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Abstract: 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 West and Central Africa and threats to the populations.
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 areas.

CONSERVATION OF THE LION IN WEST AFRICA AND CENTRAL AFRICA

BACKGROUND WORKING PAPER

For:

the Workshop of Conservation of the Lion of West Africa and Central Africa October 2005, Douala, CAMEROON

1ère PARTIE – STATUT AND DISTRIBUTION

Hans Bauer, Philippe Chardonnet, Kristin Nowell & William Crosmary

2ème PARTIE – MAJOR CONSERVATION ISSUES

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September 2005

*Machine translation (automatic) from French to English by Google (with some editing)

CONTENTS

ACRONYMS

ALWG	*African Lion Working Group (IUCN/SSC/Cat Specialist Group)*
ASS	Sub-Saharan Africa
CCC	Central committee of Coordination of the Regional Workshops of Conservation African lion
CSG	Group Specialists in Cat-like (*Cat Specialists Group*)
BAILED OUT	Programndtme regional PARC/ECOPAS
IGF	International foundation for Safeguard of Fauna
CAP	Control Animals with Problems
PDRN	Program Development of the Area North
PN	National park
PNHN	National park of High Niger
PNMGSF	National park of Manovo-Gounda-St Flowered
RCA	Central African Republic
RDC	Democratic republic of Congo
SIG	Geographical information system
SSC	*Species Survival Commission (IUCN)*
SUSG	*Sustainable Uses Specialist Group (IUCN)*
UICN	World union for Nature
UNDP	*United Nations Development Programs*
UNESCO	United Nations for education, science and the culture
WAP	W Arly-Pendjari
WCS	*Wildlife Society Conservation*
WWF	*World Wildlife Fund*
ZIC	Zone of Interest Hunting

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 West and Central Africa and threats to the populations.

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 areas.

The document is articulated in two parts:

- Part I : Lion Status and Distribution

  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 West and Central African lion range state. A summary of the 2004 assessment of the lion for the IUCN Red List of Threatened Species is also included.

- Part II: Influences

  Part II describes the various influences on the long-term conservation of the lion in West and Central Africa. Direct influences are the factors responsible for mortality and/or of the morbidity of the lion. These include lion-human conflict, as well as the various types of exploitation of the lion, and finally the various diseases and pathogens which affect the species. Indirect influences are those which degrade in one way or another the conditions necessary for lion conservation, including human factors, habitat loss, and prey availability.

PART I : LION STATUS AND DISTRIBUTION

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 Safeguard of Fauna (IGF), Philippe Chardonnet, 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 >.

Both publications raised considerable interest, and there were calls for a comparative presentation (Bertram, 2003). This chapter does this, underlining convergences and differences between the two.

II. METHODOLOGY

1. SOURCES USED

The 4 following tables (table 1, 2, 3, 4) present in a factual way and without comments 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 Africa Centrale, 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 also includes references to the data available, some of which are very old i.e. dating of more than 10 years, or relatively old i.e. going back to several years. Obviously, as the two studies go back to 2002, all their data are former, i.e. they are already old today a few years, of 4 or 5 years at best for most recent.

– The study of Bauer and Van Der Merwe, 2004 rests primarily on personal communications of person-resources. There is just one published bibliographic reference. The study of Chardonnet, 2002 relies on a wider range of sources, about half being equivalent to published references, and half personal communications of person-resources.

Table 1: Exhaustive list of the sources of information quoted by the two studies for West Africa

Afrique de l'Ouest		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
Bénin	Complexe de la Pendjari				(I. Di Silvestre, A. Tehou)
	Complexe du W				
	National		(Ph. Chardonnet)		(A. Tehou)
Burkina Faso	Complexe Arly-Singou	(Chardonnet *et al.* , 1999)			(P. Bouche, H. Bauer)
	Complexe du W		(Ph. Chardonnet)		
	Vallée de la Sirba		(B. Chardonnet)		
	National		(Y. Iniyé)		
Côte d'Ivoire	PN de la Comoé	(Poilecot, 1991)	(R. Gilon); (F. Lauginie); (J-M. Pavy)		(F. Fischer, H. Bauer)
	National		(H. Ressaire); (S. Diarrassouba); (D. Koffi); (S. Roux); (F. N'Golo)		
Gambie	National	(Bigourdan & Prunier, 1937)	(Ph. Chardonnet)		(H. Bauer)
Guinée	Guinée centrale	(Brugière *et al.* , 2002); (Hunter, 2001)			(A. Oulare)
	Nord de la Guinée		(S. Darroze)		(A. Oulare)
	National	(Bigourdan et Prunier,1937)			
Guinée-Bissau	Région de Doulombi-Boe		(Ph. Chardonnet); (A. Baldé)		(D. Fai)
Ghana	PN de Mole	(Wilson, 1993)	(B. Chardonnet); (Abaka Haizel)		(Ghana Wildlife Society)
	Réserve de Gbele				(Ghana Wildlife Society)
	National	(Wilson, 1993)			
Libéria	National			(Garnett & Utas, 2000)	
Mali	Région de Baoulé	(UNESCO/UNDP, 2000); (Roure, 1956); (Traoré, 1993)			
	Sud				(Moriba)
	National	(Chudeau, 1920 *in* Le Berre, 1990); (Lhote, 1951); (Bigourdan and Prunier, 1937); (Jachmann, 1991)			
Mauritanie	National	(Prévost, 1987); (Roure, 1956)		(Nowell & Jackson, 1996)	
Niger	Complexe du W	(Tiega & Price, 1995)	(O. Buttin)		(Moussa & P. Gay)
	National	(Le Berre, 1990); (Bigourdan & Prunier, 1937); (Lhote, 1951)			
Nigeria	PN de Kainji				
	PN de Kamuku		(J. Rudge); (F. Hurst)		
	PN de Yankari		(B. Chardonnet)		
	National				(P. Jenkins)
Sénégal	PN du Niokolo Koba + ZC de la Falémé				(O. Burnham, I. Diop & I. Di Silvestre)
	PN du Niokolo Koba	(Dupuy, 1971); (Dupuy, 1972)	(G. Mauvais)		
	Zone de Chasse de la Falémé		(G. Mauvais)		
	National	(Bigourdan & Prunier, 1937); Roure, 1956)			
Sierra Leone	National	(Smithers, 1983)		(Garnett & Utas, 2000)	
Togo	National			(Nowell & Jackson, 1996)	

Table 2: Exhaustive list of the sources of information quoted by the two studies for Central Africa

Afrique Centrale		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
Cameroun	Complexe Benoué, Bouban Djida, Faro	(Planton, 1997); (Planton, 1999)	(Jean Ngog Nje)		(P. Aarhaug, H. Bauer)
	PN de Waza	(Flizot, 1971)	(J. Thal); (J. Ngog Nje); (H. Planton); (F. Lamarque)		(H. Bauer)
Gabon	PN d'Odzalla		(C. Aveling)		(J. Anderson & C. Aveling)
	Plateau Batéké		(P. Rouquet)		(P. Henschl)
	National			(Nowell & Jackson, 1996)	
RCA	Complexe de Manovo-S.Floris & Complexe de Bamingui-Bangoran	(Ruggerio, 1991)	(B. Chardonnet); (Ph. Chardonnet); (J. Lobao Tello); (P. Roulet); (A. Iokem)		
	Plaine de la Gounda				
	Zones de Chasse de l'Est		(G. Doungoube); (F. Zowoy)		
	National	(Gauze, 1958)	(P. Roulet); (J.-P. Leroux, M. Tiran); (G. Doungoube); (F. Zowoy); (Ph. Chardonnet,)		(P. Scholte)
RDC	Complexe de Garamba		(B. Chardonnet & R. Kock); (Muhindo Lessi & Nilgilima)		(F. Smith & M. Languy)
	Domaines de Chasse de Bomu & Bili Uere		(B. des Clercs); (E. Bashige, pers. comm. 2002)		
	PN de Virunga				(M. Languy)
Soudan (Sud-Est)	Région du Bahr el Gazal	(Hillman, 1985); (Watson et al., 1977 in C. de Jong-Boon & S. Babiker Tabidi, 1985); (Jong-Boon & S. Babiker Tabidi, 1985)			
	National	(Hillman, 1985); (El Rayah O. Hassaballa & Mutasim B. Nimir, 1985)	(Sommerlatte)		
Tchad	Guerra & Salamat		(Ph. Chardonnet)		
	PN de Zakouma	(MEE et al., 2001); (Planton, 2000 in MEE et al., 2001)	(Djadou Moksia)		(P. Scholte)
	Sud (incl. Aouk)				(P. Scholte)
	Zones de Chasse de l'Aouk		(Ph. Chardonnet)		
	National	(Chardonnet et Lamarque, 1997); (Chai, 1996); (Smithers, 1983)	(Hoinathy Honimadji); (Ph. Chardonnet); (J. Tubiana)		

Tableau 3 : Liste exhaustive des sources d'information citées par les deux études pour l'Afrique de l'Est

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)		

Tableau 4 : Liste exhaustive des sources d'information citées par les deux études pour l'Afrique Australe

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)		

2. METHODS USED

The two publications present evaluations of the population and distribution of the lion in 2002, by including obviously former data, but of variable seniority, sometimes old when most recent were not available. The methods of study differ (i) on the one hand by the geographic coverage and (ii) on the other hand by the mode from evaluation from the populations.

2.1. Geographic coverage

The geographic coverage of the data is different between the two studies because their respective objectives were distinct: Bauer aimed for the best possible list of available census data, whereas Chardonnet aimed for the best possible estimate of total lion numbers. 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:**

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 that 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).

Lastly, the study chose approach of the "national" type while retaining as tallies of work the political borders of the countries, with the advantage of being easy to include/understand but with the disadvantage of the risk of producing a national population estimate starting from data limited to a percentage of the national range.

- **Study of Chardonnet, 2002:**

The study tried to cover the whole of the potential range of the lion. The advantage of this approach is to stick to more close with likely range of the lion, including all countries within the range, all ecosystems, and non-protected areas.

The disadvantage of this approach is that it requires difficult estimates which must be based on the opinion of tested person-resources 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" while retaining as tallies of work the méga-ecosystems, because the political borders have little ecological significance. Thus, the transborder 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. Com..) 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 skew of undervaluation 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:**

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. Chardonnet assumes a much higher precision than Bauer&Merwe, reasoning that managers on the ground which live in and regularly traverse their areas may be more accurate in their estimations 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 its study; Bauer & Van Der Merwe did not use the first two for lack of accuracy, 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: this method (" *wrestling effort* ") comprises several alternatives of effort of observation, effort of hunting, etc. It compares between them indices of meeting per unit of time, space, effort, etc. Ella was used by the Chardonnet study to cross data in West Africa and Africa Centrale.

- Deductive cartography: this method is connected with that developed by Rowan Martin to evaluate the population of leopard in its surface of distribution. It was used by the Chardonnet study for Sudan.

- Identification of the groups: it is about 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 it is

this method which the men of ground use intuitively who work in bush in a permanent or regular way. Moreover since 2004, Chardonnet(pers. Com..) test an adaptation of the method developped at the point by P. Stander in Namibia for the follow-up of the large carnivores. The operation called "notebook of bush" passes by a vast network of observers of ground which are, they or their teams, permanently located in lion areas, including administrators, managers, tourist operators, and others.

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 size of the total staff complement which constrained inevitably variations.

– East Africa: one can perhaps explain relative convergence for this area 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 Africa Centrale and Southern Africa:

– Central Africa: Bauer & Van Der Merwe evaluate a population 3 times lower than that of Chardonnet. A possible reason to explain this much lower population could be the defect 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 there too find one of its reasons in the limited number of sources. Another reason, however, is that Bauer & Van Der Merwe quote mainly sources within 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' and historical literature) than in that of Bauer & Van Der Merwe, who restricted their presentation to contemporary estimates (tables 1, 2, 3, 4).

- Method:

Bauer puts forth the assumption that the 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 the small ones.

– Interpretation:

There can be a skew in favour of a "conservative" estimate by one or the other of the evaluations, for example:

- Bauer & Van Der Merwe are more conservative than Chardonnet for Complex WAP, but less for Guinea.
- Chardonnetis more conservative than Bauer & Van Der Merwe for Nigeria but less for Chad.

2. SURFACE OF DISTRIBUTION

2.1. Presence of the lion

"The lions have a great tolerance" [1[1]] (Smithers, 1983). They can occupy a large variety of habitats, from desert to some tropical forest, with all types in between including woodland, dry forest, savanna, steppe, etc. Lions are found in the equatorial part of Africa Centrale; these lions even live in the tropical forest, or a mosaic of pieces of grassy savannas and galleries forest. The lion can move into the arid and semi-desert regions in certain parts of the Sahel in Center and West Africa.

According to Chardonnet (2002), Africa Centrale comprises more than 1/5 of the lion distribution area on the continent (22 %) and West Africa a little less than 1/20 (4 %), with the continental range estimated at approximately 3 million km². About half of the area of distribution of the lion is protected, while the other half has no official conservation status (Table 7)

Table 7 Extended and status of the surfaces of distribution of the lion in sub-Saharan Africa according to Chardonnet*and Al (* 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

* % distribution of the lion in the under-areas, the last line relating to the continent.
** except the enclosed Protected Surfaces.

2.2. Absence

- **Historical absence**

Historically the lion was distributed on the whole of the continent, from North to South. It seems nevertheless not to have ever been present in some African areas such as Equatorial Guinea, the tropical forest of the Gulf of Guinea and the basin of Congo.

- **Disappearances**

"Probably no other species than the lion did not see its distribution decreasing as much during its history" [2[2]] (Smithers, 1983).

Several countries of West Africa saw the lion recently disappearing from their territory: Gambia (Bigourdan & Prunier, 1937), Mauritania (Prévost, 1987; Berre, 1990; Roure, 1956), Sierra Leone (Smithers, 1983) and Algerian South. In Central Africa, no country definitively lost the species.

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 décisionnaires and other people.

- **Presence of the lion:**

– The 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

[1[2]] " *There is probably No other species whose distribution arranges has shrunk over historical times to the extent shown by the lion* "

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			
	Gamndtbie				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**

IV. WEST AFRICA

1. Guinea

Table 9: Comparison of the estimates of lions for Guinea

Guinea	Chardonnet, 2002				Bauer & Van Der Merwe, 2004			
Area	**min**	**is**	**max**	**method**	**min**	**is**	**max**	**method**
North of Guinea	17	21	25	C	75	150	225	5
Central Guinea	5	6	8		25	50	75	5
Total	22	27	33		100	200	300	

The figures mentioned by Bauer&Merwe are also mentioned by Chardonnet, only the latter found out that it was a three times over-estimate due to an error in methodology. Chardonnet mentions extra lion sightings in the text that are not in the tables. The estimate of Chardonnet is more careful than that of Bauer & Van Der Merwe, although it mentions in its text other observations of lions which do not appear in its tables of 2002. It may be that it is too conservative considering new work in the North-western part of the country (Prefecture of Boké), where an investigation led in 2003-2004 (Brugière *et al. in* press) demonstrated the presence of the lion from the predation on cattle and retaliatory hunting. The return of the lion in the National park of Haut Niger (PNHN), in the center of Guinea, is a remarkable phenomenon after 20 years of absence (Hunter, 2001). The lion is now well established there in the forest of Mafou in the north of the PNHN (Brugière *et al..* , 2002).

2. Guinea Bissau

Table 10: Comparaison of the estimates of lions for Guinea Bissau

Guinea Bissau	Chardonnet, 2002				Bauer & Van Der Merwe, 2004			
Area	**min**	**is**	**Max**	**method**	**min**	**is**	**max**	**method**
Area of Douloumbi-Boe	7	10	13	C	15	30	45	5
Total	7	10	13		15	30	45	

The two studies going back to 2002 agree on the presence of small population of lion in the country. But Brugiere et al's (in press) work in the southern part of the country demonstrated lion presence there.

3. Mali

Table 11 Comparison of the estimates of lions for Mali

Mali	Chardonnet, 2002				Bauer & Van Der Merwe, 2004			
Area	**min**	**is**	**max**	**method**	**min**	**is**	**max**	**method**
Area of the Loop of Baoulé	2	3	4	C				

Southern area	14	18	21	C	25	50	75	5
Total	16	21	25		25	50	75	

Mali is a country with serious lion livestock conflict, which has led to a decimation in numbers and distribution area over the past decades. The two studies diverge little. Chardonnet is more conservative than Bauer & Van Der Merwe. Bauer & Van Der Merwe present a total figure for the southern part of the country while Chardonnet distinguishes two possible core areas for the lion in Mali. Today the principal remaining subpopulation would be at the border guinéenne in the areas of Haut-Bafing and Haut-Bakoy.

4. Senegal

Table 12 Comparison of the estimates of lions for Senegal

Senegal	**Chardonnet, 2002**				**Bauer & Van Der Merwe, 2004**			
Area	**min**	**is**	**Max**	**method**	**min**	**is**	**max**	**method**
PN of Niokolo Koba	100	125	150	B				
ZIC of Falémé	25	31	37	C				
Niokolo Koba + Falémé					20	60	150	6
Total	125	156	187		20	60	150	

The two studies agreed in 2002 on a population lower than a maximum of 150 lions in the National park of Niokolo Koba (PNNK). The principal difference between the two studies is due to the surface of distribution of the lion. Chardonnet reports that the lion is quite present in the ZIC of Falémé (1,37 Million hectares) and certain sources even estimate that it is more abundant outside than within the National park of Niokolo Koba (PNNK), which is confirmed since 2002 by new information (Chardonnet, pers. Com.).

5. Benin

Table 13 Comparison of the estimates of lions for Benin

Benin	**Chardonnet, 2002**				**Bauer & Van Der Merwe, 2004**			
Area	**min**	**is**	**max**	**method**	**min**	**is**	**max**	**method**
Complex of Pendjari	198	248	297	B	39	45	52	2
Complex of W *	33	42	50	B	49	70	91	3
Complex Alibori & Three Rivers	28	35	42	B				
Other **					12	20	28	4
Total	259	325	389		100	135	171	

* The complex of W is composed of National parks and Zones of Hunting belonging to three different nations (Benin, Burkina Faso, Niger); Chardonnet gives figures for each one, whereas Bauer & Van Der Merwe give only one total (its estimate for the béninoise part of W would be of 41 lions)

** It is the sum of data of Bauer & Van Der Merwe and Al (2001) including the Forest Complex of the Mount Kouffé-Wari Maro.

It is advisable to recall that the lions of Benin North (there are no lions in the Benin South) share the same ecosystem which is also found in Burkina Faso and the South-west of Niger, the immense Complex WAP: W-Arly-Pendjari.

The two studies diverge on a certain number of points, notably:

- The most significant difference concerning the estimates of the populations of lions in Benin is that of the Complex of Pendjari. This complex was the subject of an monitoring study in 2003 and 2004 by the regional program WAP/ECOPAS (I di Silvestre) by using calling stations and questionnaires near certain tourists. Its methods were subject so some debate which encouraged the development of a new monitoring system.
-
- The lions existing outside the 2 large National parks (W and Pendjari) and of the joint Zones of Hunting were not taken into account by Bauer & Van Der Merwe. Chardonnet tried to take outside lion populations into account, notably in some of the Classified Forests peripherals. As an example, the Alibori Complex & Three Rivers which cover more than one half Million of hectares (at least on paper). These protected areas probably share their lions with the Kainji Lake National Park in neighboring Nigeria, a National Park which is also more than half a million hectares in size.

6. Burkina Faso

Table 14 Comparison of the estimates of lions for Burkina Faso

Burkina Faso	**Chardonnet, 2002**				**Bauer & Van der Merwe 2004**			
Area	**min**	**is**	**max**	**method**	**Min**	**is**	**max**	**method**
Complex of Arly-Singou	364	404	444	A	50	100	150	5
Complex W	22	27	32	B	49	70	91	3
Valley of Sirba	9	13	17	C				
Total	395	444	493		99	170	241	

* for the burkinabè part of W, Bauer & Van Der Merwe estimates population at 15 lions

It is advisable here too to recall that the lions of eastern Burkina Faso share the same ecosystem which is also found in North Benin and the South-west of Niger, the immense Complex WAP: W-Arly-Pendjari.

The two studies differ clearly for the Complex of Arly which comprises a vast mosaic of protected surfaces including Parks, Reserves and Game Zones of Hunting. The figures of Bauer & Van Der Merwe result from personal communications of two advisors who proceed by comparison with the Complex to that of Pendjari. In 2002, Chardonnet had used two types of sources: reports/ratios of aerial census of fauna and follow-ups carried out on the ground, and of the personal communications of people-resources having an intensive practice of the ground. The censuses highlighted densities of prey locally high.

The monitoring of lions, especially by the method of the identification of the groups, revealed the wide presence of the lion with heterogeneous densities, some locally high. Since 2002, the densities of preys were confirmed by new aerial censuses carried out by the programme regional WAP/ECOPAS and by the CITES MIKE Program (Bouché *and Al,* 2004), as well as terrestrial follow-ups (Bouché, 2005). In addition, always since 2002, three new sources of information come to confirm the order of magnitude of the densities of lion of 2002: a specific study by permanent total follow-up with foot on the Zone of Hunting of Konkombouri (Bouché, 2005), the exhaustive investigation led by the concession managers and hunting guides (Chardonnet, pers. Comm..), and the launching of the regional operation "notebook of bush" which sets up the method of the identification of the groups (Chardonnet, in preparation).

In the National park of W, the density of lions is, according to Chardonnet, much lower than that of Arly, which could be explained by a lower density of prey. A very small population seems to persist on the catchment area of the Mouhoun river, in the North-West of the country, close to the border Malian (Y. Iniyé, pers. comm.). The valley of Sirba is a surface not classified, and badly known, where a small subpopulation could persist (B Chardonnet, comm. pers.; Belemsobgo, pers. Com.). These populations were not taken into account by Bauer & Van Der Merwe. Some areas like those of Comoé-Leraba or Nazinga have levels of preys which could probably support populations of lions. Moreover lions are seen (in Tenkodogo in 2004) or are heard (in Nazinga in 2004) in areas from where it was thought that it had disappeared.

The Sirba valley was missed by Bauer&Merwe, but more significant is the difference in figures for the Arly-Singou complex. Bauer&Merwe's figures are based on statements by two regional informants comparing this complex with the Pendjari complex. Chardonnet, however, used unpublished information from aerial and ground surveys indicating an extremely high prey and lion density. The reliability of lion census from transects is notoriously low, but the prey figures mentioned in these reports could well sustain higher lion numbers than indicated by Bauer&Merwe, so further investigation is recommended.

7. Côte d'Ivoire

Table 15 Comparison of the estimates of lions for the Côte d'Ivoire

Côte.d'ivoire	**Chardonnet, 2002**				**Bauer & Van Der Merwe, 2004**			
Area	**min**	**is**	**max**	**method**	**min**	**is**	**max**	**method**
PN of Comoé	80	100	120	B	15	30	45	5
Total	80	100	120		15	30	45	

The two reports agree on the restricted number of lions in the National park of Comoé. In 2002, Chardonnet was a little more optimistic than Bauer & Van Der Merwe, but in 2005 Francis Lauginie (pers. Com..) estimated that the situation has worsened with the political economic situation and that lion population must

be re-examined. Incidents of poaching were reported besides (Fischer & Linsenmair, 2001).

Today the lion of Côte.d'ivoire seems to be restricted to the savannas of the North-East and the PN of Comoé. It is however interesting to note that recurring observations of lions in the North-western part of the Côte.d'ivoire, far in the West from Comoé, and not far from areas protected in Guinea.

8. Ghana

Table 16 Comparison of the estimates of lions for Ghana

Ghana	Chardonnet, 2002				Bauer & Van Der Merwe, 2004			
Area	**min**	**is**	**max**	**method**	**min**	**is**	**max**	**method**
PN of Mole	12	15	18	B	12	20	28	4
Reserve of Gbele					6	10	14	4
Total	12	15	18		18	30	42	

The data of the two studies for the National park of Mole are similar. It is significant to keep in mind that the PN of Molé is located only 80 km of the Southern border of the game ranch of Nazinga of Burkina Faso and only 80 km from Bouna, which is the base of the PN of Comoé of Côte.d'ivoire. Chardonnet did not propose an estimate for the small population of Gbele.

9. Niger

Table 17 Comparison of the estimates of lions for Niger

Niger	Chardonnet, 2002				Bauer & Van DER Merwe 2004			
Area	**min**	**is**	**max**	**method**	**min**	**is**	**max**	**method**
Complex W *	38	47	57	B	49	70	91	3
Total	38	47	57		49	70	91	

* for the native of Niger part of W, Bauer & Van Der Merwe estimates population at 15 lions

The two publications agree on the fact that there is not more that one population in Niger, and give comparable estimates overall.

There it is advisable still to recall that the lions of the South-east of Niger share the same ecosystem that their congeneric Is of Burkina faso and Benin North, inside immense Complexe WAP: W-Arly-Pendjari.

Today, one finds the lion only in the PN of W and the peripheral surfaces of the Park, mainly in the faunal Reserve Partial of Tamou. In 2002, Chardonnet is a little a more consevative than Bauer & Van Der Merwe, although it uses additional sources : (Tiega & Price, 1995) estimating the size of the population of lions in Niger at a little less than 100 individuals in the surfaces of W, Tamou and Sirba. It is interesting besides to note that in 2004 an experienced burkinabé

dealer, Abdoulaye Idani (pers. Com.), observed a lion in the area of Sirba, Niger side. In addition, the protection ensured by the program regional WAP-ECOPAS seems to lead to a rectification of the population of lions in W of Niger.

10. Nigeria (Western)

Table 18 Comparison of the estimates of lions for Nigeria

Nigeria	Chardonnet, 2002				Bauer & Van DER Merwe 2004			
Area	**min**	**is**	**max**	**method**	**min**	**is**	**max**	**method**
PN of Kainji	20	25	30	B				
PN of Kamndtuku	7	10	13	C				
PN of Yankari	40	50	60	B				
National					100	200	300	5
Total	67	85	103		100	200	300	

The two studies agree on an order of magnitude between 100 and 200 roughly. The figure of Bauer & Van Der Merwe comes from an assumption emitted in 1999. Those of Chardonnet come from personal communications. Chardonnet retains two populations in the West of Nigeria: in the National park of the Lake Kainji, and in the Complex made up of the National parks of Kamuku et Kwiambana and peripheral zones.

Chardonnet considers that the National park of Yankari belongs to a Central African subpopulation. Indeed, in terms of biodiversity, one considers that the Western bank of the Niger river belongs to the area of West Africa.

11. Togo

Bauer & Van Der Merwe do not consider Togo a lion range state. Chardonnet estimates that the lion is present there only in a transient way, but for this reason considers it within lion range. Since 2002, the year of the two studies, information was obtained on the presence of the lion to Togo. The Director of the Fauna of Togo, Mr. Abdou-Kérim Moumouni (pers. Com..) reported that very recently, in August 2005, a case of a migratory shepherd who lilled a lion having undergone losses of cattle in the area of Mandouri, with the North-East of the country.

V. CENTRAL AFRICA

1. Cameroon

Table 19 Comparison of the estimates of lions for Cameroon

Cameroon	Chardonnet, 2002	Bauer & Van Der Merwe, 2004

Area	min	is	max	method	min	is	max	method
Complex of Benoué	276	345	414	B	100	200	400	6
PN of Waza	56	70	84	B	42	60	78	3
Total	332	415	498		142	260	478	

The higher limits of the two estimates coincide, but Bauer & Van Der Merwe present larger confidence intervals. The population of Waza seems to be isolated from the population of the complex of Benoué (with three PN and several zones of hunting).

In the complex of Faro-Bénoué-Bubandjida, there is still a habitat very favorable and available for the lion. This area of approximately 3 million hectares, made up of three National parks, many zones of huntings, and vast not classified peripheral surfaces, has a great number of prey for the lion. In the National park of Bénoué, faunal censuses were carried out (Orderly, 1999): the size of the population of lions was 30 in 1997 according to Planton (1997), and 22 according to project WWF-FAC (1998), that is to say respective densities of 1,7 and 1,2 lions by 100 km².

2. Nigeria (East)

Bauer & Van Der Merwe do not detail its national estimate, which thus does not make it possible to know if it takes account of this part of the country.

Chardonnet considers that in terms of biodiversity, the eastern bank of the Niger river estuary and the eastern side of the Jos plateau are considered to belong to the region of Central Africa. The Northern sector of the PN of Gashaka-Gumti may still contain a small population of lions. A permanent population of lions lives in the National park of Yankari. Although this population is of small size, its status of conservation is relatively good (B Chardonnet, pers. comm.). It is possible that some lions still penetrate in the Game Reserve of Sambisa n the North-East of Nigeria, coming from the National park of Faro of Cameroon.

3. Central African Republic

Table 20 Comparison of the estimates of lions for the RCA

R.C.A.	Chardonnet, 2002				Bauer & Van Der Merwe, 2004			
Area	min	is	max	method	min	is	max	method
National					150	300	500	5
Plain of Gounda	53	66	79	B				
Complex of Manovo-Gounda S.Floris & Complex of Bamndtingui- Bangoran	391	489	587	B				
Zones of hunting of the East	302	431	560	C				
Total	746	986	1226		150	300	500	

The two studies differ in a significant way, perhaps because Chardonnet has much more information owing to the fact that he has worked there regularly for a long time. One can consider that the estimate suggested by Bauer & Van Der Merwe starting from only one personal communication is probably conservative, and that that of Chardonnet would deserve probably more research to be confirmed. As the estimate of Bauer & Van der Merwe is total (national), one cannot carry out comparison by site with Chardonnet.

It is certain that few sites were the subject of studies on the lion in this country:

- In the Plain of Gounda, inside the National park of Manovo-Gounda-St Floris (PNMGSF), where the local density of lions is high and probably highest of the Western and Central areas of Africa (Ruggerio, 1991; B Chardonnet, pers. comm.; PH. Chardonnet, pers. comm.). Moreover, this zone was treated separately by Chardonnet to avoid a probably unsuitable extrapolation with the remainder of the PNMGSF.
- In the Pilot Zone of Sangba (Zones of Village Hunting) and in the Zones of Hunting of Ounadja Vakaga, the ecologist Simona Savini carried out censuses of lion by the method of calling stations. S. Savini obtained in 2003 densities of lion higher than those estimated by Chardonnet in 2002.

In his study of 2002, Chardonnet supposed that the Western limit of the CRA lions was towards the Gribingui river, Western border of the Reserve of Fauna of Gribingui-Bamndtingui. But since, new information, notably from Alain Lefol, reports signs of lion in what was regarded as the interzone between two sub-populations in his 2002 study. So P. Chardonnet now suggests that two sub-populations identified as n°4 and n°5 in his stu dy now be considered a single population.

4. Democratic republic of Congo

Table 21 Comparison of the estimates of lions for the R.D.C.

R.D.C.	Chardonnet, 2002				Bauer & Van Der Merwe, 2004			
Area	**min**	**is**	**max**	**method**	**min**	**is**	**max**	**Method**
PN of Virunga	109	156	203	C	60	90	125	5
Complex of Garamba	126	180	234	C	100	150	200	5
Cd. of Bomu & Bili Uere	154	220	286	C				
Total	389	556	723		160	240	325	

The two studies are not extremely different. Bauer & Van Der Merwe did not take into account the great Fields of huntings of Bomu and Bili Uere (45 000 km²) in the North of the country, which can partly explain their lower estimate.

Given events in the north and east of this country since 2002, one speculate as the effects on the lion. Outside the PN of Garamba, one can suppose there has been a fall in both prey and lion populations (Muhindo Lessi & Nilgilima, pers.

comm.). Within the PN of Garamba, according to B Chardonnet and R. Kock (pers. comm..) who carried out captures of buffaloes in April 2002, population of lions is concentrated in the heart of the PN of Garamba, on approximately 200 km², with a size of population not exceeding 100 individuals, for a local density of 5 lions/100 km².

For Chardonnet (2002):

- The lions of the East of the country are considered part of the East Africa reigion;
- The lions of the South of the country belong to the population of Southern Africa with which they are connected.

Since 2002, P. Chardonnet (pers. Comm.) has collected new information on the presence of the lion in the immense Zone of Interest Hunting, or ZIC, which covers the whole eastern part of the country.

5. Sudan

Table 22 Comparison of the estimates of lions for Sudan

Sudan of South-east	**Chardonnet, 2002**				**Bauer & Van Der Merwe, 2004**			
Area	**min**	**is**	**max**	**method**	**min**	**is**	**max**	**method**
Area of Bahr el Gazal	255	364	473	C				
Total	255	364	473					

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 an estimate all the same, whereas Bauer & Van Der Merwe are satisfied to mention the absence of information.

The estimate of Chardonnetis primarily based on three distinct approaches:

- Bibliographical references of 1985: Jong-Boon & S. Babiker Tabidi, 1985; El Rayah O. Hassaballa & Mutasim B Nimir, 1985; Hillman, 1985; Kenyi, 1985; Dennis Akwoch Obat, 1985; Ernst & Elwasila, 1985; Mahgoub A., El Badawi & A. Hakim, 1985; El Gaily O Ahmed *et al..* , 1985; IUCN, 1987.
- Method of the deductive cartography which rests on geographical indicators such as the physical and human constraints.
- Personal communications people resources: Mr. Sommerlatte, pers. comm.; With. Radcliffe, pers. comm.

It should be noted that:

- The area located on left bank (Western) of the Nile is often regarded as pertaining to Africa Centrale;
- The area located on right bank (Eastern) of the Nile is regarded as pertaining to the area of East Africa.

6. Chad

Table 23 : Comparison of the estimates of lions for Chad

Chad	Chardonnet, 2002				Bauer & Van Der Merwe, 2004			
Area	**min**	**is**	**max**	**method**	**min**	**is**	**max**	**method**
PN of Zakouma	80	100	120	B	25	50	75	5
Southern area (incl. Aouk)					50	100	150	5
Zone of Hunting of Aouk	75	94	113	B				
Guerra & SalamndtAt	228	326	424	C				
Total	383	520	657		75	150	225	

The two studies are rather concordant on the National park of Zakouma where the lions are relatively easy to observe, in a direct or indirect way. On the other hand they diverge apart from this park, translating two differences in approach:

- Bauer & Van Der Merwe miss information: its estimate depends on only one personal communication, the same source as for the RCA; whereas Chardonnet cites several publications and personal communications;
- Chardonnet tries to take into account immense pastoral spaces where the density of lions is certainly low but not zero, and consequently a vast surface multiplied by a low density gives all the same a considerable number of lions.

The same remark that for the RCA can be made here on the gathering of the two old subpopulations n°4 and n°5 in only one subpop ulation.

In the National park of Zakouma, there has not yet been a true census of lions, but a new study has started since 2002 (Vanherle, 2004; B Chardonnet, pers. Com.). New data should thus be soon available. On the other hand, several large fauna census exercises were conducted there in recent years. All showed a positive tendency, in terms of conservation of fauna, that is to say an increase in the populations of preys of the lion, not only inside even of the Park, but also outwards with a re-colonization of new territories (MEE *et al.* ., 2001).

In the Field of Hunting of Aouk (17 Zones of Hunting), there are still lions which are connected with the RCA. In the center of Chad (Prefectures of Guera and Means-Chari), the lion is undoubtedly present, notably in vast Réserve of Fauna of Siniaka-Minia, but also outside the protected areas, in pastoral areas and apart from the Protected Surfaces, in the pastorales surfaces and the mountain chains.

Shifting now the focus to equatorial Central Africa : historically, the equatorial area of Africa Centrale had a significant population of lion, with a relatively broad area of distribution, with however an abundance higher in the Moyen-Congo than in Gabon. If the lions are represented everywhere in the area, they are not there therefore present in great number.

7. Congo

Table 24 Comparison of the estimates of lions for Congo

Congo	Chardonnet, 2002				Bauer & Van Der Merwe, 2004			
Area	**min**	**is**	**max**	**method**	**min**	**is**	**max**	**method**
PN of Odzilla	28	40	52	C	0	0	25	6
Plate of Batéké	14	20	26	C				
Total	42	60	78		0	0	25	

In the National park of Odzala and the surrounding zones, the lion is present, even if the size of its population remains dubious taking into account few information have been collected on this taxon. Bruce Davidson (pers. Com.. with P. Rouquet, pers. Com..) thought they might have heard lion roars in June 1997. Pierre Rouquet (pers. Com.) reported lion roars from Odzala in May 2005 and one track of a lion in July 2005.

8. Gabon

Table 25 Comparison of the estimates of lions for Gabon

Gabon	Chardonnet, 2002				Bauer & Van Der Merwe, 2004			
Area	**min**	**is**	**max**	**method**	**min**	**is**	**max**	**method**
National					0	0	0	6
Batéké plateau	14	20	26	C				
Total	14	20	26		0	0	0	

The lions were always present at Gabon on the Batéké Plateau, in the Province of Haut-Ogooué. P. Rouquet (pers. comm..) attended the shooting of an adult male in 1995, in the South of Lekoni and in 1996, the same person observed a lioness with two juveniles, also in the South of Lekoni. Tracks considered to be lion continue to be reported from the Batéké Plateau, but so far a WCS team has not made a direct observation yet (L. Hunter pers. Comm.)

VI GENERAL CONCLUSION

1. CONCLUSION FOR WEST AFRICA

The two publications present overall similar estimates of the numbers of lions in West Africa; it is one of the areas with the smallest differences between the two publications.

Table 26 Principal differences of the two estimates of lions for West Africa

Principal differences	Chardonnet, 2002			Bauer & Van Der Merwe, 2004		
Area	**min**	**estd**	**max**	**min**	**estd**	**max**
Benin, Complexes of Pendjari	198	248	297	39	45	52
Burkina Faso, Complex of Arly-Singou	364	404	444	50	100	150
Côte.d'ivoire, PN of Comoé	80	100	120	15	30	45
Guinea, national	22	27	33	100	200	300
Nigeria, national	67	85	103	100	200	300

- The lion distribution in the western part of West Africa is extremely significant in terms of conservation because:

– It is distant from any other large concentration of lions, probably for a long time;
– The current size of this subpopulation is low, perhaps a few hundreds of individuals only;
– It is spread out over a vast area, approximately 5 million hectares according to Chardonnet (2002);
– It is not really protected in any particular site.

- The lion distribution in the eastern part of West Africa is also significant but for different reasons, mainly because it has the best status of conservation in the area of West Africa:

– It has the largest population of the area, Chardonnet estimates the total as close to 1000 individuals;
– Threatened outside protected areas, it constitutes nevertheless a strong point for the conservation which is centered on vast Complexe WAP (the W-Arly-Pendjari ecosystem), which profits from a vast mosaic of Protected Surfaces.

- Broadly, the lion population of West Africa is of crucial importance for the conservation of the lion in Africa:

– Owing to the fact that it is isolated from the other populations, this population requires a very particular effort of conservation;
– The lion has disappeared from Gambia, Liberia, Mauritania, Sierra Leone and the south of Algeria, and is not more than a transient resident of Togo ;
– In spite of (or because of) the weakness of knowledge, the two evaluations regard it as overall not very abundant, except locally, in any case with a

population lower than 2500 individuals. This low number encouraged the Cat Specialist Group to assess the West African lion population as regionally Endangered (Bauer and Nowell 2004), according to the criteria of the IUCN Red List of Threatened Species. It should bear in mind the official IUCN Red List does not include regional assessments.

- The defect of investigations of this population imposes the need for developing methodical specific studies because current knowledge currently rests especially on first hand information resulting from managers and users of fauna;
- The distribution of the lion in the whole of the area covers a significant surface, probably more than 12 million hectares according to Chardonnet, of which approximately two thirds are officially protected (approximately 1/3 in the National parks and a third in the Zones of Hunting). However, conservation outside classified protected areas remains problematic and requires a focus on resolving human-lion conflict.

2. CONCLUSION FOR CENTRAL AFRICA

The two publications present differing population estimates for the lions of Central Africa, Chardonnet's estimate being higher. This illustrates clearly the difficulty of estimation exercises : lions especially in Central Africa are difficult to study, so much so that it remains difficult to judge which estimate is the more accurate.

Table 27 Principal differences of the two estimates of lions for Central Africa

Principal differences	**Chardonnet, 2002**			**Bauer & Van Der Merwe, 2004**		
Area	**min**	**is**	**max**	**min**	**is**	**max**
R.C.A., national	746	986	1226	150	300	500
Chad, PN of Zakouma	80	100	120	25	50	75
Southern Chad, Aouk, SalamndtAt, Guerra	303	420	537	50	100	150
Gabon, Batéké Plateau	28	40	52	0	0	0
Congo, PN of Odzalla	28	40	52	0	0	25
Sudan, South, Baar el Gazal and periphery	255	364	473	No information		

- The lion distribution in the central part of Central Africa shows remarkable characteristics:

- It is possible that it is not completely disconnected from lion populations in the region of East Africa;
- It occupies one of the first largest range areas in Africa : Chardonnet (2002) estimates it at more than 65 million hectares;

- About half of the lion's Central African range is classified as Protected Areas including approximately 15% of National parks and Reserves and more than one-third in Zones of Hunting ;
- For similar reasons in West Africa, and with few exceptions, the knowledge of these populations remains very insufficient and requires better monitoring programs to fill the gaps;
- This defect of knowledge probably explains the differences between the various evaluations; Bauer & Van Dr. Merwe estimate a population of a little less than 1000, but with a geographic area much smaller than that considered by Chardonnet. Chardonnet estimates the population between 2500 and 3000 but on a considerably larger area, including some pockets of notable densities of lion and also of vast zones with low densities of lion;
- This subpopulation has a strong potential of development if one considers the extent of the ecologically favorable habitats and slightly occupied by the human activities; but this potential is often blocked by heavy, structural and socio-economic constraints, and sometimes by difficult political economic situations.

- The lion distribution in the southern part of Central Africa, alone for the species, remains a source of interrogations:

- It is in an environment which seems unusual for the species;
- It is completely isolated from all other sub-populations, without any possibility of known contact;
- It is extremely poorly studied;
- It is very small in number and probably in a precarious situation of survival.

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, the comparison suggests that the number of lions in African 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 (half) of the lion's current African range. 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 suggests a substantial decline in lions outside protected areas over the past two decades, and supports 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)

In Sub-Saharan Africa, the lion conservation community works in the context of four regions: West, Central, East and Southern. The lion population is classified as Endangered according to the Red List criteria (EN C2ai) in the region of West Africa (Bauer and Nowell, 2004). Lion populations of eastern West Africa are believed to be isolated from lion populations of Central Africa, with little or no exchange of breeding individuals (Chardonnet, 2002; Bauer and Van Der Merwe, 2004). The number of mature individuals in West Africa is estimated by two

separate recent surveys at 850 (Bauer and Van Der Merwe, 2004) and 1,163 (Chardonnet, 2002). Both estimates are well below the Endangered criterion level of 2,500. Lions in West Africa are grouped into three isolated sub-populations by Chardonnet (2002) and approximately seven by the African Lion Working Group (Bauer and Van Der Merwe, 2004). Chardonnet's (2002) three sub-populations consist of 18 different individual populations, between which there may be some interchange of individuals, although this is unknown. There is disagreement over the size of the largest individual population in West Africa: the African Lion Working Group (Bauer and Van Der Merwe, 2004) estimates 100 lions in Burkina Faso's Arly-Singou ecosystem, while Chardonnet (2002) estimates 404 for the same area.

The techical working session (*Conservation Priority Setting for Lions in West and Central Africa)* organized by the Wildlife Conservation Society (WCS) in cooperation with the IUCN/SSC Cat Specialist Group, 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 the estimate of the number of lions remains a significant stake, it is necessary to keep in mind that very few noncaptive populations can be estimated with 100% of exactitude, smallest settings with share. And on a regional and continental scale, the inaccuracy increases. More efforts should be agreed in the future to succeed in following the tendencies of the populations of lions by means of indices of abundance, a measurement which can be simpler and more useful for the managers of the populations.

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