STATUS AND DISTRIBUTION OF THE LION *(Panthera leo)* IN EAST AND SOUTHERN AFRICA

BACKGROUND PAPER

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ACRONYMS

ALWG	African Lion Working Group
CAT SG	Cat Specialist Group
CF	Conservation Force
GIS	Geographical information system
IGF	International Foundation for the Conservation of Wildlife
IUCN	World Conservation Union
NP	National park
PAC	Problem Animal Control
SSA	Sub-Saharan Africa
SSC	Species Survival Commission (IUCN)
WCS	Wildlife Conservation Society

INTRODUCTION

The present paper was written at the request of the Central Coordinating Committee for the World Conservation Union (IUCN) Regional African Lion Conservation Workshops. The objective of the paper is to provide current information on the status and distribution of the lion in the range states of East and Southern Africa and threats to the populations. A paper following a similar format was also prepared for the West and Central African Lion Workshop (Bauer et al., 2005).

This document must be included/understood as a working paper prepared by a small group of experts, subject to the authorities of the lion range states as well as those from the international scientific community. It is intended to be used as support for work to come which can and will supplement and improve it at the rate/rhythm of the development of knowledge on the subject. This should not be perceived as a conclusive final image of the conservation of the lion in these two regionss.

Lion population estimates from two recent publications are compared, highlighting the differences and similarities, and analyzing the methodological differences, especially insofar as they explain differences between the two publications. There is a continental overview, and detailed sections for each East and Southern African lion range state. A summary of the 2004 assessment of the lion for the IUCN Red List of Threatened Species is also included.

I. BACKGROUND

The African Lion Working Group (affiliated with IUCN Cat Specialist Group & Conservation Breeding Specialist Group) was created during a meeting in Warmbaths in 1999. The promotion of surveys and a continental compilation of surveys was among its objectives, and in 2001 a start was made by Sarel Van Der Merwe (ALWG chair) and Hans Bauer. Since least information was available on West and Central Africa, an information gathering workshop was organised in Limbe, Cameroon, in 2001 (Bauer et al., 2001). Data gathering continued with questionnaires and personal communications, mainly with members of ALWG and their networks, dominated by scientists and people working with conservation organisations. The data were presented in tables on the ALWG website by the end of 2002, a full paper including methods and analyses was published in Bauer's dissertation in September 2003 (Bauer, 2003) and four months later in the scientific journal Oryx (Bauer & Van Der Merwe, 2004).

In 2000, the Director of the International Foundation For the Conservation of Wildlife (IGF), Philippe Chardonnet, with support of the US-based NGO Conservation Force (CF), had undertaken to collect information available on the status of conservation of the lion in the whole of Africa. Information came initially from the national authorities in charge of wild fauna, but also from scientists and consultants and finally of his own observations since a score of years in a score of lion range states. In 2001, a compilation of all these data was undertaken to be finally published in September 2002 (Chardonnet Ph., ED, 2002). The information produced in this document was not limited only to the distribution of the lion, with the evaluation of its habitats and its conservation status. They proposed also an analysis of the factors influencing the conservation of the lion: the cohabitation of the man and the lion, the consumptive and non-consumptive use of the lion, the policies of management and the various prospects for conservation.

The document is downloadable from the IGF website : < www.wildlife-conservation.org >, and from the CF website : < www.conservationforce.org >.

Both publications raised considerable interest, and there were calls for a comparative presentation (Bertram, 2003). This chapter is attempting to carry out such a comparison by underlining convergences and differences between the two.

II. METHODOLOGY

1. SOURCES USED

Appendix 1 contains four tables that present the various sources which were used and quoted respectively by the two studies. These tables make it possible to have an objective idea of the raw data available at the time (2002).

Some comments can be proposed at this stage:

- The raw data available are overall very few, especially for West Africa and Central Africa, but also for many areas of the Southern Africa and East Africa.

- One notes some exceptions where the data are more abundant, notably for the South of Kenya, the North of Tanzania and some of the countries of the Southern Africa: South Africa in general, the North of Botswana, Namibia and Zimbabwe.

- In contrast to Bauer & Van Der Merwe, the study of Chardonnet includes historic data and an elaborate literature review, and therefore includes references from different periods, contemporary and older. Obviously, as the two studies go back to 2002, all their data are now at least 4 years old.

- The study of Bauer and Van Der Merwe rests primarily on personal communications of resource-persons. There is just one published bibliographic reference. The study of Chardonnet relies on a wider range of sources, about half being equivalent to published references, and half personal communications of resource-persons.

2. METHODS USED

The two publications present evaluations of the population and distribution of the lion in 2002; in several cases only older information was available, these were all included in the Chardonnet study but the Bauer & Van der Merwe study discarded all information more than 10 years old.There are two major methodological differences: (i) the extent of geographical coverage and (ii) the types of census methods used.

2.1. Geographic coverage

The geographic coverage of the data is different between the two studies because their respective objectives were distinct. Bauer & Van Der Merwe listed all census data available to them. So did Chardonnet, who proposed in addition best possible estimates when census data were not available. For several areas, Bauer just identified information gaps where Chardonnet rather put a tentative ‘educated guess’ or estimate using various methodologies

- **Study of Bauer & Van Der Merwe, 2004:**

As the study title indicates, it is an inventory of known populations, and care must be taken when interpreting the figures as a proxy for a total lion estimate. The study wished to cover only the zones for which the authors could obtain information. As a consequence, this study presents no information for three countries (Somalia, Sudan and Malawi) and for a considerable number of ecosystems, A number of these ecosystems are listed as 'lions present but not estimated'. The authors acknowledge that especially Ruaha and Tarangire ecosystems contain substantial lion populations and that a continental estimate would be higher than their inventory of known populations.

The study focused on lions in Protected Areas (in the sense of the IUCN categories which include wildlife management areas), excluding non-gazetted land, *e.g.* pastoral rangeland.

Lastly, the study chose a presentation organised by country. This has the advantage of easy interpretation but the disadvantage of not clearly highlighting connectivity between countries (transfrontier populations).

- **Study of Chardonnet, 2002:**

The study tried to cover the whole of the potential range of the lion, in an attempt to present the author's best possible estimate of lion numbers, including all countries within the range, all ecosystems, and all non-protected areas.

The disadvantage of this approach is that it requires difficult estimates which must be based on the opinion of experienced resource-persons and extrapolations starting from similarities of geographical context in the broad sense (not only natural habitat, but also human occupation, etc).

The study adopted an approach of the type "subpopulation," based on mega-ecosystems, because political borders have little ecological significance. Thus, the transboundary populations are presented as pertaining to the same subpopulations. On the other hand, the estimates of national populations are made difficult with this approach, even if one can expect that they are more exhaustive.

2.2. Mode of evaluation of the populations

The precise inventory of the populations of lion is a difficult task (Schaller, 1972; Funston, 2002), even quasi impossible (Craig Packer, pers. comm.) for many reasons, including: their low density, their vast distribution, their largely noctural activity pattern, the difficulty of observing them, etc. These difficulties can be relatively well controlled in relatively well-managed protected areas. They are exacerbated in protected areas which are subject to strong human influences (poaching, pastoral influence, etc), thus increasing the risk of underestimation. These same difficulties become often extreme outside protected areas where the bias of underestimation becomes such that it can even lead to a conclusion of total absence.

The estimates of the two publications are based on sources of information which are either published bibliographical references published or the personal communications of informed people. These various sources of information draw themselves their data from various methods.

- **Classification of the methods:**

According to Bauer, approximately 30% of the individual population estimates compiled by Bauer&Merwe were based on scientific surveys (Table 5, ALWG classes 1-3). Seventy percent of their population figures were derived from expert opinion or guesstimate (classes 4-6). In comparison, 63% of Chardonnet's individual population estimates were based on expert opinions or guesstimates (IGF class c). Twelve percent of Chardonnet's estimates were based on scientific surveys or intimate knowledge by a resident researcher (IGF class a), and a further 25% were derived from extrapolation of variables from nearby populations and catch-per-unit effort-estimates based on lion trophy hunting (IGF class b), for which there is no comparable method in Bauer&Merwe. Both publications present intervals calculated as the estimate plus or minus a percentage. In Bauer & Merwe, these percentages are based on a literature review, giving a precision ranging from 10 to 50%. Chardonnet assumes a higher precision than Bauer&Merwe, reasoning that managers living on the ground on a permanent basis have a more intimate knowledge of their areas than visiting researchers. This is a matter of debate. However, for both publications, the confidence intervals are arbitrary, and the comparison will focus on the population estimates.

Table 5: Comparison of the methods of population estimation used by the two publications

Method	ALWG Bauer&Merwe			IGF Chardonnet		
	class	error	Percent of pop estimates	class	error	Percent of pop estimates
Total count, individual identifications	1	10%	30%	A	10%	12%
Total or sample inventory using calling stations	2	20%				
Radio telemetry, photo databases, spoor counts	3	30%				
Informed guess by resident researcher	4	40%	70%			
Guesstimate based on secondary data	5	50%		C	30%	63%
Extrapolation from similar ecosystems	--			B	20%	25%
Other error to be specified by source	6	--				

- **Other methods:**

Chardonnet uses three other methods in his study; Bauer & Van Der Merwe did not use the first two because they consider these methods as insufficiently accurate, and the third was not mentioned as a separate category but may have been used as basis for guestimates by their sources.

- Effort of contact or encounter rate: this method of " *catch per unit effort* ", which is a method of abundance index, comprises several alternative variables of effort of direct or indirect observation, effort of hunting, etc. It compares indices of encounter per unit of time, space, effort, etc. It was used by the Chardonnet study in some areas of West Africa and Central Africa where other data were not available

- Deductive cartography: this method is connected with that developed by Rowan Martin (Martin and de Meulenaer 1988) to evaluate the population of leopard in SSA. It was used by the Chardonnet study for Sudan where few recent data were available.

- Identification of the groups: this method is an adaptation of the method of " *territorial mapping* " described by Overton & Davis (1969) and tested in West Africa, notably by Green (1979) in Burkina Faso. One can consider that this method is intuitively used by field observers who work in a given area on a permanent or very regular basis. It consists for a given observer to identify, not the individual lions, but the various lion groups (prides, male coalitions) inhabiting the particular area which is well known by the observer. Moreover since 2004, Chardonnet (pers. com.) is testing an adaptation of the method developed by P. Stander in Namibia for large carnivore monitoring (Hanssen and Stander 2004). Chardonnet's "Notebook of the Bush" works through a widespread network of field observers on the ground, where they or their teams are permanently located in lion areas.

III. GENERAL SITUATION

1. TOTAL POPULATION

The total results estimated by the two studies are presented by region and for the whole of the continent (table 6). The rates of difference between the two studies are also calculated.

Table 6: Estimates of the total population of lions in sub-Saharan Africa

Area	Minimum		Maximum		Estimate		Ratio of divergence: ` between the 2 studies
	Bauer & Van Der Merwe, 2004	Chardonnet, 2002	Bauer & Van Der Merwe, 2004	Chardonnet, 2002	Bauer & Van Der Merwe, 2004	Chardonnet, 2002	
West Africa	450	968	1 250	1 358	850	1 163	X 1,4
Central Africa	500	2 092	1 550	3 538	950	2 815	X 3
East Africa	8 000	11 268	15 000	18 811	11 000	15 744	X 1,4
Southern Africa	7 500	14 526	12 500	23 425	10 000	19 651	X 2
Total	**16 500**	**28 854**	**30 000**	**47 132**	**23 000**	**39 373**	**X 1,7**

- **Strongest convergences** between the two studies are for West Africa and East Africa:

– West Africa: one can perhaps explain relative convergence for this area because of the low total population size which inevitably constrained variations.

– East Africa: the relative convergence for this area can perhaps be explained by the greatest number of studies on the lion in certain sites, thus providing more sources of information and better quality. In addition certain zones with lion which were omitted by Bauer & Van Der Merwe contain low densities, thus limiting the variations: it is notably the case of a country like Somalia or an ecosystem like Ogaden.

- **There are greater divergences** between the two studies for Central Africa and Southern Africa:

– Central Africa: Bauer & Van Der Merwe estimate a population three times lower than that of Chardonnet. A possible reason to explain this much lower population could be the lack of information for this area for Bauer & Van Der Merwe. It is also possible that Chardonnet's figures are overestimated.

– Southern Africa: Bauer & Van Der Merwe evaluate a population 2 times lower than that of Chardonnet. This difference could be due to the fact that Bauer & Van Der Merwe rely on sources mainly from the scientific community, while Chardonnet uses data from other actors as well.

- **All in all,** the evaluation of Chardonnet leads to a continental lion population 1.7 times larger than that of Bauer & Van Der Merwe. Several reasons can explain this difference:

– The geographic coverage:

Bauer & Van Der Merwe estimate that about half of the difference in the overall estimate can be explained by the areas for which they prefer not to give data and for which Chardonnet either had data or used extrapolations.
Non-protected areas are referenced more frequently by Chardonnet.

– Wealth of information:

The sources of information appear clearly more abundant and more diversified in the study of Chardonnet (more references, especially to 'grey', current and historical literature) than in that of Bauer & Van Der Merwe, who restricted their presentation to contemporary estimates (Annex 1).

- Method:

Table 5 suggests the data quality category "1-4" of Bauer & Van Der Merwe seems close to category "A" of Chardonnet. On the total number of lions, 54% were estimated by these methods in Bauer & Van Der Merwe, while only 14% of the data of Chardonnet would concern this category. This could illustrate the fact that Bauer & Van Der Merwe

often draw its information from the scientific community, which could give an indication of precision but not necessarily of exactitude.

Certain estimates of Bauer & Van Der Merwe do not take account juveniles (lion cubs) in the calculations because certain census methods do not detect them.

- Interpretation:
  - Bauer & Merwe can probably be called more conservative, but not systematically so.

2. DISTRIBUTION

2.1. Presence of the lion

The lion occupies a large variety of habitats, from desert to some tropical forest, with all types in between including woodland, dry forest, savanna, steppe, etc. A lion population is found in the equatorial part of Central Africa in the tropical forest itself and in a mosaic of savanna/forest patches. The lion also inhabits arid and semi-desert regions such as the Kalahari desert or the Namibian coastal desert for example. .

According to Chardonnet (2002), East Africa comprises nearly 40% of the lion distribution area on the continent, and Southern Africa more than one third 35%), with

the continental range estimated at approximately 3 million km². About half of the lion range is gazetted as protected, while the other half has no official conservation status (Table 7).

Table 7 Extent and status of lion distribution areas in Sub-Saharan Africa according to Chardonnet *(2002)*

Distribution of the lion (Km² & % *)		**Total**	**Protected surfaces**			**Not classified surfaces**
			National parks	**Reserves**	**Zones of hunting**	
West Africa	km²	121 980	43 190	14 690	18 400	45 700
	%	4	35	12	15	37
Central Africa	km²	651 970	67 555	24 860	247 860	311 695
	%	22	10	4	38	48
East Africa	km²	1 137 205	149 347	139 594	116 730	731 534
	%	39	13	12	10	64
Southern Africa **	km²	1 039 212	289 139	405 404	27 472	317 197
	%	35	28	39	3	31
Sub-Saharan Africa	km²	2 950 367	549 231	584 548	410 462	1 406 126
	%		19	20	14	48

* % of the existing lion range in the sub-region, except for the last line, which is relative to the continent.
** excluding fenced protected areas.

2.2. Absence

- **Historical absence**

Historically, the lion ranged across most of the continent, with the exception of the rainforests of the Congo basin and the interior of the Saharan desert.

- **Disappearances**

Several countries have seen the lion recently disappearing from their territory:

- West Africa: Gambia, Mauritania, Sierra Leone and South Algeria.
- Central Africa: no country definitively lost the species.
- East Africa: Burundi, Djibouti, Eritrea.
- Southern Africa: Lesotho and Swaziland (now reintroduced).

2.3. Range States

Information suggested here does not have a political value, insofar as the authorities were not consulted in a formal way to validate them officially. The data are presented only as an indication with an aim of informing and of helping the interested decision makers and other actors.

- **Presence of the lion:**

– Lions are present in 34 countries
– They are present permanently in 32 countries
– They are occasional in 2 countries

- **Absence of the lion:**

– 8 countries of SSA are not lion range states:
– 2 of them never had lions, and
– The 6 others lost their lions in a recent past

Table 8: Lion Range States (list proposed by Chardonnet, 2002)

Area	Country	Presence of the lion		Absence of the lion	
		permanent	occasional	Never present	recently extinct
West Africa (15 country)	Benin	1			
	Burkina Faso	1			
	Côte.d'ivoire	1			
	Gambia				1
	Ghana	1			
	Guinea	1			
	Guinea Bissau	1			
	Liberia			1	
	Mali	1			
	Mauritania				1
	Niger	1			
	Nigeria	1			
	Senegal	1			
	Sierra Leone				1
	Togo		1		
	Under total	**10**	**1**	**1**	**3**
Central Africa (7 countries)	Cameroon	1			
	Congo	1			
	Gabon	1			
	Equatorial Guinea			1	
	R.C.A.	1			
	R.D.C.	1			
	Chad	1			
	Under total	**6**	**0**	**1**	**0**
East Africa (10 countries)	Burundi		1		
	Djibouti				1
	Érythrée				1
	Ethiopia	1			
	Kenya	1			
	Uganda	1			
	Rwanda	1			
	Somalia	1			
	Tanzania	1			
	Sudan	1			
	Under total	**7**	**1**	**0**	**2**
Southern Africa (10 countries)	South Africa	1			
	Angola	1			
	Botswana	1			
	Lesotho				1
	Malawi	1			
	Mozambique	1			
	Namibia	1			
	Swaziland	1			
	Zambia	1			
	Zimbabwe	1			
	Under total	**9**	**0**	**0**	**1**
Continent (SSA)	**42 countries**	**32**	**2**	**2**	**6**

6. LION POPULATION ESTIMATES: EAST AFRICA

For the figures of Bauer & Van Der Merwe (2004), note that the estimates do not include some populations known to exist but for which they had no estimate. The figures of Chardonnet follow ecological borders. In the country tables which follow, his figures were re-calculated to national borders, leading to some discrepancies in the national and regional totals.

6.1 Burundi

Both publications agree that there are no permanent lions in Burundi.

6.2 Djibouti

Both publications agree that there are no permanent lions in Djibouti.

6.3 Eritrea

Both publications agree that there are no permanent lions in Eritrea.

6.4 Ethiopia

Country: Ethiopia	Chardonnet				Bauer&Merwe			
Area	min	est	Max	method	min	est	max	method
Babile, Darkata, Webe Shebelle	245	350	455	C	180	300	420	4
Bale, Sof Omar	68	97	126	C	30	50	70	4
Borana, South West, L.Stephanie/Turkana	197 84	281 120	365 156	C	60	100	140	4
Gambella NP	113	162	211	C	90	150	200	4
North East / Babile	210	300	390	C	200	250	300	4
Omo NP & Mago NP	99	141	183	C		n.e.		
Rest					75	150	225	4
Afar Complex	297	423	549	C				
Ogaden	35	50	65	C				
Total	1035	1477	1919		635	1000	1355	

Even though Chardonnet's figures are generally higher, there are no particular discrepancies for Ethiopia. Omo and Mago NPs were not missed by Bauer&Merwe but listed as present and not estimated due to insufficient data.

6.5 Kenya

Country: Kenya	Chardonnet				Bauer&Merwe			
Area	min	Est	Max	method	min	est	max	method
Aberdares NP	130	162	194	C	5	7	15	6
Amboseli NP	117	130	143	A	20	20	20	4
South, East of Rift Valley					20	20	20	6
North, East of Rift Valley	189	271	353	C	325	650	1300	5
Galana Game Ranch					75	150	225	5
Nairobi NP	20	22	24	A				
Hells Gate & Kedong	7	9	11	B				
Lake Nakuru NP	33	37	41	A				
Laikipia plateau	280	362	444	B	96	120	144	2
Masai Mara NP	492	547	602	A	502	558	614	2
Surrounds of Masai Mara	317	394	487	B/C				
Meru Complex	52	65	78		40	80	120	5
Tsavo NPs	600	750	900	B	338	675	1350	5
Total	2237	2749	3277		1421	2280	3808	

The estimates for Kenya do not differ much, except for Aberdares and Amboseli NPs and the Laikipia Highlands. These areas are relatively well known, and it should be possible to get better information.

6.6 Rwanda

Country: Rwanda	Chardonnet				Bauer&Merwe			
Area	min	est	max	method	min	est	max	method
Akagera NP	32	45	59	C	15	25	35	4
Total	32	45	59		15	25	35	

Both publications agree that lions were more abundant before 1994, Bauer&Merwe gives a figure of 250.

6.7 Somalia

Country: Somalia	Chardonnet				Bauer&Merwe			
Area	min	est	max	method	min	est	max	method
Nogal & Haud region	48	68	88	C				
El Bur region	90	128	166	C				
Swamp NP	15	21	27	C				
Total	153	217	281					

Chardonnet has some information for Somalia; Bauer&Merwe list the country as ‘no information’.

6.8 Sudan

Country: Sudan	Chardonnet				Bauer&Merwe			
Area	Min	est	Max	method	min	est	max	method
Bahr el Gazal region	255	364	473	C				
Zeraf Game Reserve	27	39	51	C				
Badingilo NP	116	165	215	C				
Nimule NP	3	4	5	C				
Boma NP	160	228	296	C				
Total	561	800	1040					

The case of Sudan illustrates well the difference in approach between the two studies. Chardonnet specifies that information concerning the population of lions in Sudan is "highly speculative", but presents a tentative estimate, whereas Bauer & Van Der Merwe suffice to mention the absence of information.

The estimate of Chardonnetis combines three distinct approaches:

- Bibliographical references of 1985 (Annex 1, Table 1);
- Method of deductive cartography based on geographical indicators such as the physical and human constraints;
- Personal communications by resource persons.

It should be noted that:

- The area located on the western bank of the Nile River is often regarded as pertaining to Central Africa;

– The area located on the eastern bank of the Nile is regarded as pertaining to the area of East Africa.

6.9 Tanzania

Country: Tanzania	Chardonnet				Bauer&Merwe			
Area	Min	Est	Max	Method	min	est	max	method
Manyara NP	3412	4437	5222	B	20	20	20	4
Ngorongoro Crater					53	53	53	1
Serengeti & surrounds					1750	2500	3250	3
Tarangire NP								
Selous	3080	4400	5720	C	3000	3750	4500	5
Selous surrounds	378	540	702	C	500	750	100	6
Ruaha Complex	2352	3360	4368	C				
North West	445	637	828	C				
South West	741	1058	1375	C				
Total	10408	14432	18215		5323	7073	7923	

Tanzania hosts arguably the largest number of lions in Africa, with populations inside and outside Protected Areas. It is an important country for this paper, explaining much of the difference in the total figures. While most unknown populations not included by Bauer&Merwe were relatively small, Tanzania's lion populations of Ruaha and Tarangire are estimated at 5,244 by Chardonnet. If this figure is deducted from both survey's continental totals, the differences are not so large.

6.10 Uganda

Country: Uganda	Chardonnet				Bauer&Merwe			
Area	Min	est	Max	method	min	Est	max	method
Kidepo Valley NP	18	25	58	C	20	25	30	2
Murchison Falls Complex	255	364	473	C	280	350	420	2
Queen Elizabeth Complex	206	229	253	A	140	200	260	2
Total	479	618	784		440	575	710	

There is well documented information for Uganda, leading to similar figures.

V. LION POPULATION ESTIMATES: SOUTHERN AFRICA

7.1 Angola

Country: Angola	Chardonnet				Bauer&Merwe			
Area	Min	est	Max	method	min	Est	max	method
Mavinga, Luiana & Cuando-Cubango areas	165	235	305	C				
Kameia & Moxico	69	98	121	C				
Kangandala, Kisama & Luando	112	160	208	C				
Iona, Mupa &Bikuar	179	256	333	C				
National					270	450	630	4
Total	525	749	967		270	450	630	

Chardonnet states that his figures must be viewed with caution, since information is scarce and declines are suspected. Bauer&Merwe presented less detail, only a national estimate that is not very different from the Chardonnet sub-total.

7.2 Botswana

Country: Botswana	Chardonnet				Bauer&Merwe			
Area	Min	est	Max	method	Min	Est	max	method
Okavango Delta	1358	1698	2038	B	1006	1438	1869	3
Kwando & Chobe front	205	256	307	B	149	213	277	3
Dry North	156	223	290	C	133	223	312	4
Nxai Pan, Makgaligadi NP & Central Kalahari GR	315	450	585	C				
Central Kalahari GR					166	312	458	6
Makgaligadi NP					28	39	59	6
Nxai Pan								
Tuli Block					0	10	20	6
Kgalagadi Complex	522	580	638	A	628	683	728	6
Total	2556	3207	3858		2110	2918	3723	

The figures for Botswana are similar; the difference for Okavango may seem large in large in absolute terms but not in relative terms.

7.3 Lesotho

Both publications agree that there are no lions in Lesotho

7.4 Malawi

Country: Malawi	Chardonnet				Bauer&Merwe			
Area	Min	est	Max	method	min	Est	max	method
Liwonde NP	4	5	6	B				
Nyika NP & Vwaza Marsh	4	5	6	B				
Nkhotakota Wildlife Res	8	10	12	B				
Kasungu NP	4	5	6	B				
Total	20	25	30					

Bauer&Merwe presents no reliable information, but sources confirm that there are some very small pockets of lion populations as presented by Chardonnet.

7.5 Mozambique

Country: Mozambique	Chardonnet				Bauer&Merwe			
Area	Min	est	Max	method	min	Est	max	method

Manica Gaza	56	80	104	C	15	25	35	4
Niassa, Cabo Delgado	350	500	650	C	105	175	245	4
Zambezi Valley	70	100	130	C	105	175	245	4
Rest					15	25	35	4
Northern non-gazetted	105	150	195	C				
Tete Province	87	125	163	C				
Total	668	955	1242		240	400	560	

Chardonnet gives figures with larger population sizes than Bauer&Merwe who acknowledge that some areas were missed. The figure for Niassa/Cabo Delgado are disputed, however.

7.6 Namibia

Country: Namibia	Chardonnet				Bauer&Merwe			
Area	Min	est	Max	method	min	Est	max	method
Etosha NP	252	315	378	B	191	230	266	6
Rest					476	680	884	3
Kaudom & Nyae Nyae	75	94	113	B				
Caprivi	144	180	216	B				
Kunene region	82	102	122	B				
Total	553	691	829		667	910	1150	

P Stander, who was the source for Bauer&Merwe's estimate, recently published a Large Carnviore Atlas for Namibia, which estimates lions at 562-894 (Hanssen and Stander, 2004).

7.7 South Africa

Country: South Africa	Chardonnet				Bauer&Merwe			
Area	Min	est	Max	method	min	Est	max	method
Eastern Cape	107	119	131	A	12	13	14	1
Kruger ecosystem	2277	2530	2783	A	2200	2200	2200	6
Hluluwe-Umfolozi NP					72	120	168	4
Phinda, St Lucia, Thembe, Ndumu					15	15	15	1
Lowveld region					153	161	169	6
Venetia Limpopo Mine					15	30	45	5
Ligwalagwala (Malelane)					13	13	13	1
Madikwe, Pilanesberg					99	110	121	1
Kgalagadi Transfrontier	84	120	156	C	See Botswana			
Waterberg Region					54	54	54	1
Mpumalanga	11	13	14	A				
Free State	450	500	550	A				
Gauteng	182	202	222	A				
Kwazulu Natal	143	159	175	A				
Northern Cape	19	21	23	A				
Northern Province	49	54	59	A				
North West Province	121	134	147	A				
Total	3443	3852	4260		2633	2716	2799	

Chardonnet's figures are organised by province, Bauer&Merwe's figures by specific area. Chardonnet's figures include more fenced areas, especially private reserves. Bauer&Merwe's figure for Kruger is from Gus Mills and is probably the most reliable.

7.8 Swaziland

Country: Swaziland	Chardonnet				Bauer&Merwe			
Area	Min	est	Max	method	min	Est	max	method
Hlane Royal NP	17	19	21	A	15	15	15	1
Nisela Safaris	7	8	9	A				
Total	24	27	30		15	15	15	

The lion population in Hlane Royal NP was reintroduced.

7.9 Zambia

Country: Zambia	Chardonnet				Bauer&Merwe			
Area	Min	est	Max	method	min	Est	max	method
Kafue, Luangua & Lower Zambezi					1000	1500	2000	6
Sumbu Complex	27	39	51	C				
Luangua Complex	1143	1633	2123	C				
Chisomo, Luano & West Petauke	115	165	215	C				
Lower Zambezi & Kariba	128	183	238	C				
Kafue, Lochinvar & Blue Lagoon	718	1026	1334	C				
West Lunga Complex	107	153	199	C				
Total	2238	3199	4160		1000	1500	2000	

For Zambia, Chardonnet mentions populations in specific conservation areas and adds in the text that lions also occur outside such areas, be it at decreasing scale. Bauer & Van Der Merwe present much less geographic detail, their estimate represents a national total; however, from the label we see that it includes at least the three areas with the highest numbers mentioned by Chardonnet, so the totals should be similar but they are not, which suggests a difference of opinion. Bauer & Van Der Merwe mention Zambia specifically in their methods section, as the only country specifically surveyed for their publication.

7.10 Zimbabwe

Country: Zimbabwe	Chardonnet				Bauer&Merwe			
Area	Min	est	Max	method	Min	Est	max	method
Charara Safari Area					24	40	56	4
Chete, Sijarira Safari Area					24	40	56	4
Chewore Safari Area					60	100	140	4
Chirisa Safari Area					24	40	56	4
Chizarira NP					36	60	84	4
Dande Safari Area					30	50	70	4
Doma Safari Area					21	35	49	4
Gonarezhou, Save, Chiredzi, Malilangwe, Beit Bridge, Tuli	130	188	245	C	91	130	169	3
Hurungwe Safari Area					48	80	112	4
Hwange ecosystem	434	543	652	B	72	120	168	4
Mana Pools NP	396	495	594	B	83	97	112	6
Matetsi Safari Area	120	150	180	B	36	60	84	4
Matusadona NP	248	310	372	B	72	120	168	4
Sapi Safari Area					24	40	56	4
Zambezi NP					15	25	35	4
Total	1328	1686	2043		660	1037	1415	

The differences between estimates are large for Hwange and Mana Pools NP. For Hwange NP, Chardonnet mentions in the text that 199 of the 543 are cubs, whereas some sources of Bauer&Merwe did not count cubs; this may partly explain the difference. For Mana Pools NP, the difference may be due to the inclusion of surrounding common land in the Chardonnet figure as opposed to the Bauer&Merwe figure. For Matusadona, Chardonnet mentions that there are 110 lions inside the park, the difference is thus entirely attributable top the inclusion of surrounding areas for which Bauer&Merwe present no information.

VI GENERAL CONCLUSION

1. CONCLUSION FOR EAST AFRICA

Major differences	Chardonnet				Bauer&Merwe			
Area	min	est	Max		min	Est	max	
Afar Complex	297	423	549		Not estimated			
Aberdares NP	130	162	194		5	7	15	
Amboseli NP	117	130	143		20	20	20	
Laikipia plateau	280	362	444		96	120	144	
Somalia	153	217	281		Not estimated			
Sudan	561	800	1040					
Ruaha Complex	2352	3360	4368					
North West Tanzania	445	637	828					
South West Tanzania	741	1058	1375					

There is much more information about lion populations for most of this region (especially compared to West and Central Africa: Bauer et al. 2005). There are several areas, however, for which Bauer&Merwe had no information or information judged too speculative. These areas are extensive, and for some Chardonnet presents considerable lion densities. Paradoxically, therefore, lack of information accounts for a difference of 7191 lions between the Bauer&Merwe and Chardonnet estimates in this region. Most of this is due to estimates from Tanzania and Sudan.

2. CONCLUSION FOR SOUTHERN AFRICA

Major differences	Chardonnet				Bauer&Merwe			
Area	min	Est	max		min	Est	Max	
Mozambique	668	955	1242		240	400	560	
Kruger ecosystem	2277	2530	2783		2200	2200	2200	
Hwange ecosystem	434	543	652		72	120	168	
Mana Pools NP	396	495	594		83	97	112	
Matusadona Complex	248	310	372		72	120	168	

Chardonnet's estimate for the southern African lion population (19,651) is almost twice as high as Bauer&Merwe's estimate of 10,0000. Lion populations are relatively well known in South Africa, Namibia and Botswana, but less so in the other countries of the region.

3. POPULATION TREND AND ASSESSMENT OF THE LION FOR THE IUCN RED LIST OF THREATENED SPECIES

There have been few efforts in the past to estimate the number of lions in Africa. Former IUCN/SSC Cat Specialist Group Chairman Norman Myers carried out status surveys for the leopard *Panthera pardus* and cheetah *Acinonyx jubatus* in Africa, and also looked, in less detail, at the status of the lion. Myers (1975) wrote, "Since 1950, their numbers may well have been cut in half, perhaps to as low as 200,000 in all or even less." Later, Myers (1984) wrote, "In light of evidence from all the main countries of its range, the lion has been undergoing decline in both range and numbers, often an accelerating decline, during the past two decades." In the early 1990s, IUCN/SSC Cat Specialist Group members made educated "guesstimates" of 30,000 to 100,000 for the African lion population (Nowell & Jackson, 1996).

The most quantitative historical estimate of the African lion population in the recent past was made by Ferreras and Cousins (1996), at the UK's Cranfield University. They developed a GIS-based model to predict African lion range and numbers, calibrated by surveying lion experts about the factors affecting lion populations. Because of the age of their data sources on extent of agriculture and pastoralism, Ferreras and Cousins (1996) selected 1980 as the base year for their predicted African lion population of 75,800.

The IUCN/SSC Cat Specialist Group estimated a recent decline in the African lion population for the 2004 IUCN Red List of Threatened Species through the following calculation (Cat Specialist Group, 2004). In 1980, Ferreras and Cousins (1996) predicted 18,600 lions to occur in protected areas. This was probably an underestimate as not all protected areas inhabited by lions at that time were included. Still, comparison of their figure with Bauer and Van Der Merwe's 23,000, which focused mainly on protected areas, suggests that the number of lions in protected areas has remained stable or possibly increased over time. But Ferreras and Cousins (1996) predicted that most lions in 1980 were found outside protected areas. Chardonnet (2002) finds that unprotected areas still comprise a significant portion (about half) of the lion's current African range (Table 7). Comparison of Ferreras and Cousin's (1996) prediction of 75,800 lions in 1980 (3 lion generations ago) to Chardonnet's (2002) estimate of 39,000 lions yields a suspected decline of 48.5%. This calculation, although quite theoretical, would suggest a substantial decline in lions outside protected areas over the past two decades, and if it is realistic, it would support the recommendation of the African Lion Working Group that the lion continue to be classified as Vulnerable on the IUCN Red List of Threatened Species (Bauer and Van Der Merwe, 2004). Ferreras and Cousins (1996) may have over-estimated the African lion population in 1980, as their number was derived from a model rather than actual lion counts. While it is possible that the rate of decline of the African lion population may be lower (e.g., less than the 30% cut-off for classification as Vulnerable), the precautionary principle precludes removing the lion from the list of Threatened Species (IUCN, 2004). The rate of decline is quite unlikely to have been as high as 90%, as reported in a series of news reports in 2003 (Kirby 2003, Frank and Packer 2003).

The lion was thus assessed as Vulnerable (VU A2abcd) for the 2004 IUCN Red List of Threatened Species according to the following justification**:** "A species population

reduction of >30 - <50% is suspected over the past two decades (three lion generations = 19.5 years). The causes of this reduction are not well understood, are unlikely to have ceased, and may not be reversible. This suspected reduction is based on direct observation; appropriate indices of abundance; a decline in area of occupation, extent of occupation and habitat quality; and actual and potential levels of exploitation" (Cat Specialist Group 2004).

The technical working session of the East and Southern African Lion Conservation Workshop (*Conservation Priority Setting for Lions in East and Southern Africa),* organized by the Wildlife Conservation Society (WCS) in cooperation with the Cat SG, should help to solve some of the difficulties in the estimates to lead to a consensus on the distribution and the status of the populations. But even if regional and continental estimates of lion numbers remains a significant goal for the conservation community, it is necessary to keep in mind that very few noncaptive populations can be estimated with 100% accuracy. And on a regional and continental scale, the inaccuracy increases. More efforts should be directed in the future to monitoring lion population trends through indices of abundance, a measurement which can be simpler and more useful for wildlife managers. .

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Annex 1. Sources used in the two surveys (see Chardonnet 2002 and Bauer and Van Der Merwe 204 for citations)

Table 1 : complete list of sources mentioned for East Africa

Afrique de l'Est		Liste complète des sources d'information citées par :			
		Chardonnet, 2002		Bauer & Van der Merwe, 2004	
Pays	Région	Références bibliographiques	Communications personnelles	Références bibliographiques	Communications personnelles
Burundi	National		(Ph. Chardonnet)		
Djibouti	National	(Laurent, 2002)		(Nowell & Jackson, 1996)	
Ethiopie	Babile, Darkata Webe Shebelle		(S. Williams)		(S. Williams & C. Sillero-Zubiri)
	Borana, L. Stephanie, L. Turkana				(S. Williams & C. Sillero-Zubiri)
	Complexe d'Afar	(Cherie Enawgaw *et al*., 2001)	(Y.D. Abebe & T. Mattanovitch)		
	Gambella				(S. Williams & C. Sillero-Zubiri)
	Nord Est				(S. Williams & C. Sillero-Zubiri)
	PN d'Omo, PN de Mago				(S. Williams & C. Sillero-Zubiri)
	National		(Y.D. Abebe & T. Mattanovitch); (A.Radcliffe)		(S. Williams & C. Sillero-Zubiri)
Kenya	Est vallée de Rift à Est des Matthews, Ndotos, Mt Nyiru				(S. Williams)
	Hells Gate & Kedong		(J. Dawson)		
	Isiolo, Barsalinga, Wamba, Shaba				(S. Williams)
	Nord Tana, Est vallée Rift				(S. Williams)
	PN des Aberdares	(Rotich, 2000)	(A. Radcliffe)		(B. Heath)
	PN d'Amboseli		(D. Western); (C. Moss); (A. Radcliffe)		(C. Parker)
	PN de Masai Mara	(Ogutu & Dublin, 1998); (Mbugua, 1994 *in* Singida, 1995)		(Ogutu & Dublin, 2002)	
	PN Meru, R. Bisanadi				(L. Frank)
	PN de Nairobi	(Rudnai, 1983)	(A. Radcliffe); (J. Cavenagh)		(J. Cavanaugh & C.Packer)
	PN de Nakuru		(J. Dawson); (A. Radcliffe)		(L. Hannah & J. Dawson)
	PN de Tsavo		(D. King); (M. Smeth-Smith)		(C. Packer & B. Heath)
	Plateau Laikipia	(Franck, 2001); (Martin, 2001)			(L. Frank)
	Ranch de gibier de Galana				(B. Heath)
	Réserves de Boni et Dodori		(A. Pelizzoli)		
	Réserve Nationale de Kora				(M. Jenkins)
	National		(J. Cavenagh); (Radcliffe)		(S. Williams)
Ouganda	Comp. Chutes Murchinson		(A. Radcliffe); (R. Lamprey)		(L. Siefert & M. Dricuru)
	Complexe Queen Elizabeth	(Dricuru, 1999); (Dricuru, 2000); (Lamprey 2000); (Siefert, 2000); (Von Ordol, 1982)	(M. Woodford); (R. Lamprey); (A. Radcliffe)		(L. Siefert & M. Dricuru)
	PN de la vallée de Kidepo		(A. Radcliffe); (R. Lamprey)		(L. Siefert & M. Dricuru)
	National	*inter alia* : Din,1978; Van Orsdol, 1981, 1982); (Averbeck, 2001)	(A. Radcliffe); (R. Lamprey)		
RDC	National		(Ph. Chardonnet); (E. Bashige		
Rwanda	PN d'Akagera	(Draulans & Van Krunkelsven, 2002)			(S. Williams)
	National		(A. Radcliffe); (Ph. Chardonnet)		
Somalie	Région El Bur		(A. Radcliffe)		
	National	(Laurent, 2002); Chazée, 1987); (F. Fagotto, 1985)			
Soudan	PN de Dinder	(Ernst & Elwasila, 1985); (Mahgoub A., El Badawi & Salah A. Hakim, 1985); (IUCN, 1985)			
	National	(Kenyi, 1985); (Dennis Akwoch Obat, 1985); (El Gaily O. Ahmed *et al.* , 1985)	(M. Sommerlatte); (A. Radcliffe)		(G. Steehouwer)
Tanzanie	Cratère du Ngorongoro				(C. Packer)
	Ecosystème du Selous				(S. Creel)
	Ecosystème du Serengeti				(C. Packer)
	Manyara & Tarangire				(C. Packer)
	National	(Caro, 199)	(L. Seige); (R. Baldus); (V. Booth)		

Table 2 : complete list of sources mentioned for Southern Africa

Afrique Australe		Liste complète des sources d'information citées par :			
		Etude "Chardonnet, 2002"		Etude "Bauer & Van der Merwe, 2004"	
Pays	Région	Références bibliographiques	Communications personnelles	Références bibliographiques	Communications personnelles
Angola	National	(Silva, 1972)	(W. Van Hoven); (B. des Clers)		(W. Van Hoven)
Botswana	Complexe de Kgalagadi				(P. Funston)
	Delta de l'Okavango	(Winterbach & Winterbach, 1999)	(P. Funston & C. Winterbach)		(P. Kat,; C. Winterbach, H. Winterbach & L. Sechelle))
	Kwando & Chobe	(Neo-Mahupeleng *et al* ., 2001); (Sechele & Wintzerbach, 2001)	(P. Funston & C. Winterbach)		(C. Winterbach & L. Sechele)
	Nord		(P. Funston & C. Winterbach)		(C. Winterbach & L. Sechele)
	Nxai Pan, Makgaligadi, Kalahari	(Sechele & Winterbach, 2001)			(G. Hemson)
	Réserve du Kalahari	(Funston, 2001)	(P. Funston & C. Winterbach)		(P. Funston & DWNP)
	Tuli Block				(C. & H. Winterbach)
Lesotho	National				(J. Naude)
Malawi	National		(T. Ferrar)		
Mozambique	Manica Gaza				(J. Anderson)
	Niassa, Cabo Delgado		(H. Motta)		(J. Anderson)
	Vallée du Zambèze				(J. Anderson)
	National	(Smithers & Tello, 1976); (Michler, 1998)	(R. Taylor); (W. Van Hoven); (P. Jonquères)		(J. Anderson)
Namibie	PN d'Etosha	Stander, 2000); (Cat News 24, 1996); (Vernon, 1996)	(P. Stander); (V. Booth)		(P. Stander)
	Kaudom & Nyae Nyae	(Stander, 1997)			
	Région de Kunene	(Hanssen & Stander, 2000)			
	National	(Stander, 1997); (Stander & Hanssen, 2001); (Loveridge, Lyman & Macdonald, 2001)	(V. Booth)		(P. Stander)
RDC	National	(D'Huart, 1991)	(F. Bateshi Murotsi); (Nkulu Kalala); (B. Chardonnet)		
Sud-Afrique	Ecosystème du Kruger				(G. Mills)
	Est du Cap				(R. Slotow & G. Van Dyck)
	Ligwalagwala (Malelane)				(R. Slotow)
	Madikwe, Pilanesberg	(Van Dyck, 2001)			(G. Van Dyck)
	PN de Hluluwe-Umfolozi				(R. Slotow)
	Phinda, Lucia, Thembe, Ndumu				(R. Slotow & G. Van Dyck)
	PT de Kgalagadi				(P. Funston)
	Région du Lowveld				(Liversage, I. Sussens, T. Yule, L. van Losenoord, C. Jones, G. Thomson, R. Niermann, P. Owen, M. Pieterse)
	Région de Waterberg				(R. Slotow & G. Van Dyck)
	Venetia Limpopo Mine				(J. Kruger)
	National	(Van Schalkwyk, 1994)	(W & S. Van Hoven); (G. Kamasho, G. Van Dyk); (J. Kruger); (D. Balfour); (A. Shulto-Douglas); (F. Funston); (R. Slotow & V. Booth)		
Zambie	PN de Kafue, Vallée de Luanga & PN du Zambèze	(Ansell, 1978); (Jachmann, 2001); (Mitchell, Shenton & Uys, 1965)	(R. Jeffery & J.J. Pope)		(C. Stuart & T. Stuart)
	National	(C. & T. Stewart, 2001)	(R. Jeffery)		
Zimbabwe	Charara SA				(N. Monks)
	Chete, Sijarira SA's				(N. Monks)
	Chewore SA				(N. Monks)
	Chirisa SA		(V. Booth)		(N. Monks)
	Ecosystème de Hwange	(Wilson, 1975); (Wilson, 1997); (Jones, 1989)	(V. Booth)		(N. Monks)
	Dande SA				(N. Monks)
	Doma SA				(N. Monks)
	Gonarezhou, Save, Chiredzi, Malilangwe, Beit Bridge, Tuli	(Pole, 2000)	(N. Monks); (S. Clegg); (A.Pole); (V. Booth)		((C. Wenham)
	Hurungwe SA				(N. Monks)
	Matetsi SA		(V. Booth)		(N. Monks)
	PN de Chizarira				(N. Monks)
	PN de Mana Pools		(N. Monkl); (G. Purchase)		(N. Monks)
	PN de Matusadona		(G. Purchase); (F. Buyeye & G. Matipano); (R. Taylor)		(N. Monks)
	PN du Zambèze	(Heath, 2001)	(N. Monk); (V. Booth)		(N. Monks)
	Sapi SA				(N. Monks)
	National		(G. Purchase); (F. Buyeye & G. Matipano); (R. Taylor)		