attitudes towards carnivore conservation

KWS is a state agency mandated to conserve and manage wildlife and their habitats in Kenya, and thus chairs the task force, provides the secretariat, and oversees the development and implementation of species conservation strategies. KWS has a dedicated liaison officer to champion the implementation of the large carnivore recovery and action plans.

Over the past decade, the task force has been comprised of between eight and twelve members including three or four KWS members from the Biodiversity Research and Planning directorate and the Community Wildlife Service. Additional voluntary members of the task force include local and international researchers with species and/or conservation expertise, as well as representatives from various NGOs and other conservation or natural resource management organizations. The group aims to meet quarterly, to discuss and plan actions to address both timely and long-term issues under the terms of reference.

Development and implementation of the species conservation strategies has been variable due to various challenges, mainly a lack of financial and human resources. It is also often difficult to schedule meetings and achieve a quorum, due to task force members living and working across the country, if not across the globe.

Despite these challenges, KWS and the task force, with assistance from others, including the IUCN SSC Cat, Canid, and Hyaena Specialist Groups, have managed several notable achievements. These include development and implementation of two national strategies for large carnivore conservation in Kenya 2009–2014 (for Lions and Spotted Hyaenas, and for Cheetahs and Wild Dogs), streamlining carnivore research activities, use of technology to enhance carnivore research and monitoring, and implementation of an annual conference on carnivore research and conservation. The task force continues to ensure efficient collaboration and the sharing of experience and technical information across the network of people working on various aspects of large carnivore conservation and management across the country.

Box 9.3.3 African Lion Working Group

Sarel van der Merwe

The African Lion Working Group (ALWG) was founded in October 1999 at Bela-Bela in South Africa. It consisted of 15 members then, and through the years steadily grew to 113 members in October 2018. It functions in close relationship with the Cat Specialist Group and the Conservation Planning Specialist Group of the IUCN/Species Survival Commission. Most of the group's activities involve electronic communication to provide a forum for discussion and debate about a large variety of lion-related topics. This resulted, amongst other things, in the drafting of a FIV fact sheet and a hunting policy. Recently, genetic integrity of free-ranging African lions has moved rapidly to the foreground of the group's attention, and a white paper on the subject is in the draft stadium at the moment. The unplanned and haphazard translocation of captive-bred lions is of great concern.

Conservation entities which are involved in ALWG's activities from time to time are the IUCN SSC Cat Specialist Group and Conservation Planning Specialist Group, the IUCN Red List Committee, the *Réseau Ouest et Centre Africain pour la Conservation du Lion* (ROCAL), the Endangered Wildlife Trust, the Trade Records Analysis of Flora and Fauna in Commerce (TRAFFIC), World Wide Fund for Nature (WWF), Born Free Foundation, South African National Parks (SanParks), Conservation Force, and also local communities of lion range countries as interested and affected parties.

Several African countries, through ALWG's members are regularly contacted, e.g. Namibia, Mozambique, Zimbabwe, Zambia, Angola, most West African countries and northwards to Ethiopia.

The Mission of the ALWG is the promotion of comprehensive, science-based conservation strategies for all free roaming lion populations in Africa. Its aims are to:

- Provide a forum for discussion and debate regarding lion conservation and relevant research matters, and act as a communication and networking portal;
- Disseminate factual, scientifically based information to managers, politicians, NGO's and the general public;
- Support individuals conducting research on lions and who are working in Africa towards the conservation and management of free roaming lion populations in accordance with IUCN principles;
- Promote the development and maintenance of comprehensive management strategies and plans for all lion populations in Africa;
- Work with stakeholder groups within the framework of ALWG policy;
- Seek assistance from its affiliate organisations and any other credible organisation, if required, to support its recommendations.

The African Lion Working Group is affiliated with the Cat Specialist Group and the Conservation Planning Specialist Group of the International Union for the Conservation of Nature/Species Survival Commission. Its members contribute to the continuous assessment of the conservation status of the lion in Africa.

PRIDE Lion Conservation Alliance (pridelionalliance.org)

Six women, who lead conservation projects on lions in Kenya, Mozambique, Tanzania and Zambia have together formed the PRIDE Lion Conservation Alliance. Its purpose is the elimination of competition between the Alliance's members' projects for the sake of the conservation of wild African lions. The member projects share not only their knowledge, experiences and data, but also their funding. This joining of efforts allows the members to spend more focus on the actual conservation of lions in the field (PRIDE 2018).

Operators and Professional Hunting Associations of Africa (ophaa.org)

The Operators and Professional Hunting Associations of Africa (OPHAA) consist of representatives of nation-wide professional hunting associations, where such exist. Their mission is "to promote legal and ethical fair-chase sustainable hunting" (OPHAA 2018). OPHAA has developed a code of conduct, to which every member of every associated organization strictly adheres (OPHAA 2018).

Game Rangers' Association of Africa (cf. chapter 7.1; www.gameranger.org)

The Game Rangers' Association of Africa (GRAA) is a member of the worldwide International Ranger Federation (IRF). The GRAA has over 1800 members in more than 24 countries. It provides networks and support for rangers in Africa, provides equipment and training, and promotes the interests of rangers in Africa (GRAA 2018a). Moreover, the GRAA has a project aiming to provide rangers with insurance, and another one to ensure the emotional wellbeing of rangers working daily at the forefront against poaching with rising number of post-traumatic stress disorder and other syndromes (GRAA 2018b, c). The Association has its own Constitution.

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10 Building lasting structures to implement lion conservation activities

10.1 International cooperation and national coordination

Sarah Durant

Putting the national structures in place

The conservation of wide-ranging species like lion depends on international cooperation, even though implementation will ultimately have to be tailored to national policy and legislative environments. This can be managed through the development of regional strategies, where countries work together to develop an agreed conservation framework over a large region that encompasses multiple nations (Chapter 4.2, Fig. 4.2.3). The development of these strategies is most effective when regions are grouped according to broadly similar approaches to wildlife conservation. In the conservation strategic planning process for cheetah and African wild dogs, Africa was grouped into three regions: southern Africa (IUCN/SSC 2015); eastern Africa (IUCN/SSC 2007); and the largely francophone region of western, central and northern Africa (IUCN/SSC 2012). This grouping proved to be effective and manageable in developing regional consensuses when planning for the conservation of these species. In general, regions should not be so large that the workshop process needed to seek a consensus becomes unmanageable.

Once Regional Conservation Strategies (RCS) are developed and agreed by Range States, these can then be used as blueprints for National (Conservation) Action Plans (NAPs), whereby each country uses the RCS as a framework from which to develop its own NAP. This allows each country within a region to produce a NAP that is broadly aligned, in terms of overall goal, objectives and results (Chapter 4.2). NAPs will, however, differ in the detail of the activities that need to be implemented to deliver the Objectives and Results, as these will need to be aligned to the specific conservation and policy context of the country concerned. Nonetheless, broad alignment at an international level ensures that countries sharing transboundary populations can more easily coordinate and collaborate to meet shared Results and Objectives, even if the specific activities may differ. NAPs that are in alignment help ensure that countries are speaking the same language when they meet to plan transboundary conservation management of lions and eliminate any possibility of conflicting Objectives.

A potential disadvantage of using the RCS to develop the NAP is that it could be perceived to reduce the autonomy of national stakeholders in designing their own NAP. However, if the RCS is well designed, this shouldn't be a major problem, as the required Objectives and Results needed for an effective NAP will already be incorporated. Even so, the NAP development process still provides substantial flexibility for adjusting and, where necessary, rewriting activities to suit the specific context for each country, and countries are free to add or remove Objectives as they see fit, subject to time constraints within the workshop process. Thus a small loss in autonomy is more than compensated by good transboundary alignment and the reduction in time invested in the development of the NAP by busy wildlife professionals because a blueprint or framework, by way of a RCS, already exists. Out

of 20 NAP workshops undertaken to develop NAPs from regional strategic frameworks for cheetah and African wild dogs, none required a major deviation from the regional framework.

The NAP should be accepted and endorsed by the government to ensure implementation. Once the NAP is in place and endorsed, it will provide a pathway to implementation that can then, in turn, deliver on the RCS. **National Coordinators**, appointed by each government (see Chapter 7.3), are responsible for coordinating the implementation of the NAP, and are also key point people for trans-boundary cooperation.

Putting the international structures in place

The African Carnivores Initiative under CITES and CMS provides an important international framework to guide cooperation of range states in the cause of lion conservation. However, it is crucial that sufficient financial and human resources are put in place, either within CITES or CMS, or through a separate international institution or programme, to support range states in moving forward with implementing their conservation programmes. A good model is provided by the Range Wide Conservation Programme for Cheetah and African Wild dogs (Fig. 10.1.1), whereby **Regional Coordinators** are appointed to coordinate each RCS, and who are tasked with providing support to range states in moving forward with their NAP activities; providing training to address capacity gaps; helping to gain access to funding sources to support activities; coordinating timely report backs on progress; and identifying and addressing gaps in implementation, all in close partnership with the relevant governments. This model ensures that momentum on implementing NAPs can be maintained while lasting capacity can be established to improve the long term sustainability of lion conservation. This will require long term investment; however, without such support, there is a risk that the NAPs may not get implemented, to the detriment of lion conservation.

Fig. 10.1.1. The Range Wide Conservation Program for Cheetah & African Wild Dogs has adapted and refined the strategic planning approach for species conservation as started for the conservation of lions in Africa in 2005 with the development of the Regional Conservation Strategies (Chapter 3.1).

Regional Coordinators for lion conservation can also act as point people for communication between NGOs and other stakeholders, and particularly between the National Coordinator and the supporting NGOs. Since they are tasked in focusing on gaps in implementation, they are not in competition with other stakeholders in delivering on activities. It is important that coordinators maintain a pseudo-diplomatic status and non-aligned role in in implementing their NAPs, to ensure they can maintain the trust and confidence across a wide range of government and non-governmental stakeholders.

National Coordinators do not report to Regional Coordinators – they report to their national governments. However, both the Regional Coordinators and the National Coordinators (and their governments) have a common interest in implementing the NAPs, and this is the focus of the work they may do together. Finally, Regional Coordinators can also be tasked with providing training, mentoring and support to National Coordinators, enabling them to fulfil their roles and develop the skills they need to implement their NAPs. They can also be tasked with developing standardised international data requirements for sharing data between countries (see e.g. Chapter 9.1).

Transboundary conservation

Lion populations know no borders, and a single population may straddle multiple countries. Each country will have different policy, legal and institutional structures, management and governance regimes. They may also be affected by different social, cultural and economic factors, and conservation may be hampered by complex relationships between neighbouring countries. Transboundary conservation is an approach that has emerged as a practical way to address these challenges and achieve cooperation to deliver conservation goals across international boundaries.

The IUCN World Commission on Protected Areas (WCPA) describes three types and one special designation of Transboundary Conservation Areas (see also Chapter 4.3):

Type 1 – **Transboundary Protected Area**: A clearly defined geographical space that consists of protected areas that are ecologically connected across one or more international boundaries and involves some form of cooperation.

Type 2 – **Transboundary Conservation Landscape** and/or Seascape: An ecologically connected area that sustains ecological processes and crosses one or more international boundaries, and which includes both protected areas and multiple resource use areas, involving some form of cooperation.

Type 3 – **Transboundary Migration Conservation Areas**: Wildlife habitats in two or more countries that are necessary to sustain populations of migratory species and involve some form of cooperation.

Special designation – **Park for Peace** is a special designation that may be applied to any of the three types of Transboundary Conservation Areas, and is dedicated to the promotion, celebration and/or commemoration of peace and cooperation.

There are now multiple transboundary conservation initiatives encompassing lion range with varying degrees of formal cooperation between neighbouring countries, from relatively informal joint management agreements to government-to-government treaties. An added advantage of establishing transboundary conservation agreements is that this can help to provide a common ground for neighbouring states to cooperate, and hence can promote peace and reduce conflict, hence the designation of 'Park for Peace' recognised by the WCPA (Chapter 4.3).

Establishing the multiple agreements that are required for lasting cooperation in the conservation of a transboundary area, such as joint law enforcement operations; immigration and customs agreements to allow wildlife tourists to move easily from country to country; transboundary monitoring of wildlife populations etc. is a complex undertaking and is outside the scope of these Guidelines. However, useful guidance is available through the IUCN's handbook on 'Transboundary conservation: a systematic and integrated approach' (Vasilijević et al. 2015).

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10.2. International support for lion conservation and funding opportunities

Peter Lindsey, Andrew Jacobson and Jason Riggio

Funding opportunities relevant to lion conservation

There are a number of funding opportunities for lion conservation in Africa (Table 10.2.1). Some of these are exclusively available to governments, others only to non-governmental organisations (NGO), and others to both. Some funders do not accept unsolicited proposals (preferring to invite applications), whereas others issue open calls for proposals. Funders can be broadly categorised as follows:

Multi-lateral donor agencies

There are a variety of multi-lateral agencies that provide or administer conservation funds. Examples include the Global Environment Facility, World Bank, United Nations Development Programme, United Nations Environment Programme, and the European Union.

Bi-lateral donor agencies

A number of countries regularly support wildlife conservation efforts in Africa, including among others those of France, Germany, Norway, UK, and USA.

NGOs and zoos

Some NGOs act as pure implementers (see next section), others act as pure funders, and some under-take a combination of funding and implementing of their own projects. For example, African Parks acts as a pure implementer and does not issue grants. The African Wildlife Foundation under-takes a mix-ture of implementing and granting. The Lion Recovery Fund (a joint initiative of Wildlife Conservation Network and the Leonardo DiCaprio Foundation) is a pure funder (Box 10.2.1). Similarly, zoos typically focus primarily upon granting, though some also implement their own conservation projects.

Foundations and philanthropists

There are a number of foundations that provide significant funding to conservation efforts of relevance to lions, such as Band, Oak, Segré, Wild Cat and Wyss Foundations.

Non-governmental conservation projects relevant to lion conservation in Africa

There are a vast number of conservation projects undertaken by not-for profit organisations in Africa (Table 10.2.2). The distribution of these projects is somewhat skewed with particular concentrations in a minority of southern and East African countries, with the majority of range states having few. The activities of conservation NGOs are extremely varied. However, the majority of projects fall in one of the following categories:

Support for the management of wildlife areas

A number of projects are designed to provide support to wildlife authorities, communities or private landowners for the management of wildlife areas. There are a growing number of such projects in Africa's state PAs. Such projects generally fall within one of three types of partnership model: financial and technical support, co-management, or delegated management (Box 6.2.2 in Chapter 6.2; Baghai et al. 2017). These projects are relevant to lion conservation because they provide support to wildlife authorities for tackling threats such as the poaching of prey for bushmeat, targeted lion poaching, and habitat destruction stemming from illegal incursions of people and livestock into PAs.

Tackling the illegal wildlife trade

A number of projects are designed specifically to tackle the trade in illegal wildlife products, such as bushmeat or big cat body parts. Methods employed by such NGOs (working in conjunction with the relevant authorities) are e.g. anti-trafficking, training of the police and judiciary, courtroom monitoring, advocacy for the strengthening of wildlife-laws, and campaigns to reduce the demand for illegal wildlife products.

Coexistence between people and wildlife

Several projects were designed to work with communities and private landowners to promote coexistence between people and wildlife outside of and often on the edges of state PAs. These projects fall within a number of sub-categories, including (among others):

- Support for the establishment of wildlife areas on community or private land;
- Support for the land rights of communities;
- Support for the sustainable management of livestock and rangelands;
- Support to help mitigate conflict between lions and livestock farmers;
- Support for anti-poaching on community or private lands;
- Support for the training of community members;
- Support for community-based tourism development; and
- Financial incentives for conservation outside of PAs, such as compensation programmes, conservation easements, payments for environmental services, carbon offsets, and performance payments.

At a number of sites in Africa, variants of the conservation model developed by the NGO 'Lion Guardians' has been adapted and rolled out. This model basically involves hiring community members to act as liaisons between the conservation organisation and the community, and to undertake combinations of the following activities:

- Monitoring of lions in high conflict zones;
- Providing training to communities in conflict mitigation methods;
- Finding lost livestock;
- Intervening before retaliatory lion killing occurs;

- Warning communities when lions approach their livestock; and in some cases,
- Chasing lions away from homesteads or livestock-grazing areas.

Others

NGOs are engaged in a wide range of other activities of relevance to lion conservation, including (among others):

- Support for the development of transfrontier conservation areas (TFCAs);
- Veterinary support (e.g. for treating animals wounded in snares);
- Research including population surveys, demographic studies and threat assessments;
- Support for the training of rangers and other wildlife authority staff;
- Convening around pertinent conservation issues;
- Campaigns designed to build public or political will for conservation; and
- Rehabilitation of wounded or orphaned wild animals.

Table 10.2.1. Examples of funding opportunities relevant to lion conservation (derived and adapted from CITES Notification to the Parties No. 2018/042).

Source	Funding programme	Grant Size	Path to accessing funding
GOVERNMENT AGENCIES AND MULTILATERAL SOURCES			
Critical Ecosystem Partnership Fund	Small Grants	USD $15,000	Application process via ConservationGrants website
	Large Grants	USD $150,000 - 500,000	Application process via ConservationGrants website
DOEN Foundation	Dutch Postcode Lottery	Large and Medium grants	Application process via website Available to legal entities Website
EU	International Cooperation and Development / European Development Fund	Large grants	Calls for proposals made public on website Available to Governments, NGOs, IGOs
GEF	Small Grants Program (implemented by UNDP)	Up to USD $50 000	Application process via website available to Governments, NGOs, IGOs
	Full-sized Projects	Over USD $2 Million	Available to Governments Website
	Medium-sized Projects	Up to USD $2 Million	Available to wide range of stakeholders Website
	Enabling Activities	Up to USD $1 million	Available to Governments and GEF Agencies Website
Germany	International Climate Initiative (IKI)	Large grants	Application process via website Available to Governments, NGOs, IGOs
UK / Defra	Darwin Initiative Main project funding	Medium grants (£50,000 - £430,000)	Application process via website Available to organisations based in any country. Project to take place in specified list of countries.
	Darwin Initiative Illegal Wildlife Trade (IWT) Challenge Fund	Medium grants	Application process via website Available to organisations based in any country. Project to take place in specified list of countries.
	Darwin Initiative Scoping Projects	Small grants	Application process via website Available to organisations based in any country. Project to take place in specified list of countries.
USAID	Environmental and Global Climate Change	Large and Medium grants	Application process via grants.gov website
US Fish and Wildlife Service	International Affairs Program	Large and Medium grants	Application process via grants.gov website
ORGANISATIONS AND CHARITABLE FOUNDATIONS SUPPORTING CONSERVATION EFFORTS			
Association of Zoos and Aquariums	Conservation Endowment Fund	Average USD $18,000	Application process via website PI must have AZA membership
Band Foundation	Nature conservation		Website proposals by invitation only
Chicago Zoological Society	Endangered Species Fund	Maximum USD$5000	Application process via website Proposals must be endorsed by SSC Specialist Group, AZA, WAZA, or other zoo organisation
Christensen Fund		USD $5,000-$100,000	Application process via website Available to organisations

Source	Funding programme	Grant Size	Path to accessing funding
Cleveland Metropark Zoo	Africa Seed Grants	USD $1,000 - $3,500	Application process via website
Conservation, Food and Health Foundation		Average USD $20,000	Application process via website Available to organisations
David and Lucile Packard Foundation	Conservation and Science Program	Small, Medium, and Large grants	Initial submission of short request via online form Available primarily to NGOs
Disney Corporation	Disney Conservation Fund	Maximum USD $50,000	Application process via website Available to charitable organisations
Earthwatch Research Funding		USD $20,000–$80,000	Requests for proposals posted on website Available to researchers with a PhD, affiliated with a university, government agency, or science-focused NGO
Endangered Species Chocolate Company		Minimum USD$10,000	Application process unspecified Available to current GiveBack Partners Website
Ernest Kleinwort Charitable Trust		Small and Medium grants	Application forms available on website Available to charitable organisations registered in the UK
Explorers' Club	Exploration Fund	USD $500 - $5,000	Online application process Available to students Website
Fondation Segré	Biodiversity and Conservation		Website – on invitation following submission of a satisfactory concept note
Fresno Chaffee Zoo	Wildlife Conservation Fund	USD $2,000 - $4,000	Application vie email or post Available to investigators associated with accredited zoo, academic institution, conservation or non-profit organisation Website
Gordon and Betty Moore Foundation		Varies	Initial inquiry via email Available to non-profit organisations Website
Helen V. Brach Foundation		USD $225-$50,000	Application process unspecified Website
Idea Wild		USD $50-$1500	Application process via website Provides research equipment to students of conservation
Indianapolis Zoo		USD $300,000	By invitation only Website
John Ball Zoo	Wildlife Conservation Fund	USD $750 to $2,500	Application form on the website Available to investigators associated with accredited zoo, academic institution, conservation or non-profit organisation

Source	Funding programme	Grant Size	Path to accessing funding
Keidanren Nature Conservation Fund		Medium and Large grants	Application process via website Available to groups or organisations
Kohlberg Foundation		Small, Medium, and Large grants	By invitation only Website
Lee and Ramona Bass Foundation		USD $35,000 to $200,000	Application process not specified
Levinson Foundation		USD $30,000	Available to various organisations, application process not specified Website
Linden Trust for Conservation		USD $100 - $560,000	By invitation only Website
Lion Recovery Fund (Box 10.2.1)		Up to USD 150,000	By invitation only Available to NGOs and other entities Website
Liz Claiborne and Art Ortenberg Foundation		USD $1,000 - $650,000	By invitation only Website
Lynn Chase Wildlife Foundation		None Specified	Not accepting applications Website
Memphis Zoo	Conservation Action Network (CAN)	None Specified	By invitation only, led by Memphis Zoo staff Website
Mohamed bin Zayed Species Conservation Fund		Maximum USD $25,000	Application process via website Available to anyone directly involved in species conservation
Morris Animal Foundation	Research grants for animal health	Up to USD $50,000 per year	Application process via website Available to scientists researching animal health
Nando Peretti Foundation		None Specified	Application process via website Application system opens December 2018 Recipients unspecified
National Geographic	Big Cats Conservation	Maximum USD $50,000	Application process via website Available to individuals and organisations
	Early Career Grant	USD $5,000 - $10,000	Application process via website Available to early career conservationists
	Exploration Grant	USD $10,000 - $30,000	Application process via website Available to experienced project leaders
	Species Recovery	Maximum USD $50,000	Application process via website Available to individuals and organisations
Oak Foundation	Illegal Wildlife Trade		Website
Phoenix Zoo	Conservation and Science Grants	Up to USD $3,000	Application process via a two-part process available through a link on the website Recipients unspecified
Pittsburgh Zoo and Aquarium	Conservation and Sustainability Fund	USD $1,000 - $3,000	Application process via website Recipients unspecified
Rainforest Trust	New Protected Areas	Large grants	Application process via website Available to NGOs based in the country of the proposed protected area

Source	Funding programme	Grant Size	Path to accessing funding
Regina Bauer Frankenberg Foundation		USD $40,000 - $125,000	Application process via website Available only to USA-based NGOs
Riverbanks Zoo and Gardens	Satch Krantz Conservation Fund	USD $1,000 - $5,000	Application process via online application Available to individuals
Roger Williams Zoo	Sophie Danforth Conservation Biology Fund	USD $1,000 annually	Application process via website Available to organisations
Rufford Small Grants Foundation		Up to £6,000	Application process via website Available to individuals or small groups
SeaWorld and Busch Gardens	SeaWorld and Busch Gardens Conservation Fund	USD $10,000 - $25,000	Application process via website Available to NGOs, Governments, schools and universities
Shared Earth Foundation		Small grants	New partners or unsolicited applications not accepted Website
SOS Save Our Species (Box 10.2.2)	Threatened Species Grants	USD $25,000 – 800,000	Available to Governments, NGOs, IGOs Website
	Rapid Action Grants	Up to USD $25,000	Available to Governments, NGOs, IGOs Website
Van Tienhoven Foundation		Maximum € 20,000	Application process via website Available to NGOs and scientific institutions
Wallace Genetic Foundation		USD $5,000 - $2,000,000	By invitation only Website
Wallace Global Fund		USD $1,000 - $250,000	Application process via website Available to NGOs
Whitley Fund for Nature	Whitley Awards	£40,000	Application process via website Available to individuals from low income countries
	Continuation awards	£70000	Application process via website Available to individuals from low income countries who are previous winners
Wild Cat Foundation		USD $50,000-1,000,000	Website
Wild Felid Legacy Scholarship		USD $5,000	Application process via website Available to Graduate level university students involved in wild felid research
Woodland Park Zoo	Wildlife Survival Fund	USD $2,000 to $5,000	Upon recommendation by Woodland Park Zoo curators Website
World Association of Zoos and Aquariums WAZA			Website Fundraising initiatives for “branded” conservation projects
World Bank			Website
Wyss Foundation			Website – application via invitation only
Zoo Boise	Zoo Boise Conservation Fund	Small and Medium sized grants	Currently not accepting applications. Website

Box 10.2.1 The Lion Recovery Fund (www.lionrecoveryfund.org)

Peter Lindsey

The Lion Recovery Fund (LRF) is a partnership between the Wildlife Conservation Network and the Leonardo DiCaprio Foundation. The LRF was established in light of the catastrophic decline in lion numbers experienced in Africa over the last 20 years (a 43% decline in 21 years (Bauer et al. 2016)). The aim of the LRF is to help to halt declines in the species, and turn population declines into recovery, with the ultimate aspirational vision of doubling the number of lions by 2050. This vision was outlined in recognition of the fact that if Africa's protected areas (PAs) were optimally managed, they could support 3–4 times the numbers of the current wild African population (Lindsey et al. 2017). The LRF has developed a strategy which recognises that for lion conservation to succeed, conservation stakeholders need to collectively succeed in:

- Expanding the footprint of conservation support in lion range;
- Scaling the funding available for the conservation of lions and their landscapes; and
- Building the public and political will for the conservation of lions and their landscapes in Africa.

The LRF makes three kinds of investments:

- Field conservation projects (which account for the large majority of funds);
- Campaigns designed to build the public, political and philanthropic will for lion conservation; and
- Convening – in situations where encouraging key stakeholders to work together can increase conservation impact.

While a wide range of conservation actions are required to secure lions, the majority of LRF investments in lion conservation fall into one of three categories:

- Support for the management of PAs and other wildlife areas;
- Promoting coexistence between people and lions; and
- Tackling the illegal wildlife trade (principally the trade in bushmeat and lion body parts).

The LRF has not identified specific priority sites. Rather, their investments are focused on three scenarios, named 'Retain', 'Recover', "Rescue':

- Retain: speaks to investing in sites with the largest lion populations;
- Recover: speaks to investing in sites with the greatest potential to foster recovery in lion numbers; and
- Rescue: speaks to investing in countries where lions are at greatest risk of going locally extinct.

The LRF funds non-governmental organisations that work hand in hand with governments and/or communities. Proposals are reviewed on invitation by a granting committee comprised of conservationists with broad geographic and thematic expertise. Since its formation in 2017, the LRF has (as of September 2018) invested USD 2.4 million in 28 projects from 20 organisations in 14 countries. The LRF strictly abides by the '100% model', whereby 100% of funds raised are re-granted, with zero overheads being taken off.

Table 10.2.2. Non-exhaustive list of examples of NGOs working on activities relevant to lion conservation in Africa (adapted from Jacobson & Riggio 2018).

Name	Focal Area(s)
Africa Nature Investors	NGA (Gashaka Gumti)
Africa Network for Animal Welfare (ANAW)	KEN
African Conservation Centre	KEN (South Rift)
African Conservation Foundation	CMR, COD, MOZ
African Conservation Trust	ZAF
African Lion & Environment Research Trust (LionALERT)	Africa, ZMB
African Parks (AP)	BEN (Pendjari), CAF (Chinko), MWI (Liwonde, Majete), RWA (Akagera), TCD (Zakouma), ZMB (Liuwa Plain)
African People & Wildlife Fund	TZA (northern Tanzania)
African Predator Conservation Research Organisation	BWA (CT 3 Tamafupa)
African Wildlife Conservation Fund	ZWE
AfriCat Foundation	NAM (Okonjima Nature Reserve)
Amboseli Ecosystem Trust	KEN (Amboseli)
Anne K. Taylor Fund	KEN (Mara Triangle)
Askari Wilderness Conservation Programme	ZAF (Pidwa Wilderness Reserve)
Association for the Valorisation of the Ecotourism in Niger	NER (Dallol Bosso)
AWARE Trust	ZWE
African Wildlife Foundation (AWF)	ETH (Bale Mountains), KEN (Amboseli-Tsavo, Chyulu Hills, Nairobi-Kitengela) NAM (Etosha), TZA (Maasai Steppe)
Big Life Foundation	KEN (Chyulu Hills, Amboseli-Tsavo)
Birdlife Zimbabwe	ZWE
Born Free	ETH (Babile Elephant Sanctuary), KEN (Amboseli NP, Mt Elgon, Mt Kenya, Meru-Kora), TZA (West Kilimanjaro)
Botswana Predator Conservation Trust	BWA (Okavango Delta)
Bulindi Chimpanzee & Community Project	UGA (Bulindi)
Bumi Hills Foundation	ZWE (Bumi Hills)
Bushlife Support Unit	ZWE (Mana Pools)
CAMPFIRE Association	ZWE
CARACAL	BWA (northern Botswana)
Care for the Wild, Kenya	KEN (Tsavo NP, Masai Mara Conservancies)
Carnivore Research Malawi	MWI (Liwonde, Kasungu, Nyika, Vwaza Marsh)
Central Kalahari Lion Research	BWA (Central Kalahari GR)
Cheetah and Wild Dog Rangewide Conservation Programme	Africa
Cheetah Conservation Botswana	BWA
Cheetah Conservation Fund	NAM (Otjiwarongo)
Claws Conservancy	BWA (Okavango Delta)
Conservation & Wildlife Fund	ZWE
Conservation International	Africa
Conservation Lower Zambezi	ZMB (Lower Zambezi)
Conservation South Luangwa	ZMB (South Luangwa)
David Sheldrick Wildlife Trust	KEN
Desert Lion Conservation	NAM (Skeleton Coast NP)
Dete Animal Rescue Trust	ZWE
Eco Activists for Governance and Law Enforcement (EAGLE)	BEN, CIV, CMR, COG, GAB, GIN, SEN, TGO
East African Wildlife Society	KEN
Endangered Wildlife Trust (EWT)	ZAF
Ewaso Lions	KEN (Westgate)
Fauna & Flora Iinternational (FFI)	Africa, MOZ (Chuilexi Conservancy in Niassa NR)
Flying for Wildlife	ZWE
Friends of Hwange Trust	ZWE (Hwange NP)
Friends of Nairobi National Park	KEN (Nairobi NP)
Friends of Serengeti	TZA

Name	Focal Area(s)
Frankfurt Zoological Society (FZS)	COD (Virunga), ETH (Bale Mountains), TZA (Mahale Mountains, Selous, Serengeti), ZMB (North Luangwa, Nsumbu NP) ZWE (Gonarezhou)
Game Rangers International	ZMB (Kafue)
George Adamson Wildlife Preservation Trust	KEN
Global Wildlife Conservation	Africa
Gorongosa Lion Project – Projecto Leões da Gorongosa	MOZ (Gorongosa NP)
Great Plains Conservation & Foundation	BWA, KEN, ZWE
Greater Limpopo Carnivore Program	MOZ (Limpopo NP)
Greater Virunga Transboundary Collaboration	COD, RWA, UGA (Greater Virunga)
Hemmersbach Rhino Force	ZAF (Greater Kruger), ZWE (Hurungwe Zimbabwe)
Honeyguide Foundation	TZA (northern Tanzania)
Hwange Lion Research	ZWE (Hwange)
International Fund for Animal Welfare (IFAW)	Africa
Integrated Rural Development and Nature Conservation	NAM
International Anti-Poaching Foundation	ZAF, ZWE
International Foundation for the Conservation of Wildlife (IGF)	MOZ (Gile), TZA
Invictus K9	Africa
Kalahari Conservation Society	BWA (Kalahari)
Kalahari Research and Conservation	BWA (Kalahari)
Kariba Animal Welfare Fund Trust	ZWE
Kasanka Trust	ZMB (Kasanka & Lavushi Manda)
Kenya Wildlife Conservancies Association (KWCA)	KEN
Kenya Wildlife Trust	KEN
Kenya-Tanzania Borderlands Conservation Initiative	KEN-TZA border area
Kgalagadi Lion Project	BWA, ZAF (Kgalagadi)
Kope Lion	TZA (Ngorongoro)
Kwando Carnivore Project	NAM (Kwando, Zambezi region)
Laikipia Wildlife Forum	KEN (Laikipia)
Leo Foundation	CMR (Benoue, Bouba-Ndjidda, Faro), KEN (Amboseli, Nairobi NP), NGA (Gashaka-Gumti), TCD (Sena Oura)
Lilongwe Wildlife Trust	MWI
Lion Guardians	KEN (Amboseli, Maasai Maro, Tsavo) RWA (Akagera), TZA (Mikumi, Ngorongoro, Ruaha, Tarangira)
Lion Landscapes	KEN (Laikipia-Samburu), ZMB
Living With Lions	KEN (Mara; Laikipia)
Looking4Lion	BWA (Okavango Delta)
Maasai Wilderness Conservation Trust	KEN (Chyulu Hills)
Mara-Meru Cheetah Project	KEN (Masai Mara, Meru)
Matusadona anti-poaching project	ZWE (Matusadona)
Matusadona Lion Project	ZWE (Matusadona)
Milgis Trust	KEN (northern Kenya)
Mpingo Conservation and Development Initiative	TZA (south-eastern Tanzania)
Na'an ku se Carnivore Research Project	NAM
Namibia Nature Foundation	NAM
Natural Resource Conservation Network	UGA
Nature Uganda	UGA
Network of Protected Areas of Central Africa (RAPAC)	Central Africa
Ngamba Island (Chimp Sanctuary and Wildlife Conservation Trust)	UGA
National Geographic Society, Okavango Wilderness Project	AGO, BWA
Niassa Carnivore Project	MOZ (Niassa NR)
Nigerian Conservation Foundation	NGA
Nikela Wildlife	Africa, TZA

Name	Focal Area(s)
Northern Tanzania Rangelands Initiative	TZA (northern Tanzania)
Nyika-Vwaza Trust	MWI (Nyika NP, Vwaza Marsh)
Painted Dog Conservation	ZWE
Painted Dog Research Trust	ZWE (Hwange NP)
PAMS Foundation	TZA
Panthera	Africa
Peace Parks Foundation	AGO, BWA, MOZ, MWI, NAM, ZAF, ZMB, ZWE
Protrack Anti-poaching Unit	ZAF
Robin Hurt Wildlife Foundation	KEN, NAM, TZA
Ruaha Carnivore Project	TZA (Ruaha)
Safari Club International Foundation	BWA, CMR, COG, ETH, MWI, MOZ, NAM, SWZ, TAZ, ZAF, ZMB, ZWE
SAVE-wildlife	BWA (Makgadikgadi NP & Kalahari Botswana)
Shamwari Wildlife Rehab Centre	ZAF (Shamwari GR)
Singita Grumeti Foundation	TZA (Serengeti - Grumeti)
Sino-Zim Wildlife Foundation	ZWE
Soft Foot Alliance	ZWE (Hwange)
SORALO	KEN (South Rift Valley region)
Southern Africa Wildlife College	ZAF
Tanzania Natural Resources Forum	TZA
Tarangire Lion Project	TZA (Tarangire)
The Nature Conservancy	KEN (Samburu-Laikipia, Loisaba, Maasai Mara)
The Tashinga Trust	ZWE (Zambezi Valley)
Tikki Hywood Trust	ZWE
Tlhokomela Botswana Endangered Wildlife Trust	BWA
Tongwe Trust	TZA (Mahale Mountains)
Uganda Carnivore Program	UGA (Queen Elizabeth NP)
Uganda Conservation Foundation	UGA
Uganda Wildlife Society	UGA
Ujamaa Community Resource Team	TZA
Victoria Falls Anti-Poaching Unit	ZWE (Victoria Falls)
Victoria Falls Wildlife Trust	ZWE (Victoria Falls)
WASIMA	TZA (Mpimbwe)
Wildlife Conservation Society (WCS)	CMR (Bouba Ndjida), COD (Virunga, Itombwe), MOZ (Niassa), NGA (Yankari), SSD (Boma NP), TZA (Katavi-Rukwa, Ruaha-Rungwa), UGA (Murchison, Queen Elizabeth, Kidepo)
Wild Nature Institute	TZA
WildAid	Africa
WildCRU, Lions and the trans-Kalahari Predator Programme	BWA (Northern Botswana)
Wildlife ACT Fund	BWA, ZAF
Wildlife Action Group Malawi	MWI (Thuma and Dedza-Salima FRs)
Wildlife Conservation Foundation of Tanzania	TZA
Wildlife Crime Prevention	ZMB
Wildlife Direct	KEN
Wildlife Environmental Society of Malawi	MWI
Wildlife NOW	KEN (Kora NP), TZA (Mkomazi NP)
Working Dogs for Conservation	Africa
World Wide Fund For Nature (WWF)	Africa
Zambezi Society	ZWE (Zambezi Valley)
Zambezi Valley Conservation Alliance Network (Z-CAN)	ZWE (Zambezi Valley)
Zambian Carnivore Programme	ZMB
Zoological Society of London (ZSL)	Africa

Box 10.2.2. IUCN SOS African Wildlife: A grant making mechanism for carnivore conservation in Africa (http://www.saveourspecies.org/african-wildlife)

Ana Nieto

The African Wildlife Initiative (AWI) is a 12 million Euro European Commission funded programme under IUCN's Save Our Species (SOS) portfolio. The five-year programme, which started in 2017, is coordinated by IUCN as a grant making mechanism geared towards providing rapid small (maximum of EUR 20,000) and medium to large (maximum of EUR 500,000) grants to Non-Governmental Organisations (NGOs) to carry out actions that prevent the extinction of threatened species and improve their conservation status. This initiative is set up to ensure smaller projects funded through SOS are complementary to larger projects directly supported by the European Commission to implement its approach to wildlife conservation in Africa, as laid out in the strategy "Larger than Elephants". Grants awarded under this initiative will also contribute to Sustainable Development Goals: 1 (poverty), 12 (responsible consumption and production), 13 (climate action), 15 (life on land) and 17 (partnerships).

Concretely, the initiative aims to tackle specific threats such as habitat loss, human-wildlife conflict and illegal wildlife trade. Projects supported at species and landscape levels contribute to two objectives: (i) to demonstrate impact of conservation actions on threatened species and their habitats in Africa, in particular large African carnivores, and (ii) to empower and strengthen civil society organisations which are committed to biodiversity conservation and sustainable development. Probable carnivore conservation actions to be funded by AWI include those that address and reduce human-wildlife conflict, poaching of carnivores and their prey, wildlife trafficking, as well as those focussed on enhancing law enforcement and implementing solutions that empower communities to participate in conservation as part of innovative livelihood solutions.

In its first year of operation, one call for proposals was issued and over EUR 2 million has been earmarked for disbursement to NGOs through 11 projects. These projects target carnivores (lions, leopards, cheetahs, wild dogs and Ethiopian wolves) and other flagship species (notably wild ass, zebra and giraffes), and will be implemented in eight countries across West, East and Southern Africa.

Capacity building is a hallmark of the initiative's activities. SOS will organise and participate in various capacity building events with the aim of helping national/ local organisations to develop and submit good proposals in response to future AWI calls. In addition, other events will be organised to provide a platform for grantees, nature conservation organisations and other stakeholders in Africa to share examples, case studies and lessons learned from their grant implementation and ultimately facilitate the adoption of successful experiences in threatened species conservation projects and conservation activities more broadly.

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