

**DIRECT AND INDIRECT INFLUENCES ON CONSERVATION OF THE LION IN
WEST AFRICA AND CENTRAL AFRICA**

BACKGROUND PAPER

For:

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CONTENTS

I. INDIRECT INFLUENCES

1. THE HUMAN ELEMENT
 - 1.1. Requirements of the development
 - 1.2. The sedentary risk
2. THE HABITATS FACTOR
 - 2.1. Natural factors
 - 2.2. Agricultural influence
 - 2.3. Pastoral influence
3. THE PREY FACTOR
 - 3.1. Availability in prey
 - 3.2. Pathology of the prey

II. DIRECT INFLUENCES

1. CONFLICTS
 - 1.1. Predation of the cattle
 - 1.2. Attacks on the man
 - 1.3. Predation of threatened fauna
 - 1.4. Attitudes and perceptions
2. OFFTAKE OF THE LION
 - 2.1. Offtake by the local populations
 - 2.2. Offtake by the trophy hunters
 - 2.3. Offtake by the administration
 - 2.4. International Trade
3. PATHOLOGY OF THE LION
 - 3.1. Infectious risk
 - 3.2. Toxicological risk
 - 3.3. Genetic risk

BIBLIOGRAPHICAL REFERENCES

ABBREVIATIONS

ALWG	<i>African Lion Working Group (IUCN/SSC/Cat Specialist Group)</i>
CCC of	<i>Exchange Comittee Coordination /Central Committee of Coordination Regional workshops of Conservation African lion</i>
PVC	Canine Parvovirus
CSG	<i>Cat Specialists Group)</i>
DDT	Dichloro Diphenyl Trichloroethane
BAILED OUT (Programme	<i>ECOsystemes Protected from Africa Soudano-sahélienne regional W/ECOPAS)</i>
FCFA	Francs CFA
FeLV	Feline Leukemia Virus
FIV	Viral Cat-like Immunodéficience
FPV	Cat-like Parvovirose
IGF	International foundation for Safeguard of Fauna
WHO	The World Health Organization (WHO)
CAP	<i>Animal Problem Control /Control of the Animals with Problems</i>
PDRN	Program of Development of the Area North, RCA
PHVA	<i>Population and Habitat Viability Assessment</i>
GDP	Gross domestic product
PN	National park
PNHN	National park of High Niger, Guinea
PNMGSF	National park of Manovo-Gounda-St Floris, RCA
UNDP	Program of the United Nations for development (UNDP)
PNUE	Program of the United Nations for Environment (UNEP)
RCA	Central African Republic/ <i>BUS</i>
RDC	Democratic republic of Congo/ <i>DRC</i>
SIG	Geographical information system/ <i>GIS</i>
SSA	Sub-Saharan Africa
SSC	<i>Species Survival Commission (IUCN)</i>
SUSG	<i>Sustainable Uses Specialist Group (IUCN/SSC)</i>
UICN	World union for Nature
UNDP	<i>United Nations Development Programme (UNDP)</i>
UNEP	<i>United Nations Environment Programme (PNUE)</i>
UNESCO	United Nations for Education, Science and Culture
VMC	Virus of the Disease of Square
WAP	W-Arly-Pendjari
WCS	<i>Wildlife Society Conservation</i>
WWF	<i>World Wildlife Fund (Funds World for Nature)</i>
ZIC	Zone of Interest Hunting

I. INDIRECT INFLUENCES

1. THE HUMAN ELEMENT

1.1. Requirements of the human development

Whereas the contribution of the countries developed with the world demographic growth stagnates since the years 1990, that of Africa Sub-Saharienne (SSA) does not cease increasing, indicating thus clearly one of the requirements of the development in SSA. In 1950, the human population of the SSA accounted for only 7% of the world population. In 2000, it reached 11 %, and it will probably reach the 14,5% in 2030, that is to say a total of approximately 1,2 billion individuals, almost as much as in the developed countries (Figure 1). Dependent on demography (but not strictly), the effort of development is an essential need under penalty of impoverishment.

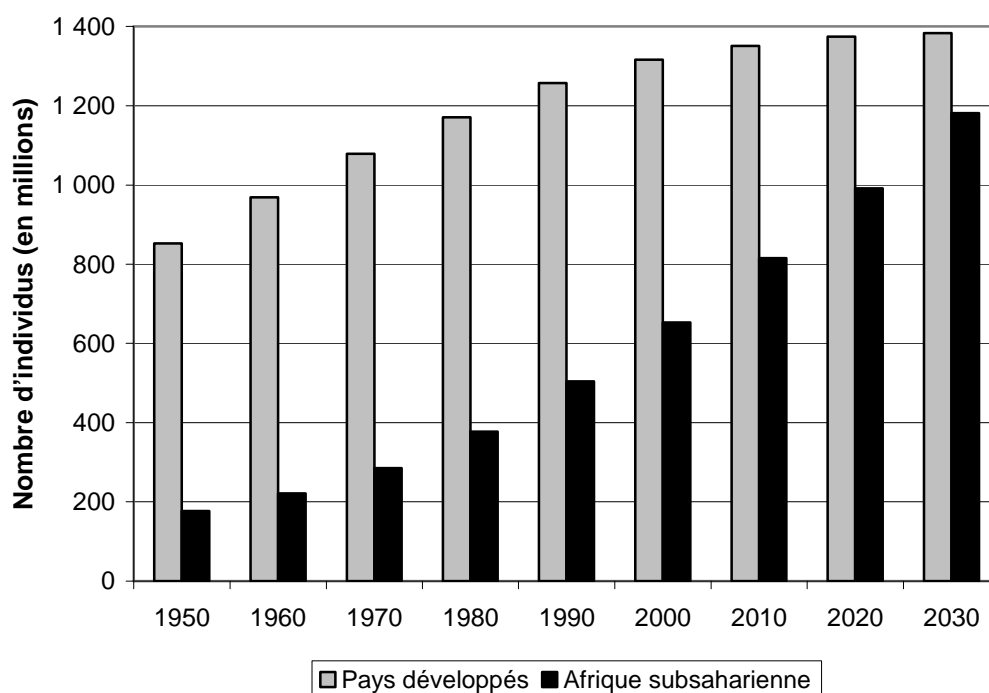


Fig. 1: Demographic growth of the human populations in Sub-Saharan Africa and in the developed countries (Source: Tacher, 2002)

Another geographic factor is that urbanization has developed very quickly in SSA: in 50 years, from 1950 to 2000, the size of the urban population was multiplied by 12, and is estimated to increase again by a factor of 2.7 from today to 2030. As for the sub-Saharan rural population, it increased by a factor of 2.7 "only" for the same period, and it is estimated to increase again by 1.6 from today to 2030 (Figure 2). It is understood that the rural population is confronted with a formidable challenge: improving their own food situation as well as that of the urban population.

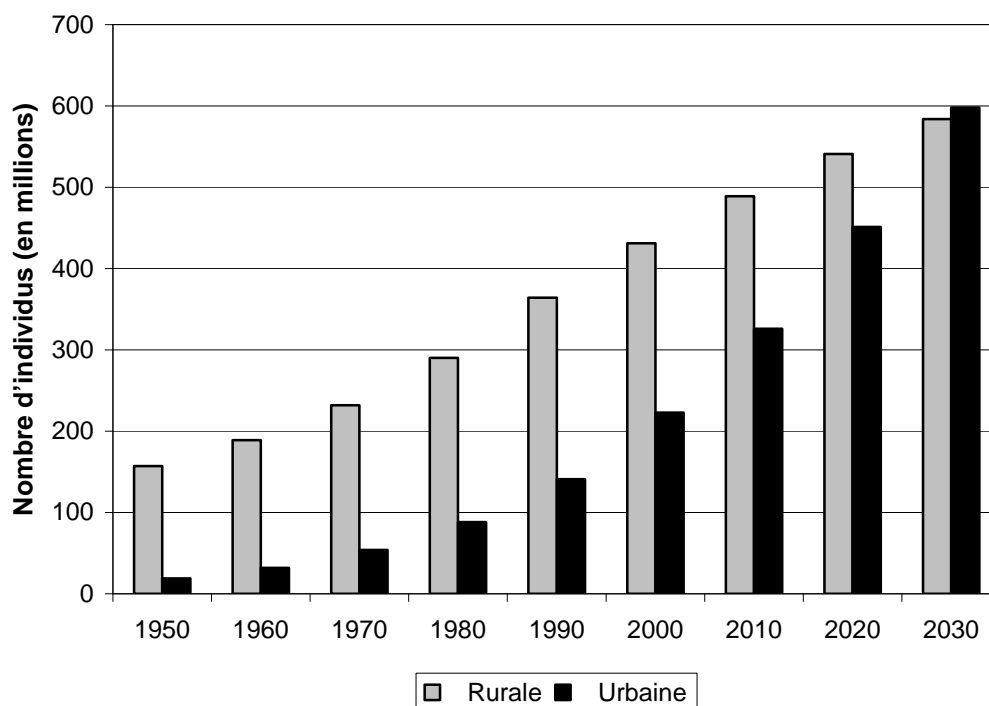


Fig. 2: Evolution of the rural and urban populations in Sub-Saharan Africa (Source: Tacher, 2002)

Since 1950, most of the increasing demand for food in the world was satisfied by the intensification of agriculture, husbandry and farming systems, rather than by the increase in the geographic area of the zones of production. Thus, in the whole of the developing countries, between 1961 and 1999, the expansion of agricultural land area counted only for 29 % in the increase in the production. But the situation is opposite in Africa Sub-Saharienne: expansion of agricultural area contributed to two thirds of productivity increase in SSA (Millenium Ecosystem Assessment, 2005). It is understood that the increase in the production in SSA cannot be assured only by improvement of the productivity (production per unit of area and unit of time) because progress does not follow the imposed rate/rhythm yet. So a continued expansion of agriculture and husbandry areas can be expected, varying in impact on habitats and biodiversity in general. Development in SSA thus inevitably involves, given the current state of things, by an accelerated transformation of natural areas, unless development undergoes a major change in strategy.

1.2. The security risk

• Political safety

In SSA, as in other parts of the world, the alternation (space and temporal) of stability and instability creates a mosaic of situations which impose new constraints - security - on the development (without set of priorities): safety of the people and the goods, safety of the structures and the services in place, food safety, environmental safety, etc.

The conflicts of all kinds, which they are local, regional, national and international were and remain still responsible for negative environmental impacts very significant.

Africa knew more than 30 wars since the years 1970 (Myers, 1996) and more than 200 and attempt coups d'etat of blows (Renner, 1999).

The impact of a conflict is multiple and depends much on its nature: the conflicts in SSA range from conflicts of strong intensity and short duration to conflicts of low intensity and long duration (Shambaugh *et al.* , 2001). The destruction of the habitats and wild fauna counts among the most widespread effects and most serious of the wars on the environment and occur for strategic, commercial reasons or of subsistence. The proliferation of the light weapons is often an after-effect of these conflicts: the light weapons - more than 500 million all over the world - are accessible in quantity and at a cheap rate in various areas from the African continent (Smith, 2003). The proliferation of the weapons coming from conflicts contributes in a considerable way to the intensification of the poaching in several countries, not only those implied directly in conflicts but also those in which these weapons end (Shambaugh *et al.* , 2001).

Even when the conflict is finished, armed groups can continue to exert devastating effects on wild fauna for some time (Austin & Bruch, 2000). Allah-Demngar & Falmata (2003) showed that certain villages in edge of the National park of Zakouma, in Chad, supply the large close cities with bushmeat, and that this trade is facilitated notably by the proliferation of firearms in the area.

Another consequence of the conflicts, massive displacements of population involve environmental consequences which are not always evaluated in all their diversity. The great concentrations of refugees and the moved people exert strong pressures on their environment (Binder & Mwinyihali, 2001 *in* FAO, 2005). Refugee camps are very often surrounded by a halo of degradation in terms of deforestation and erosion, but also of biodiversity.

Whether the cause or consequence of the conflicts, political instability impedes good governance in the environment and other fields. Administrators in charge of wild fauna are de-structured, unmotivated, and impoverished in means of all kinds.

The exhaustion of the resources and the environmental pollution can involve an area in a vicious circle of increased impoverishment, growing political instability and intensification of the environmental pollution (Shambaugh *et al.* , 2001). Environmental safety is one of the major influences on lion conservation, among the others discussed in this document.

• **Food safety**

- **The food question**

The satisfaction of the food need is one of the first requirements of the development: the number of people badly nourished in SSA passed from 100 million, at the end of the years 1960, with nearly 200 million in 1995. But the development is subjected to other constraints imposed by the fight against poverty on the widened direction of the term, health included/understood. Because, if a third of the sub-Saharan population suffers from malnutrition, the majority among it lives with less than one US dollar per day (UNEP, 2002).

The economic and social development of the populations of the sub-Saharan area, still today, is based mainly on the exploitation of the natural resources, to which belong integral fauna and of the flora savages which also take part them in food safety. However the environmental pollution and the increasing exhaustion of the natural resources of the area go from pair with the aggravation of poverty.

The phenomenon of desertification, induced by "natural" factors at the same time and anthropic, makes the challenge food even more difficult to raise. If the degradation of the cultivated grounds due to the turning into a desert continues, it is predicted that the outputs of harvests would be reduced by half in 40 years (UNEP, 2002).

In Niger for example, according to Burini & Ghisalberti (2001), the anthropic pressure in the villages in periphery of the Transborder Park of W, in West Africa, is one of the consequences of famines which followed one another in the area. People are probably attracted by the grounds not cultivated in edge and inside even of the Park, and perhaps also by the possibility of taking in the Park of what to nourish itself. In the village of Allambaré inside the Total Reserve of Tamou, a protected area where the majority of the human activities are theoretically prohibited, the traditional practices and the institutional texts are opposed. In addition, the village knows a strong demographic pressure because of many waves of immigration coming from North.

- Satisfaction of protein needs

The conservation of the lion depends on a context influenced by the dissatisfaction of the proteinic needs for the human population. In Sub-Saharan Africa, the red meat consumption decreased these 30 last years (FAO, 2004), passing from 9,8 kg/pers/yr in 1970 to 7,3 kg/pers/yr in 2000 (Tacher, 2002) whereas it increased overall in the other developing countries for the same period (Figure 3). The worsened dissatisfaction of the animal protein in SSA can explain, (i) on the one hand, the increase in population of the cattle which gains on the natural habitats (indirect effect), and (ii) on the other hand, the increased pressure exerted by the man on wild fauna like food resource (direct effect).

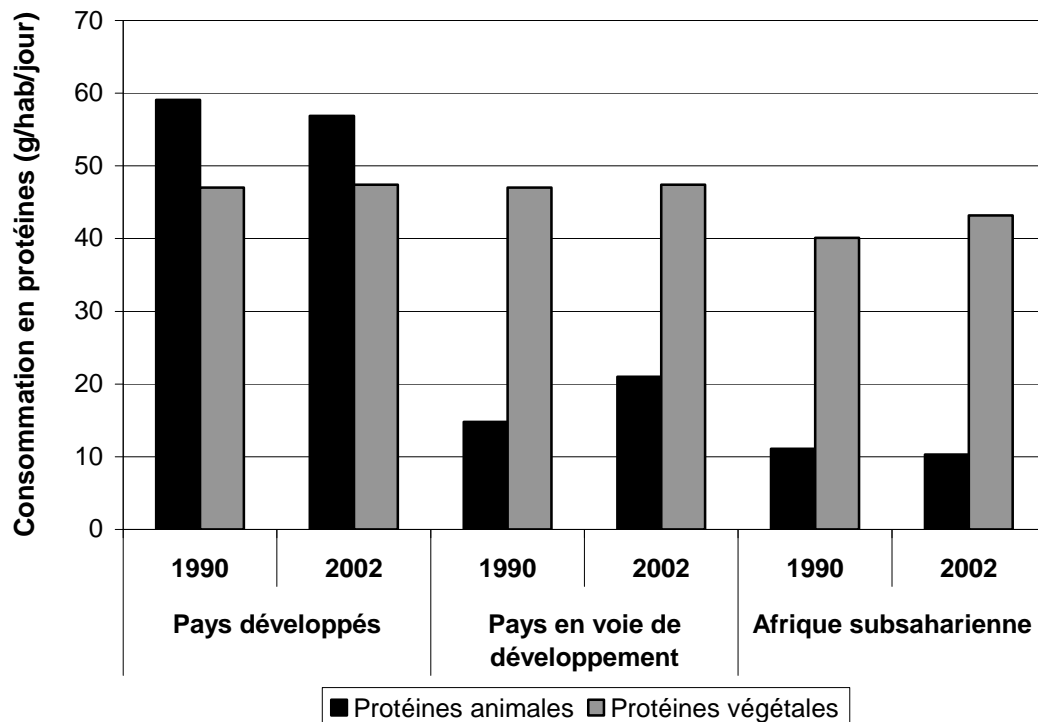


Fig. 3: Protein consumption in Sub-Saharan Africa: comparative evolution between 1990 and 2002 (Source: FAO, 2004)

One can classify the sources of animal proteins in two main unequal categories:

- domestic animal proteins: meat, the milk, eggs and fish produced by the livestock;
- wild animal proteins: products provided by the vast diversity of wild animals, including mammals, birds, reptiles, amphibians, fish and insects (note wild fish is excluded from the table 1), all grouped under the term "bushmeat".

The total production of game in Africa Sub-Saharienne is considerable since it would exceed one million tons per annum, that is to say more than 2 kg per person per year for a human population near to 600 million individuals. But bushmeat varies considerably by region (Chardonnet, Fritz, Zorzi & Féron, 1995):

- Geographical contrasts: The wild meat is consumed in the forest ecosystems than in the ecosystems of savanna, but in the latter one eats also more domestic meat (table 1). The relative proportion of bushmeat in the diet, compared with domesticated meat and with fish, ranges from 6% (Southern Africa) to 55% (Central Africa) (Chardonnet *et al.*, 2002).

- Cultural and social contrasts: Hunters-gatherers have higher levels of bushmeat consumption compared to groups of agro-hunters. In addition, wild fauna contributes for a significant share to the food of the underprivileged social layers in rural medium, on the other hand in certain cities the game meat is more expensive than domesticated meat.

- Temporal contrasts: Fallow or dry periods between two farming seasons, and years of food shortages and Famines encourages poor populations to resort to the wild resources and fauna. These populations are found sometimes in the need for

overexploiting the faunal resource with the risk of endangering its capacity to regenerate. The extremely random character of the African intertropical climate, especially in the Sahel zone, contributes largely to the food insecurity. The many rural populations which live of subsistence farming undergo these climatic risks, which have a role determining in the food choices, notably in respect to the wild prey of the lion.

Table 1: "Bushmeat" and "domestic meat": relative importance in Sub-Saharan Africa in 1994 (Source: Chardonnet *et al.* , 1995b)

Ecological area	Population human (Million inhabitants)	Production of bushmeat		Production of all meats	
		Total (ton)	Average (kg/pers/yr)	Total (ton)	Average (kg/pers/yr)
Savanna	344	405 421	1,2	4 857 133	15,2
Savanna/Forest	163	533 763	3,3	1 571 732	9,7
Forest	54	287 225	5,3	418 527	7,8
Islands	16	3 846	0,2	378 029	22,7
Total	577	1 230 255	2,1	7 225 422	12,5

2. THE FACTOR HABITATS

2.1. Natural factors

With an area of approximately 30 million km², Africa is the second-largest continent on the planet, and SSA represents approximately the three quarters of this continent. This great ground extent is being gradually transformed under the complex influence of various factors which can be simply classified (i) in factors of nonhuman origin or "natural" & (ii) into factors of human origin.

One can think that the principal factors responsible for the reduction in the habitat of the lion are probably of anthropic origins. However, there are other causes, nonhuman, which have a significant impact on the habitat of the lion, mainly desertification. Africa is the continent most seriously affected by this phenomenon, with more than 33% of its area threatened, particularly in the Sahel zone.

Desertification contributes to the exclusion of the lion from the northern latitudes of its SSA range. Not much time has passed since the lion was present in Adrar of Ifhoras at Mali, in Aïr Ténéré in Niger, in Ennedi in Chad and in other Saharan areas (Lhote, 1951). Desertification acts on the lion in several ways: (i) the reduction of the prey, (ii) the reduction of water availability, and (iii) increase of its vulnerability (Eloff, 1980), even if the lion remains well adapted to the semi-arid climate (of Waal *et al.* , 2001).

In zone soudanienne also, the phenomenon of desertification can have a negative influence on the lion. Among the prey of the lion, the Reduncinae *antelopes* , more especially the cobe of Buffon (*Kobus kob*) and the cobe defassa (*Kobus*

ellipsiprimnus), probably underwent a retraction towards the south of their area of distribution, notably because of habitat change (desertification), but also because of the movement of the human populations of the Sahel towards the South in search of arable lands and pastures (indirect effect) (Chardonnet B & pH Chardonnet, 2004).

2.2. Agricultural influence

The human expansion is probably the most influential factor on the conservation lion in Sub-Saharan Africa. The range maps of the various subpopulations of lion in Center and West Africa tend to show a negative correlation between, on the one hand, the density and the number of lions, and on the other hand, the presence of the man and his various activities (Chardonnet *et al.* , 2002).

The agricultural influence on the habitats of the lion finds its explanation in the paramount importance that agriculture has for Africa, rural and urban: it provides approximately 40% of the GDP of SSA and employs more than 60% of the labour of the area.

In 2005, FAO estimates 5,5 Million hectares as the area of forest cover which was transformed into arable lands or was exploited during the decade 1990-2000, which represents an annual rate of loss twice higher than that of South America (FAO, 2005). In 1990, *World Resources Institute* estimated that 80% of the natural habitats of origin had disappeared in Burkina Faso, 79% in Côte.d'ivoire and 45,3% in Central African Republic (WRI, 1990).

On the whole of planet, the total area of the cultivated grounds was multiplied by 1,1 during 30 last years (1970-2000). But this pressure exerted on the natural habitats is considerably different in different parts of the world. The total area of the cultivated grounds increased by 21,5 % in the developing countries, whereas it remained overall the same one in the developed countries, even decreased in certain European countries. In SSA, the total area of the cultivated grounds increased by a factor of 1,25; much more than the world average (Figure 4). Cultivated ground increased by 0.65% per annum in SSA while it decreased in the developed countries (between 1970 and 2000). Still, on a per person basis, In 2000, each inhabitant of the SSA has on average 0,27 hectares of arable lands, whereas an inhabitant of the developed countries has 0,49 hectares of them (Tacher, 2002).

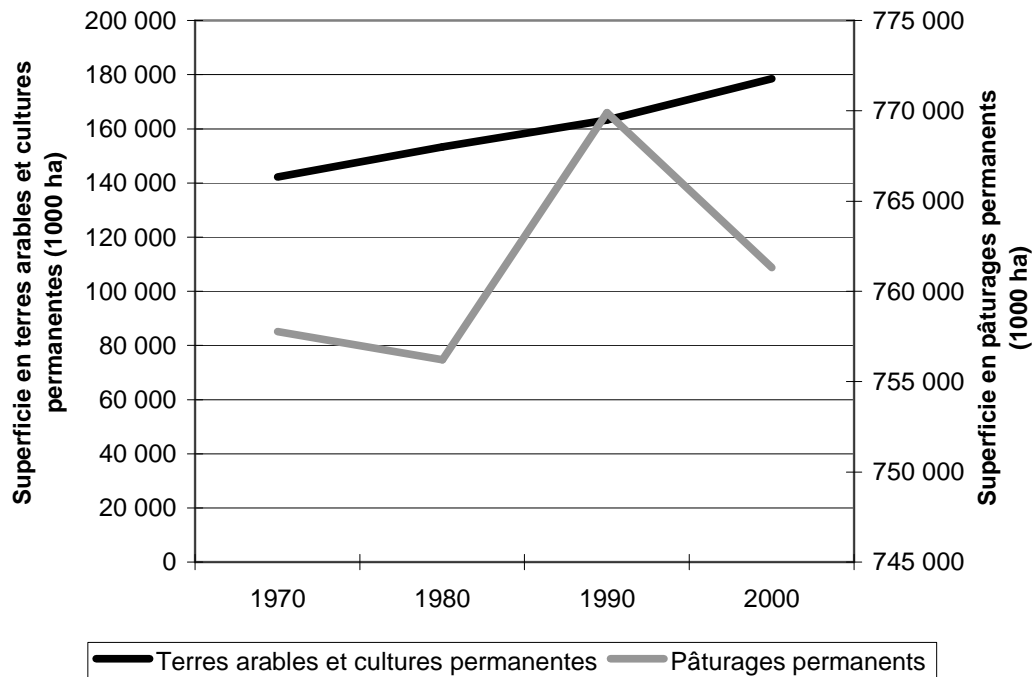


Fig. 4: Evolution of the use of the grounds in Sub-Saharan Africa
(Source: Tacher, 2002)

In West Africa and Central Africa, the area of distribution of the lion is singularly convergent with that of the cotton zone. However, cotton is one of the cultures which knew the strongest recent expansion in SSA, particularly in West Africa (Figure 5). In several areas of the world, and especially in several countries of Africa, cotton represents a paramount source of incomes for the States and a major tool for development for the rural world. The environmental assessment of cotton is difficult to establish because of the intimate interactions between development and conservation. At all events, the conclusions of such an assessment cannot be translated into terms of alternative because cotton is today a reality impossible to circumvent which it is necessary to take into account and whose conservation must be made an ally. President Centrafricain stated into 2005 that " *cotton made [however] live one the third of the population [of RCA]*" (the World, 16/09/2005).

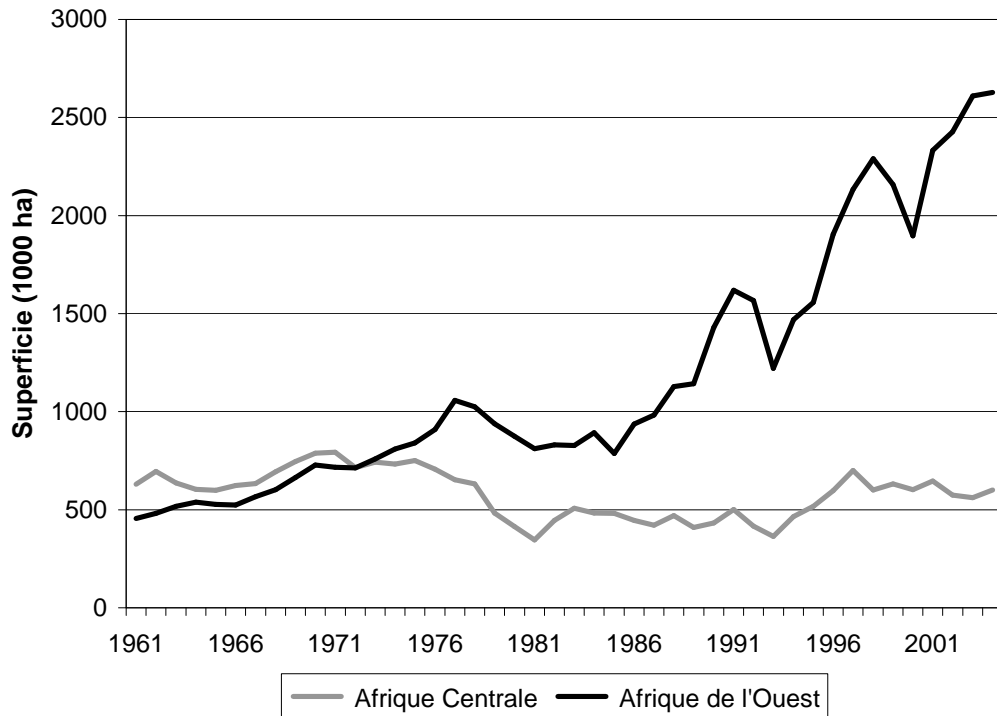


Fig. 5: Cotton in Central Africa and West Africa: increase in area of the cotton culture (Source: FAO, 2004)

In certain countries like Mali, Benin or Burkina Faso, the production of cotton knows a considerable progression compared to the other cultures (Figure 6). In Burkina Faso and Benin, certain villages which border the Transborder Park of W develop around the production of the cotton, which provides the incomes upon which the wellbeing on the villagers and the construction of the village infrastructures depend. Introduced at the end of the 1960s, the culture of cotton became the remunerative activity, and it is even the only culture for which the peasants are given financial appropriations from the agricultural banks (Burini & Ghisalberti, 2001). But this practice has also harmful consequences for the biodiversity, notably:

- the "race with space" for the expansion of the cotton-growing areas: it largely depends on natural spaces, notably on access to West African savanna protected areas,
- considerable increase in the use of the plant pesticides and fertilizers (§II.3.2.),
- the competition with the stockbreeders who have pasture less and less per capita of cattle (Figure 8), and which is thus pushed to penetrate inside the Parks,
- for example: the reduction of the wild natural habitats around the Transborder Park of W.

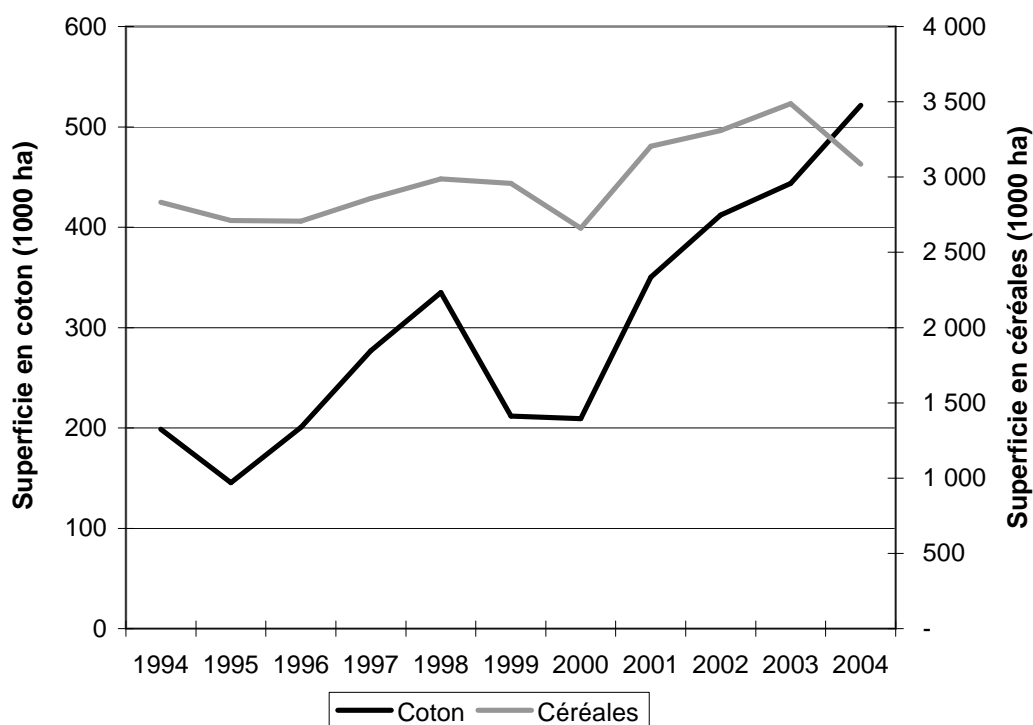


Fig. 6: Cotton and cereals in Burkina Faso: comparative evolution of cultivated areas (Source: Direction of the Agricultural Statistics, 2005)

The disappearance of the natural habitats in periphery of the Protected Areas affects their capacity potentially to preserve the biodiversity. Clerici *et al.* (2005) currently study the transformation of natural savanna in the peripheral areas of the vast Complex W-Arly-Pendjari (WAP) to which belonged the abovementioned Transborder Park of W. Within a zone 30 km wide around the perimeter of the protected areas, more than 14,5% of savanna was lost between 1984 and 2002, revealing a fast process of transformation of the landscape (3,514.4 km²). According to Clerici *et al.* (2005), the complex lost 2% of its capacity to preserve the specific richness between 1984 and 2002, and should lose 15% more of this capacity if the natural habitats in periphery of the complex completely disappear..

The peripheral areas of the Benin part of Complex WAP are significant for the long-term conservation of the lion. It is where the rate of disappearance of the indigenous vegetation has increased the most, that is to say 17,3% of their area of 1984, which corresponds to a loss of 1 764 km². Losses around the other country's parts are also high: Burkina Faso (13,1%), Niger (11,2%) and Togo (5,2%). All in all, this progressive transformation of the natural habitats of savanna into periphery of the Complex is before a a whole consequence of the strong expansion of the agricultural activities: 15,8% of the landscape in 1984 and 26,9% in 2002. It is with Benin that the agricultural expansion is most significant: 15,1% of the peripheral areas were converted into arable lands between 1984 and 2002, against 9,1% in Burkina Faso, and 7,5% in Niger

The rate of loss of natural habitat inside complex WAP is much lower than in periphery: broadly, 82,5 km² of natural savanna were lost between 1984 and 2002, are 0,3% of the whole of the complex. The "hot spots" for habitat conservation are

located in the enclaves of the Reserves Partial of Pama (*Tintagou*) and of Arly (*Madjoari*), and to a lesser extent in the Total Reserve of Tamou and in the Southern part of the Zone Hunting of Pendjari. The National parks of Arly (Burkina Faso) and Pendjari (Benin) do not seem to have undergone a significant loss of habitats, but in the béninoise part of the Park W, there is a strong pressure along the southern edge.

In addition to cotton, berbéré (a variety of sorghum) is also a culture which exerts an increasingly significant pressure around certain Protected Areas, like the National park of Zakouma, in Chad, which shelters a significant population of lions in the dry season. In an area traditionally dedicated to the breeding more than with agriculture (Tubiana, pers. comm.), agricultural areas, in particular of berbéré, knew a significant expansion. Practically non-existent formerly, it currently accounts for 97% of the cultures in periphery of the park, which they same account for 5% of the areas peripheral within a 30 km wide boundary (Edderai & Arranz, COM. pers.. 2005).

In fact, in this area, berbéré became the principal culture since the suspension of cotton in 1979. To meet the food and financial needs for the local populations, the culture of berbéré was largely spread, and encroaches today gradually on the natural habitats, tending even to gradually encircle the National park of Zakouma. Certain woody formations are more and more cleared each year to make place with the cultures of berbéré. In the Kacha-kacha village, in edge of the Park, 97% of the villagers practise before all the culture of berbéré, the culture which covers the largest areas and which produces the strongest outputs, according to the investigation of Allah-Demngar & Falmata (2003). The same investigation shows that as to have large fields of berbéré and to produce good harvests establishes the villager in a respected and coveted social position, and it is also for him a sign of bravery and masculinity. Crops of berbéré is regarded at the same time a capital and as an invaluable heritage.

2.3. Pastorale influence

The pastoral influence on the habitats of the lion results from several factors and initially from the strong and continuous increase in the domestic livestock in Africa Sub-Saharienne (Figure 7). This tendency in SSA is found besides in the whole of the developing countries, whereas the tendency is opposite in the developed countries.

The SSA has today the greatest number of small ruminants (sheep, goats and dromedaries) among all the countries in the process of development (in particular, twice more goats). It also has, after the Latin America, the greatest number of bovines per capita. SSA currently counts nearly 450 Million small ruminants and approximately 200 Million bovines.

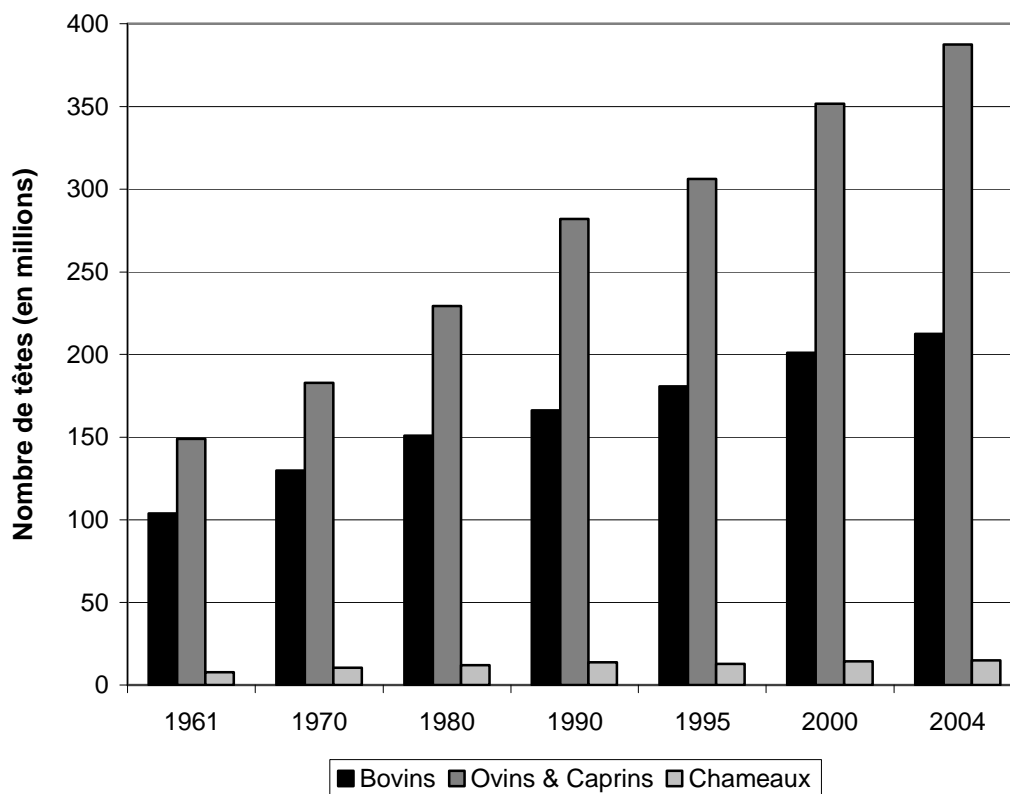


Fig. 7: Evolution of population of cattle domesticates in Africa Sub-Saharan (Source: FAO, 2004)

The influence of cattle husbandry on the habitats of the lion also results in the expansion of the grazing area (zones grazed by the cattle). The total area of the grazing area increased by 0,46% per annum in SSA between 1970 and 2000 (Tacher, 2002). It should be noted that in same time, it remained stable in the majority of the areas of the world.

There is an apparent discrepancy between the strong growth of the cattle population and the more moderate growth of grazing lands. One can suppose that makes the expansion of the breeding of it is carried by the arable lands (agricultural by-products and fallow of less than 5 years) that by a real increase in the area of the pastures (Tacher, 2002). However, the grazing areas recorded as such ("official") generally do not take counts of the vast Protected Areas which are used seasonally by the stockholders. This discrepancy emphasizes (i) on the one hand, the requirement for livestock grazing land is always growing, and (ii) on the other hand, the pastoral pressure exerted on the Protected Areas is often considered by the stockholders "free" or "unutilised".

On the other hand, during 25 last years, because of the strong human demographic growth, the area of grazing land per capita decreased, especially in SSA where it passed from 2 650 ha/hab. in 1970 to 1 166 ha/hab. in 2000, thus revealing the deep economic and environmental modifications which the husbandry sector undergoes today (Figure 8). Concerning the conservation of the lion, this indicator shows how important it is for the cattle herder to obtain new pastures for his cattle. **The cohabitation of the stockbreeder with the lion is thus far from being reduced to**

the question of the predation cattle; rather, it comprises before a whole spectrum of stakeholder problems with the sanctuarized Protected Areas excluding any human activity.

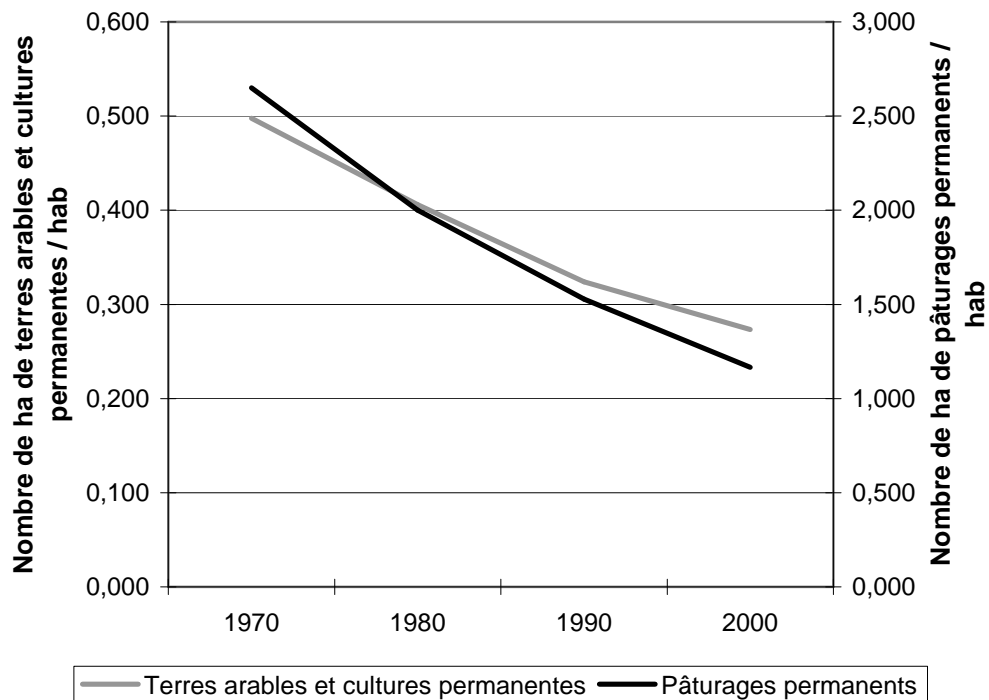


Fig. 8: Areas per capita of cultivated grounds and permanent pastures: evolution in hectares per capita (Source: Tacher, 2002)

3. THE PREY FACTOR

3.1. Prey Availability

Most research on available prey biomass is from East and Southern Africa, but this subject remains still very little studied in West and Central Africa. The availability in prey in its various aspects (diversity, abundance, distribution, accessibility, size of the prey, etc.) is known for its direct effect on the density of lions (Schaller, 1972; Dunhamndt, 1998; Dublin & Ogutu, 1998; Stander, 1997; many other authors).

In Central and West Africa, the availability in prey is very heterogeneous. It is often described in a manner “catastrophic” and one will further see than indeed the status of conservation of wild fauna appears problematic in many situations.

Nevertheless, there are situations opposite where wild fauna, in particular large fauna, is in stable situation or even in increase. In West and Central Africa, one observes at least two categories of situations which are in this case of favorable to the conservation of the lion, certain large National parks and certain great sets of Zones of Hunting:

- **Large National parks**

Today in Center and West Africa, the status of conservation of certain large National parks is rectified notably. They shelter populations of lions and this positive evolution lets predict prospects favorable for the conservation for the lion. It is notably the case of the National parks lies which profit from a significant and constant support brought by programs of regional co-operation, notably:

- the program transborder ECOPAS with Benin, Burkina Faso, Niger and Togo;
- the program regional ECOFAC in its component ZCV in RCA;
- the program Zakouma in Chad;
- the program regional AGIR in Guinea, Guinea-Bissau, Mali and Senegal.

In all these situations, the censuses of the large fauna give a report on substantial increases in the species prey of the lion these last years (Figures 9 & 10).

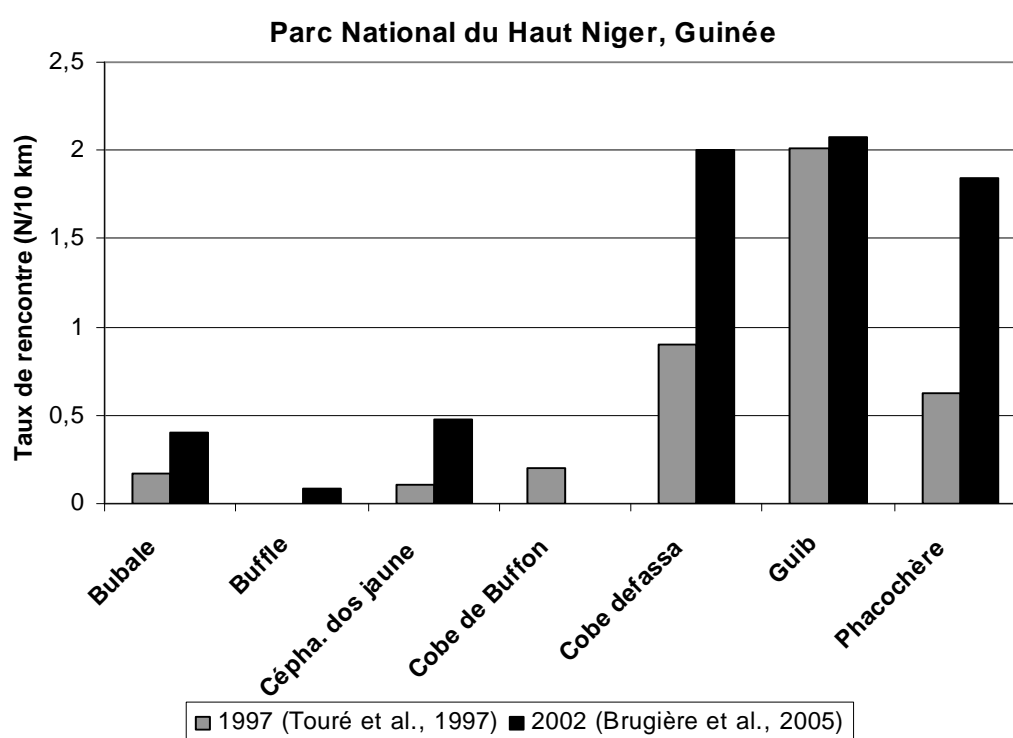


Fig. 9: Increase in the large fauna in the PN of High Niger, Guinea, between 1997 and 2005 (Sources: Touré *et al.* , 1997; Brugière *et al.* , 2005)

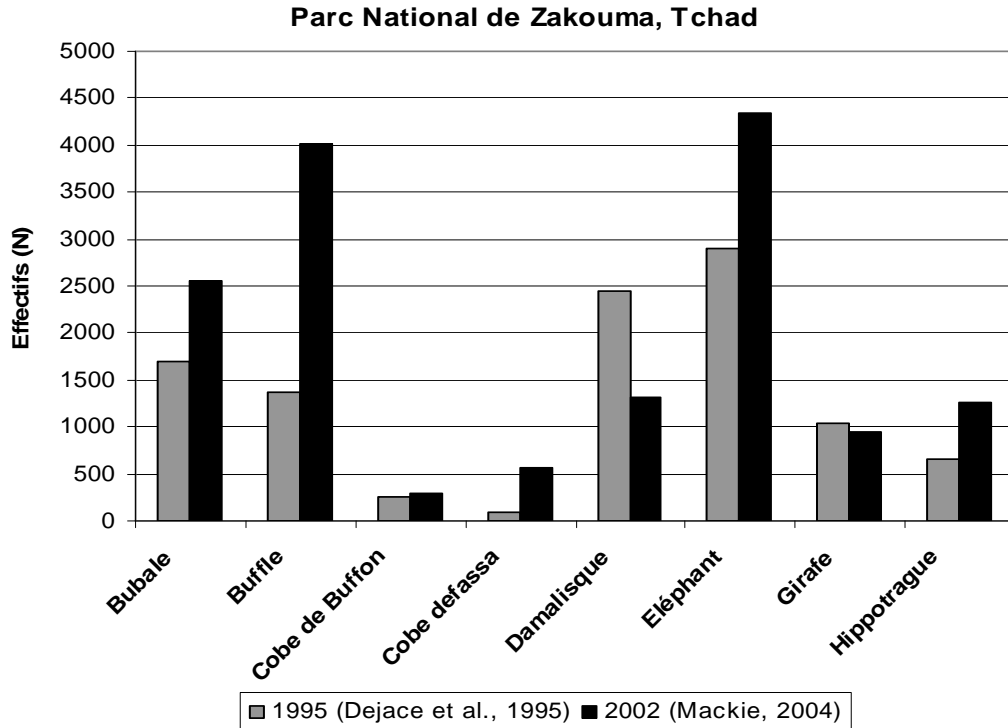


Fig. 10: Increase in the large fauna in the PN of Zakouma, Chad, between 1995 and 2004 (Sources: Dejace *et al.* , 1995; Mackie, 2004)

Great sets of Zones of Hunting

Today, vast sets of Zones of Hunting (or concessions) constitute major refuges for the lion. They are protected areas which are managed by private operators under control of the State, sometimes over long periods. These sets are immense, covering areas of several Million hectares, often even higher than those of the National parks (table 2): in SSA, the various Zones of Hunting (*Hunting Blocks*, *Game Areas Management* and others in anglophone Africa, *Coutadas* in Africa lusophone, *Domaines de Chasse* in the Belgian ex-colonies, etc), cover:

- more than 130 Million hectares on the continent,
- what represents 5,4 % of the area of the SSA, that is to say a little less than the National parks and Reserves which represent 6,7 %,
- if one sticks strictly to the countries which have Zones of Hunting, the area of these Zones of Hunting covers 9,8 % of the total area of these countries, that is to say more than that of the Parks and Réserves.

In Central and West Africa, one can quote mainly the 3 greater sets of Zones of Hunting, concerning the zone of savanna only, west to east :

1. the whole of Zones of Hunting of Complex WAP (Benin, Burkina Faso, Niger, Togo);
2. the whole of Zones of Hunting of North Cameroon;
3. the whole of Zones of Hunting of North RCA.

In Central and West Africa, the Zones of Hunting are always closely connected to the National parks with which they form true "méga-ecosystems". For the National parks, the Zones of Hunting play the ecological roles:

- **buffer zones**: the Zones of Hunting are the first grounds exposed to the agricultural and pastoral influences since they are in periphery of the National parks,
- **ecological corridors** : the Zones of Hunting ensure the maintenance of natural habitats supporting fauna between the National parks, without however constituting obstacles sanctuarized against the activities of development.

The conservation of the lion profits from the Zones of Hunting by their various functions:

- **zones of protection** of the natural habitats and wild fauna, often even with population and/or densities superior to that found in the adjacent National parks;
- **zones of not-exclusion** where certain human activities are authorized for the local communities, in contrast to National parks which are strictly exclusive;
- **zones under private management**, in which the civil company deals with its share of responsibility in management for protected area, and contributes to relieve the State of the heavy responsibility to manage the National parks;
- **zones of economy** where hunting tourism generates incomes, employment and meat involving with several sectors: State, private sector, local communities, etc.

• **The return of the lion**

There are situations in West Africa where the lion carries out a spontaneous return, i.e. without reintroduction by the man. One can quote at least two of them: the National park of Haut-Niger in Guinea and the Zone of Hunting of Comé-Leraba of Burkina Faso.

In addition, there are other situations where the conditions are ripe for a spontaneous return of the lion, notably the Game Ranch of Nazinga and the National park of Kaboré Tambi in Burkina Faso.

Table 2: Areas of the National parks, Reserves and Zones of Hunting in Sub-Saharan Africa (Roulet, 2004)

Country	Area of the country (km ²)	National parks & Natural reserves		Zones of Hunting	
		km ²	% of the country	km ²	% of the country
Angola	1 246 700	82 300	6.6	-	-
Benin	112 620	8 435	7.5	4 000	3.6
Botswana	600 370	103 953	17.3	121 000	20.2
Burkina Faso	274 200	31 937	11.6	21 500	7.8
Burundi	27 830	871	3.1	-	-
Cameroon	475 440	30 500	6.4	43 860	9.2
CRA	622 980	68 918	11.1	196 035	31.5
Chad	1 284 000	116 890	9.1	34 320	2.7
Congo	342 100	11 773	3.4	-	-
Côte.d'ivoire	342 460	21 038	6.1	-	-
Djibouti	23 000	30	0.1	-	-
D.R. Congo	2 345 410	124 700	5.3	90 362	3.9
Equatorial Guinea	28 050	3 860	13.8	-	-
Ethiopia	1 221 000	32 403	2.7	60 000	4.9
Gabon	267 670	27 150	10.1	-	-
Gambia	11 300	230	2.0	600	5.3
Ghana	238 500	13 489	5.7	1 137	0.5
Guinea	28 051	1 650	5.9	-	-
Guinea-Bissau	36 125	3 780	10.5	8 000	22.1
Kenya	582 650	44 855	7.7	-	-
Lesotho	30 350	68	0.2	-	-
Liberia	111 370	1 450	1.3	-	-
Madagascar	594 180	17 745	3.0	-	-
Malawi	118 480	12 622	10.7	-	-
Mali	1 240 000	44 853	3.6	-	-
Mauritania	1 030 700	17 500	1.7	6 000	0.6
Mozambique	783 080	36 500	4.7	56 750	7.2
Namibia	824 290	107 125	13.0	72 725	8.8
Niger	1 267 000	84 130	6.6	9 169	0.7
Nigeria	923 770	34 218	3.7	-	-
Rwanda	26 340	2 650	10.1	-	-
Senegal	196 200	21 800	11.1	24 344	12.4
Sierra Leone	71 740	2 338	3.3	-	-
Somalia	637 660	3 444	0.5	-	-
South Africa	1 221 037	56 500	4.6	160 000	13.1
Sudan	2 505 810	95 870	3.8	-	-
Swaziland	17 366	50	0.3	46	0.3
Tanzania	945 090	134 881	14.3	185 750	19.7
Togo	56 600	6 500	11.5	-	-
Uganda	236 040	17 968	7.6	-	-
Zambia	752 610	59 451	7.9	160 488	21.3
Zimbabwe	390 580	49 418	12.7	40 000	10.2
Total area (km²)	24 090 749	1 535 843	6,7 %	1 296 086	9,8 % (country with Zones of Hunting)

					5,4 % (all countries)
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• Competition for prey between the man and the lion

The use of the prey of the lion by the man is due initially to the satisfaction of the proteinic need and, as one saw with section § 1.1.2. (Food Safety), the food function of wild fauna is very significant for certain human groups. So it comes to be that man and lion compete directly for the same thing : consumption of wild prey for food.

In Central and West Africa, the share of the game meat in the human consumption is very high for certain countries, being able to reach 40% of the total proteinic contribution (Tables 3 and 4). Such a level of contribution should not be perceived in a simplistic way as an obstacle to the conservation of the lion because the substitution of the wild meat by the domestic meat inevitably implies an increased transformation of natural habitats into agricultural zones for:

- to create new pastures necessary to the ruminants domestic, bovine, ovine, caprine;
- to put in culture new spaces to produce the manioc and corn essential to the breeding of pig and poultries.

These perverse effects must be taken into account before launching out in a policy of change of diets, without neglecting either the cultural and social factors which are impossible to circumvent.

Table 3: Respective contributions of the meats "wild and domestic" in 3 countries of West Africa and Central Africa (Source: Chardonnet *et al.* , 1999ä)

Country	Domestic meat consumption (kg/hab/an)	Wild meat consumption	
		Kg/hab/an	% of the total meat
Burkina Faso	9,2	3,7	28,7
Côte.d'Ivoire	11,8	7,4	38,5
RCA	16,9	11,6	40,7

In Chad, in the village of Kacha-Kacha located in periphery of the National park of Zakouma, 35% of the consumed meat are bushmeat. The meat of hunting is intended for 42% for subsistence of the hunter's family, 41% for sale, and 17% for gifts, legacy, etc. In addition to the food contribution that hunting represents, this activity confers on the hunter a significant social consideration (Allah-Demngar & Falmata, 2003).

In the Park of W, the poaching is practised notably by professionals external to the area, who are armed with G3s or Kalachnikovs. The commercial poaching thus represents a significant threat. In contrast is traditional bow-hunting, which is not very effective and less and less practised, but which constitutes a significant sociocultural inheritance (Galhano Alves & Harouna, 2005).

Table 4: Some levels of bushmeat consumption in 5 countries of Central Africa (Source: Chardonnet *et al.* , 2002)

COUNTRY	SITE CONCERNS	GAME CONSUMPTION (kg/pers./an *)	SOURCE
Central African Republic	RCA	11,6	Chardonnet <i>and Al</i> , 1995
	Bangui	14,6	Dieval, 200
	Urban zones	11,05	Bui Quang Minh, 1977
	Rural zones	14,4	Bui Quang Minh, 1977
	Cities (except Bangui)	11,58	Docky, 1987
	Kaga Bandoro	15,2	Redjehoya, 1988
	Moussapoula (Babenjele)	18,25	Noss, 1995
	Kanaré, forest of Ngotto	85,25	Dethier & Guirghi, 200
Cameroon	South (Mvae, Bakola, Yassa)	[7,3 - 73]	Kopper <i>et al.</i> , 1990
	Reserve of Campo	69,35	Dounias <i>et al.</i> , 1995
Congo Brazzaville	UFA of Pokola	[58,4 - 105,5]	Auzel, 1996
	Park of Odzala	[29,2 - 73]	Delvingt, 1997
Congo RDC	Ituri, hunters-gatherers	58,4	Bailey & Peacock, 1988
	Ituri, farmers	43,8	Aunger, 1992
Gabon	Gabon	17,2	Chardonnet & Bonnet, 1996
	Ogoué-Ivindo	[36,5 - 62]	Lahm, 1996

Another forms of competition for the prey between the man and the lion include that, in certain cases, including in West Africa, certain dealers of Zones of Hunting and guides of hunting complain about the significant offtake carried out by large predators on the antelopes significant for hunting, especially when the predatory species is not driven out at all, as it is the case for the leopard in West Africa (Mr. Bardet, pers. Com.) or when it is subjected to a very restricted quota, as it is the case of the lion (F Kaboré, pers. Com.).

3.3. Pathology of the prey

The fragmentation of the natural habitats, caused notably by the human influence on space in general, is accompanied by an increasingly greater overlap between the zone of influence of the man and the area of distribution of wild fauna. In this way, the interface does not cease increasing between the lion and the human activities. The promiscuity which results from it spurs the conflicts between man and lion (cf § II.1.), but it exacerbates also the disease intercatations between domestic and wild animals. It follows from there a direct effect on the lion itself (cf § II.3.1.) but also an indirect effect on the animal species which constitute the prey of the lion.

One can distinguish two types of mechanisms by which the diseases of the prey (wild or domestic) of the lion can have an impact on the lion:

- **Diseases transmitted to the lion by its prey (direct impact)**

This refers to contagion of the lion at the time of the predation.

- Among the conclusive examples, **the tuberculosis** of the buffalo is well-known to be transmitted to predators and vultures (Michel, 2002). The case of the Kruger ecosystem is well documented (Keet, D.F. *et al.* , 1996; Keet D.F. *et al.* , 1998; Keet *et al.* , 2000), that of the ecosystem Queen Elizabeth is less so (Mr. Woodford, pers. Com.). On the other hand, the situation in this respect in Central and West Africa is not studied at all to our knowledge although the contagious risk is quite real.

- Another risk must be mentioned for Central and West Africa lions: **Feline Leukemia virus** (FeLV). It was recently shown that this disease is quite present in the domestic cats around the Regional Park of W, in West Africa, with an average séroprévalence of 8,2% (0-13,3) (Herme-Rey, 2004). Mode of contamination of wild felines could be predation of the domestic cats ; it could perhaps also be indirect by the environment. It is not known yet if the lion and the wild cats ff W are affected by FeLV, but the medical risk is indeed there.

- Anthrax can also be transmitted to the lion by a prey, as seen in Southern Africa, but it is occasional, notably because of a better resistance of the carnivores compared with that of the herbivores (Jager *et al.* , 1990; Berry, 1993). The disease exists in West and Central Africa, but it has not yet been investigated with respect to the lion.

- **The diseases which affect the prey and reduce the food resource of the lion (indirect impact)**

They are the diseases which are not transmitted to the lion itself, but which involves a strong mortality at the prey, and thus a reduction in their availability, with obvious effects on the population dynamics of the lion.

When an epizootic occurs among a lion prey species, there are generally two principal phases:

- In a **first phase** , the disease kills a great number of individuals of the prey species. The surplus of sick and dead animals brings an exceptional abundance of food easily accessible for carnivores. A positive effect can result from it for carnivore population dynamics : he number of predators in general, and the lion in particular, can increase temporarily.

- In a **second phase**, after the initial phase of prey morbidity and mortality, the remaining number of animals is lower than the original situation. This drastic reduction in the food resources can impact the lion population negatively, even more seriously given the initial increase in food abundance caused by the mortality surplus. This further unbalances predator/prey ratios

We will not list here all the diseases which affect to the domestic and wild prey of the lion. On a purely conclusive basis, one can quote one of most spectacular, rinderpest, which affects several lion prey species (eg, giraffe, buffalo, antelopes, phacochère) without being contagious to the lion. This disease may have had major effects on the lions of West and Central Africa, with 1984 being the date of the last

great epizootic. Today the impact is not known, but rinderpest is in the process of eradication in this part of the continent.

There is one notable exception in this category, a disease which affects both the lion and the prey : **tuberculosis** is undoubtedly one of the "complete" diseases in terms of impact on the lion because:

- it affects the prey of the lion and reduces its food resources,
- in addition, it affects the lion itself, and can be spread lion to lion.

II. DIRECT INFLUENCES

1. CONFLICTS

1.1. Predation of cattle

Human expansion increasingly restricts the lion to protected areas, including National parks and Zones of Hunting. It is on the periphery of these areas that the majority of the conflicts take place (Mills, 2000). Owing to the fact that the herders penetrate with their cattle in these Protected Areas, and that new villages settle at their borders, the risks increase of lion attacks on both livestock and people (Bourn & Blench, 1999).

When the availability in wild prey is reduced, such as for example after a drought or following the degradation of natural habitats, lions and other large predators are increasingly likely to prey on cattle, all the more so when herders graze their cattle inside Protected Areas.

In the area of W, for example, many herds cross or station inside the Park, accompanied by the shepherds and their dogs. It was recently estimated that more than 100 000 heads of cattle (65% of bovines, 35% of sheep and caprine) were stationed illegally in the Park, mainly in the béninoise part (Hars, 2002).

In Mali, the conflicts lion-cattle conflicts are one of the reasons which led to the drastic reduction of the number of lions. In the same way, in the north of the RCA, one of the principal reasons of the decrease of the population of lions is the systematic shooting of the latter by the stockbreeders who enter with their cattle the Areas Protected during the dry season (B Chardonnet, COM. pers.).

Between 1997 and 1998, in the National park of Haut-Niger, Guinea, 7 lions killed, according to local authorities, 168 domestic bovines (Oulare, pers. Com. in Bauer, 2003). In reaction, the authorities organized a beat with local hunters with an aim of pushing back the lions inside the Park, and of thus reducing the number of attacks on the cattle.

The impact of the predation of the lion on the domestic animals varies according to the size of the herds. This impact is considerable for the small stockbreeders who have only few bovines or small ruminants. The problem is significant on a local scale such as for example around the National park of Waza, Cameroon (Table 5).

Table 5: Herds of cattle and annual losses declared due to the predation of the large carnivores around the National park of Waza (Source: Bauer, 2003)

Zone	Villages and Permanent Camps	Cattle shepherds (number of heads)	Loss	%	Small domestic ruminants (number of heads)	Loss	%
1	Badaday	300	20	6,7	100	30	30

	Amaheiri	400	20	5	150	30	20
2	Andirni	680	5	0,7	450	75	16,7
	Dieguere	80	0	0	300	300	10
	Tchede	0	/	/	150	25	16,7
	Camp 1	400	5	1,3	0	/	/
3	Mahe	40	2	5	325	60	18,5
	Camp 2	400	4	1	50	0	0
	Camp 3	1 100	4	0,4	300	5	1,7
4	Zina	0	/	/	200	8	4
	Camp 4	350	1	0,3	125	0	0
	Sifna	150	0	0	200	3	1,5
	Camp 5	700	0	0	350	0	0

Around Waza National park, predators cause losses as significant as the diseases (respectively 220 000 \$\$US/an and 225 000 \$\$US/an). The lion is the predator responsible for the greatest number of cases of predation on the cattle. It is estimated that approximately 700 bovines and more than 1000 small ruminants are taken each year by lions. With them only, the lions cause losses of 130 000 \$\$US, primarily on the bovine herds, that is to say approximately 370 \$\$US per stockbreeder (Bauer & De longh, 2001) (Table 6).

Table 6: Predation of the domestic animals by predators (average between 1996-1998 in a number of heads) in periphery of the National park of Waza (Source: Bauer, 2003) .

	Predator			
	Lion	Hyene	Jackal	Others
Bovines (number of heads)	699	27	1	0
Sheep	742	1 141	911	0
Goats	507	1 227	1 263	0
Poultres	0	867	40	5 297
Value (\$ US)	130 000	47 000	38 000	5 000

In the area of Waza, the domestic animals would constitute even the principal prey for a score of lions (Sounds, 1998 *in* Bauer, 2003). The attacks take place during the day primarily. At night, the herds are kept in enclosures inside the villages where the lions generally do not dare to venture. In contrast to East Africa (Butler, 2000 *in* Bauer, 2003), these attacks mainly take place during the rainy season. What is more to fear, according to Bauer *et al.* (2001), it is that the lions of the area, offered the opportunity of domestic herds both inside and outside the Park, can become exclusive killers of cattle.

The attacks of lion take place also inside the park where herders illegally take their animals (Scholte, Kari & Moritz, 1996 *in* Bauer, 2003). In this area, there is no mechanism of financial compensation for the endured losses, but people have the right to kill lions in defense of life and livestock. Nevertheless the administrative procedures to obtain the authorization from it are complex.

Galhano Alves, an anthropologist, is studying the relationship between people and lions in the periphery of the National park of W in Niger. His research more precisely concentrated on the village of Moli-Haoussa/Gourma (400 inhabitants), in the buffer zone of the Réserve Fauna of Tamou where the population coexists narrowly and daily with the lion. Investigations were made into all the aspects of the relationship between the population and fauna (ethologic, technical, cultural, economic, etc), and into the lion in particular. He estimated that, during its period of investigation, the attacks of the lion on the cattle amounted to approximately 4 % of the cattle population each year, that is to say approximately 10 cows out of a total of 250 (Galhano Alves & Harouna, 2005).

The attacks of lion on the domestic herds can represent a significant problem for the rural populations, for whom the domestic animals often represent the only wealth:

- milk and the meat constitute a food essential with their survival;
- To have cattle is a means of saving and of ensuring a source of income;
- the social role of the cattle has major importance in the pastoral cultures. The loss of this capital resource to the predation of a lion results in a true suffering which can push people to be hostile toward lions.

Generally, the attacks of lion on cattle lead to the elimination of the accused lions, either by the means of government problem animal control, or by poisoning and poaching practised by the local populations. It happens that certain lions kill more cattle than they consume (" *surplus killing* "); this behavior is likely to exacerbate of advantage the human hostility.

1.2. Attacks on humans

In West Africa and Central Africa, it seems that the lion attacks the man only in an occasional way. However, it is extremely probable that some of these attacks are not recorded. Certain particular circumstances, notably a person alone at night, can result in a lack of recording. Certain lions can develop an aggressive behavior towards the man. It is generally allowed that the lion avoids the man because it is afraid of it, but this fear can attenuate once that the lion already killed a man.

In Cameroon, around the National park of Waza, people do not fear lion attacks, and indeed such attacks are rare, with 3 men being attacked in the whole area during one 10 year peiod (Bauer, 2003). Disarmed herders yield to lions and are seldom attacked.

In Niger, around the National park of W, the attacks on the man are rare, but they are often mortal. For example, in the zone of Moli Houassa, since the end of 1990, a child was killed by a lion, and a shepherd was seriously wounded (Galhano Alves & Harouna, 2005).

The migratory pastoralists are not generally afraid of the lion, even if they are not armed, when they meet it with their cattle. They know how to simply pursue it and frighten it with their sticks and by shouting certain particular cries (Galhano Alves & Harouna, 2005), as do the migratory herders further north with the cheetah (J

Tubiana, pers. Com.). Confrontation between the lion and the herder consists in frightening the lion away and not killing it.

1.3. Predation of threatened fauna

It happens sometimes that the lion threatens other rare species through predation. Such situations known and are documented in East Africa and Southern Africa. On the other hand, in West Africa and Central Africa, such circumstances did not make the object of writings (in any case known of our share), but the risk remain and deserve to be evoked.

1.4. Attitudes and Perceptions

A consequence of human encroachment on lion habitat and the conflicts which result from it is the development of a negative perception with regard to the lion by the local communities. For many rural communities of Africa, the lions are noxious animals which would have to be eliminated.

In Cameroon, for example, out of 236 questioned people from 10 different villages along the borders of Waza National Park, 50 % of the herders have a negative perception of the lion (Bauer, 2003). However, the damage due to the lion is sometimes lower than perception than the stockbreeders have some. One can perhaps explain it owing to the fact that the lion is an impressive species whose movements are influenced with difficulty by the local populations, and who is potentially able to devastate a domestic herd. One finds similar perceptions in East Africa, notably among the communities of the National park Queen Elizabeth in Uganda, which openly express their negative attitude with regard to the lion (Dricuru, 2000): 37% of the villagers questioned (156 analyzed questionnaires) wanted wandering lions which penetrate villages to be killed. And according to Siefert (2000): "... in the PN Queen Elizabeth... we of advantage are concerned with the poisoning of the carnivores and vultures wild (lions, hyenes, vultures, etc.)... it is extremely destructive, as well from the ecological point of view as economic " ^[5] .

Even in the countries where the populations of lions are of small size, the psychological impact of the lion remains very strong. According to Abdoulaye Kane (pers. Com.), representing UICN in Senegal, "a strong pressure is exerted by the local populations on the authorities to organize eradication campaigns against lions in response to the losses caused with the herds of cattle " .

Positive cultural perceptions with regard to the lion exist among certain people of West Africa and Africa Centrale. In spite of the pressure exerted by the lion on their pastoral economy, certain herder people preserve a balanced attitude with regard to the lion. They do not systematically seek to poison it, trap it or shoot it with a rifle. In Niger, at Gourmantché, in spite of the attacks on the cattle, and sometimes on the

man, " in general, the opinions of the inhabitants are favorable to the conservation of the lion, because of importance symbolic system of the species in their representations [Fouali], and of its emblematic importance in the environment" (Galhano Alves & Harouna, 2005) . In addition, beyond the cultural interest that certain African people allot to the lion, there is also the financial interest far from being negligible: the lion is perceived like a source "of potential incomes in tourist terms for the area, more especially as certain villagers work seasonally like guides or employees in the Park " (Galhano Alves & Harouna, 2005).

As the natural habitats of the prey are converted into arable lands, or grazing land for the domestic cattle, the conflicts opposing the men to the lions are accentuated unrelentingly. If this tendency continues, the rural populations will continue to shoot at the lion, it to trap or poison it, unless the conflicts are not prevented or are solved with incomes generated by the various forms of tourism, of the compensations for the incurred losses, displacements of the lions with problem, etc. Stander (1997) considers that " the future of large predatory apart from the areas of conservation in Africa depends on the sights and aspirations as of the local populations. It is only when the buildings... have an interest particular to preserve the large predatory ones that their future will be to ensure " ^{1[6]} .

2. OFFTAKEOF THE LION

2.1. Offtake by the local populations

The local communities take lions for various reasons which can be very different from/to each other, it can act to seek benefit of nature financial, social, cultural, or other, or to resolve difficulties as to eliminate lions which cause damage:

- **Offtakeof the "preventive" type or by way of "reprisals"**

The initial reaction of the man in response to the conflict which opposes it to the lion is to eliminate the individual responsible for the caused damage. The responsible lion (and often any other lion met in these circumstances) are shot with rifle or trapped or poisoned to prevent all new aggression of the predator. The use of poisons is a method frequently employed to kill the lions which attacked the herds. The poisons can be manufactured starting from plants, of agricultural pesticides (cf §3.2.) or of veterinary pesticides like the accaricides (produced used for the fight against the ticks). This practice touches also the other carnivores, including birds.

Local hunting for the lion undoubtedly is not practised much any more in West Africa. But few data are available concerning local hunting in the area: the fact that these data are rare is perhaps in relation to limited lion numbers .

The situation in Africa Centrale is different from that of West Africa, in the sense that there are more lions and more case of attacks on the cattle. Very few statistical data are available. Nevertheless a certain number of lions are cut down each year with an aim of defending the domestic herds, in particular when the guards of herds enter Protected Area to graze their animals. For the tradesmen of cattle "who do nothing but pass" to convey their oxen through political borders (sometimes even from Sudan to Nigeria), the shooting of lions can become a rule of life.

The use of poison to limit the impact of the lions on the cattle seems widespread in SSA. However information too limited to measure its extent (Schoemaker, 1999 *in* Bauer, 2003). Like all illegal practices it is a difficult task to get information on it (Scholte et al. 1999a *in* Bauer, 2003).

- **Offtakeof the "accidental" type**

Hunting for the meat is a usual practice for great number of rural people in SSA, even if it is described as poaching by certain national legislations. This type of hunting is sometimes nondiscriminating, i.e. it can kill animals not targetted by the hunter. Trapping is the main indiscriminate hunting method which can result in lions being caught in snares, jawtraps and other devices. It is not rare, not to say "usual", that trackers and hunting guides of hunting in Benin and Burkina Faso encounter lions with snares around the neck or around a leg.

The villagers of Kacha-kacha, close to the PN of Zakouma in Chad, use for the metal traps known as *Am cadjaman*. In addition to the buffalo, Damallisque and small antelopes, they capture hyenas and lions, either quite simply to contemplate them, or to use them for traditional medicine (Allah-Demngar & Falmata, 2003). For example, the heart and the whiskers of the lion are traditionally mixed with food to cure accidentally introduced poisons (Allah-Demngar & Falmata, 2003).

In Côte.d'ivoire , Djedje (1990) recognizes various forms of poaching which can affect the lion to differing degrees: "A side of the poaching which one can describe as subsistence or artisanal, intended for the family and which relates especially to the small mammals (aulacode, pigs-épics, céphalophes, monkeys, etc.) or the birds and whose consequences are not irremediable for the future of the wild fauna. There is also a semi-industrial poaching which is the fact of organized individuals, working for the account of true companies and which are devoted to intensive massacres with a commercial aim ".

2.2. Offtake by trophy hunters

In some large areas of wild habitat which are not very favorable for development of mass tourism (some being several million hectares in extent), sport hunting, in particular hunting for the lion, represent a significant activity to justify to rather preserve these vast areas in the state than to convert them for the agriculture or the breeding cattle. The Executif Director of the PNUE, Dr. Klaus Töpfer, declared in 2001: *"the sustainable use of wildlife fo rtrophy hunting generates incomes for the local rural populations, reduces poaching and constitutes true motivation to preserve the natural habitats "* ^{1[1]} .

Trophy hunting is distinguished from the other forms of offtake in the sense that it targets only one small segment of the population, the adult males only (Table 7), in such way that the impact on the population is small (Bell & McShane-Caluzi, 1984), on the condition, however, that the taken adult males are greater than five years of age and beyond their reproductive period (Packer, *et al.* , 2005).

Table 7: Quotas of lion according to the literature (% of the population of lion per annum)

Category	Maximum offtake(%)		Source
	Prélèv. durable maximum	Prélèv. of trophy hunting max.	
Lioness	6	3	WWF, 1997
Male lion	6	5	WWF, 1997
Mature male lion	10		Greene <i>et al.</i> (1998) <i>in</i> Loveridge, 2002
	2-3		Creel & Creel (1997) <i>in</i> Loveridge, 2002
Total of lions in the population	8		Jachmann, 2001
	10		Cumming <i>in</i> Bell & McShane-Caluzi (eds.), 1984

- **West Africa**

Of the 15 countries of West Africa, 3 countries allow lion trophy hunting : Benin, Burkina Faso and Senegal. In Senegal however, the lion is registered on the list of the partially protected species, but its hunting requires a presidential authorization in addition to the usual licences for the other species game. In fact, since season 1999/2000, there no was authorization allotted for lion hunting in Senegal. The average total number of lions taken by tourists hunters in West Africa was 14,8 between 1999 and 2004 (table 8), over approximately 18 to 20 years (Chardonnet ED, 2002). In this area, the primary destination for hunting for the lion is Burkina

^{1[1]} " *The sustainable use of wild animals through trophy hunting offers economic incentives to the local rural population, reduces poaching and offers incentives to preserves critical habitat "*

Faso: 12 lions on average have been taken there for 20 years. This stability is an interesting indicator of the value of the system of the quotas in force, and level of use of the lion resource.

In West Africa, the lion belongs to the species sought by the hunters even if it is not the principal collected species. The tourists hunters seek initially a trophy of buffalo or roan antelope which they have more chance to obtain. Nevertheless, (i) to drive out other species in the habitat of the lion, (ii) the possibility, even weak, to observe a lion during its stay of hunting, (iii) and the possibility, even weaker, to collect a trophy of lion, are very strong attractions for tourism of hunting in these countries. When a tourist reserves a stay of hunting, it does not buy only one hunting but also the advisability of approaching closely the « star » species such as the lion, or the elephant, even if these species are not hutable.

- **Central Africa**

Of the 9 countries of Central Africa, 3 allow lion trophy hunting : Cameroon, the RCA and Chad. In this area, as in West Africa, the lion plays an essential gravitational role for the tourist hunters, even if it is not the species which they consider a priority, since they seek mainly the elephant (Cameroon only), the buffalo, the éland of Derby, the bongo, etc.

Each year, in Central Africa, the tourists take on average 17,4 adult lions, a figure comparable with that of West Africa. Thus, the total average number of taken lions each year by the trophy hunters in West Africa and of Africa Centrale is about thirty individuals (Chardonnet, 2002).

The first tourist destination for the hunters in Africa Centrale is Cameroon: nine lions on average are taken there each year since a score of years.

Table 8: Quotas of hunting allotted and obtained in West Africa and Central Africa

		Afrique de l'Ouest			Afrique Centrale			
		Bénin	Burkina Faso	Sénégal	Cameroun	R.C.A.	Tchad	
		Taxe de trophée (Euros / F CFA)	2 290 / 1 500 000	1 372 / 900 000	458 / 300 000		1 221 / 800 000	305 / 200000
1999/2000	QUOTAS	Attribués	3	23	1		19	par zone
		obtenus	2	11	1		6	
2000/2001		Attribués	4	28	0		23	
		obtenus	3	12	/		13	
2001/2002		Attribués	4	31	0		26	
		obtenus	4	13	/		9	
2002/2003		Attribués	0	28	0		0	
		obtenus	/	15	/		/	
2003/2004		Attribués	0	28	0	28	0	
		obtenus	/	13	/	6	/	
2004/2005		Attribués	5	28	0	34	12	
		obtenus			/	12	1	
2005/2006		Attribués					12	
		obtenus					4	
2006/2007	Attribués					12		

2.3. Offtake by the administrative authorities

In the majority of the countries of Sub-Saharan Africa, the laws contain an article guaranteeing the defense of the people and their goods in the event of aggression by wild animals. The self-defence is thus authorized: it is completely legal to destroy a lion which attacks people or the domestic animals. One can suppose that, very often, the defense of the people and the cattle is carried out by the herders themselves, and that they rarely make these practices publicly known.

Nevertheless, in reality, the actions of reprisals are generally placed under the responsibility of the authorities in charge of wild fauna. In West Africa and Africa Centrale, the administration of supervision can proceed to what are called " battues administratives " whose goal is officially to eliminate the wildlife responsible for damage, and who sometimes indiscriminately kill representatives of the accused species in order to calm the legitimate anger of the populations.

Not such a long time ago, even after independence, some States organized campaigns of "vermin" destruction, which included lions. Each year, during cattle vaccination campaigns in Upper Volta for example, the administration carried out massive poisonings of predators, using strychnine (Table 9).

Table 9: Numbers of animals officially poisoned with strychnin between 1970 and 1979 in Upper Volta (ex-Burkina Faso) (Source: Annual files of the Service of the Health protection)

	1970	1971	1972	1973	1974	1975	1979
Jackals	216	136	83	40	187	509	1256
Hyenes	173	88	105	39	99	383	431
Lions	39	4	12	0	0	9	0
Leopards	4	0	0	0	0	35	0

2.4. International Trade

CITES – the Convention on International Trade in Endangered Species of Fauna and Flora – is the treaty governing international trade in wildlife. As of September 2005 169 countries are party, including all the lion range states in

Africa. The lion has been listed on CITES Appendix II since 1976. Appendix II listing requires issuance of a CITES export permit from the exporting countries. CITES Parties are required to make annual reports to the CITES Secretariat detailing trade in species listed on the CITES Appendices. An online database with annual trade records beginning when CITES entered into force in 1975 is managed by the World Conservation Monitoring Center and United Nations Environment Program < <http://sea.unep-wcmc.org/citestrade/>>.

The database was searched for gross and net exports from African lion range states in September 2005. Net exports subtracts those items which were originally imported from other countries and then re-exported, and the totals are lower than gross exports.

Table 10 shows total gross lion exports from African range states, for the history of CITES (1975-2004), as well as more recently (1998-2003), with annual averages of the different categories.

Table 10. Total lion exports (gross) from African range states

Item	1975-2004	Annual average	1998-2003	Annual average
Lion trophy	13,386	478.1	3,734	622.3
Lion skin	8,193	292.6	1,107	184.5
Lion skull	3,559	127.1	1,201	200.2
Lion body	243	10.6	47	7.8
Lion claws	11,736	434.7	1,146	191.0
Live lion	891	33.0	399	66.5

Trophies, skulls and live lions show a higher recent annual average trade (1998-2003), compared to the annual average for all CITES years (1975-2004). The trophy category has the highest annual average recent trade (622.3 trophies per year).

Table 11 shows range state gross exports of lions. The major exporters of lion hunting trophies, both historically and recently, are Tanzania, South Africa, Zimbabwe and Botswana. Regionally, most international trade in lions originates in East and Southern Africa. West and Central Africa have comparatively little international trade in lions.

Table 11. Lion exports (gross) by region and range state

Exporter	Trophies		Skins		Skulls		Claws		Bodies		Live	
	1975-2004	1998-2003	1975-2004	1998-2003	1975-2004	1998-2003	1975-2004	1998-2003	1975-2004	1998-2003	1975-2004	1998-2003
West Africa	161	78	17	3	6	0	14	0			51	18
Benin	34	13	2	1	4	0					2	2
Burkina Faso	114	64	3	0								
Ivory Coast	6	0	1	1	2	0					7	0
Ghana			1	0								
Liberia	3	0									1	0
Mali			2	0								
Niger											32	7
Nigeria			6	0								
Senegal	3	0	1	0							8	8
Togo	1	1	1	1							1	1
Central Africa	751	114	208	1	86	1	108	0			4	0
CAR	542	36	171	0	75	0	108	0			1	0
Chad	15	13										
Congo	1	0										
Cameroon	189	61	35	1	11	1					3	0
DR Congo	2	2										
Gabon	2	2	2	0								
East Africa	3,775	1,326	1,417	142	847	125	2,114	37	19	0	74	12
Ethiopia	60	11	32	6	2	0					2	0
Kenya	33	3	359	4	197	0	1,596	5			50	8
Rwanda			3	0	8	0						
Sudan	75	0	17	0	6	0					1	1
Tanzania	3,605	1,312	1,004	132	633	125	518	32	19	0	21	3
Uganda	2	0	2	0	1	0						
Southern Africa	8,698	2,216	6,548	961	2,220	668	9,500	1,109	224	47	729	349
Angola											1	0
Botswana	1,380	72	2,380	231	411	7	6,976	104	11	0	31	18
Malawi	5	0	36	0	6	0					6	0
Mozambique	160	91	48	43	44	44					1	0
Namibia	243	62	274	30	37	17	69	1	4	0	85	12
South Africa	2,915	1,110	2,005	463	953	412	1,329	501	150	26	379	185
Swaziland											26	26
Zambia	1,355	268	332	39	147	33	72	0	4	0	7	0
Zimbabwe	2,640	613	1,473	155	622	162	1,054	503	55	21	190	108

Table 12 compares recent annual average net exports of trophies and skins from major exporters to their estimated national lion population. Zimbabwe's stands out for its high average recent net exports, compared to estimated population. Burkina Faso, South Africa and Mozambique export over 5% of their lion population per year, according to Bauer and van der Merwe's (2004) national estimates, but not those of Chardonnet (2002) suggest a lower rate of offtake.

Table 12. Major recent exports (net) of lion trophies and skins as a percentage of estimated population

Range state	Annual average trophy+skin net exports, 1998-2003	Percentage of estimated lion population (Chardonnet, 2002)	Percentage of estimated lion population (Bauer & van der Merwe, 2004)
Benin	2.3	0.7	1.7
Burkina Faso	10.7	2.4	6.3
Cameroon	10.3	2.5	4.0
Centr African Rep.	6.0	0.6	2.0
Ethiopia	2.5	0.2	0.3
Tanzania	240.3	1.7	3.4
Botswana	49.7	1.6	1.7
Mozambique	22.3	2.3	5.6
Namibia	14.3	2.1	1.6
South Africa	178.5	4.6	6.6
Zambia	49.3	3.4	3.3
Zimbabwe	124.8	7.4	12.0

Table 13 shows annual reported gross exports of lion skins, skulls and trophies from 1990-2004 for West and Central African lion range states.

At the 13th meeting of the Convention of the Parties to CITES in Bangkok, October 2004, Kenya proposed to include the African lion in Appendix I, a more restrictive trade category which requires both an import and export permit, and

essentially eliminates trade for “commercial purposes”. This proposal was withdrawn after extensive informal discussions among the Parties, in a negotiated compromise which led to the IUCN lion conservation workshop initiative (Nowell, 2005).

In a separate initiative, Kenya recommended the African lion as a candidate for the CITES Significant Trade Review process at the 20th and 21st meeting of the CITES Animals Committee. This process reviews biological, trade and other relevant information on Appendix-II species subject to levels of trade that are significant in relation to the population of the species, in order to identify problems concerning the implementation of Article IV, paragraphs 2 (a), 3 and 6 (a) of the Convention, and possible solutions. The species subject to the Review of Significant Trade are selected by the Animals and Plants Committees. Non-compliance by any State with the solutions recommended by these Committees may ultimately lead to a recommendation by the CITES Standing Committee to suspend trade with that State in specimens of the species concerned.

UNEP-WCMC did not recommend the lion for inclusion in the review, finding that trade was relatively high but stable from the few countries where lions were considered abundant (Tanzania, South Africa and Zimbabwe) (UNEP-WCMC, 2004 and CITES AC 2005a). On the other hand, TRAFFIC and the IUCN/SSC Wildlife Trade Monitoring Program did recommend the lion for inclusion in the significant trade review at the 20th Animals Committee meeting, saying “Although trophy hunting is considered a means to provide economic incentives for wild areas and species, there is concern about the sustainability of current rates of trophy hunting of lions... New research suggests that sustainability can be increased by targeting males that have completed their reproductive period (Whitman et al., 2004), but such practices are not widespread. Given the threats facing lions and new research findings, a review of the sustainability of trophy exports is recommended.” (TRAFFIC-IUCN 2004: 6).

While Kenya suggested the inclusion of the lion in the Significant Trade Review at the 20th Animals Committee meeting, no supporting document was submitted by Kenya and the Chairman was reluctant to include it. It was agreed that Kenya could submit supporting documents for the inclusion of the lion in the Sig Trade Review at the 21st Animals Committee meeting in 2005 (CITES AC 2004: 12). However, at the 21st meeting the lion was excluded from the Significant Trade Review on the recommendation of WCMC-UNEP (CITES AC 2005a). At the same meeting, a decision was made to defer inclusion of the lion in another CITES trade review process, the Periodic Review of the Felidae, until after the IUCN regional lion conservation workshops (CITES AC 2005b). The Periodic Review of the Felidae has been motivated by the United States, which points out that all 36 species in the family Felidae were listed on the CITES Appendices prior to the adoption of scientific criteria for species inclusion in the appendices (Res. Conf. 9.24, Rev. COP13), and thus their listings deserve closer scrutiny at this point in time.

Table 13. Annual lion exports (gross: skins, skulls and trophies) from West and Central African lion range states, 1990-2004

Term	Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Totals
skins	BF	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	3
skulls	BF	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2
trophies	BF	3	1	8	3	14	8	5	7	12	12	20	10	2	8	0	113
skins	BJ	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
trophies	BJ	0	0	0	0	3	4	4	10	3	3	4	3	0	0	0	34
trophies	CD	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	2
skins	CF	1	0	3	0	0	1	1	0	0	0	0	0	0	0	0	6
skulls	CF	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	2
trophies	CF	66	20	23	8	9	9	6	6	3	10	14	9	0	0	0	183
trophies	CG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
skins	CI	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
skulls	CI	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2
trophies	CI	0	1	2	0	0	2	0	0	0	0	0	0	0	0	0	5
skins	CM	1	4	0	0	2	0	0	0	0	1	0	0	0	0	0	8
skulls	CM	1	0	0	0	2	0	0	0	0	1	0	0	0	0	0	4
trophies	CM	24	16	26	7	5	10	14	12	9	16	20	6	9	1	0	175
skins	GA	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
trophies	GA	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
skins	GH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
skins	ML	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
skins	NG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
skins	SN	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
trophies	SN	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	3
trophies	TD	0	0	0	0	0	0	0	1	1	0	1	8	3	0	1	15
skins	TG	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
trophies	TG	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1

Country codes: BF: Burkina Faso; BJ: Benin; CD: Dem. Rep. Congo; CF: Central African Rep.; CG: Congo; CI: Ivory Coast; CM: Cameroon; GA: Gabon; GH: Ghana; ML: Mali; NG: Nigeria; SN: Senegal; TD: Chad; TG: Togo

3. PATHOLOGY OF THE LION

3.1. Infectious risk

Because of its proximity growing with the man, and in particular with his domestic animals, the lion is more and more often exposed to the diseases which the latter are carrying.

The domestic cats are potential vectors of cat-like leucosis, cat-like parvovirose, cat-like immunodéficiency, rage, etc. The domestic dogs are potential vectors of the disease of Square, canine parvovirose, rage, etc. All these diseases can contaminate directly lions or to predispose it to contract other diseases.

An epidemiologic investigation into the diseases of the domestic carnivores was led in 2004 around the Transborder Park of W in West Africa. In the immediate vicinity of the Park, there are 8 000-10 000 domestic dogs and 4 000-5 000 domestic cats. Tests serologic were carried out on 386 dogs and 83 cats. The results of this study show that a strong proportion of these domestic animals is carrying transmissible viruses to wild fauna and notably to the lion (Figure 11).

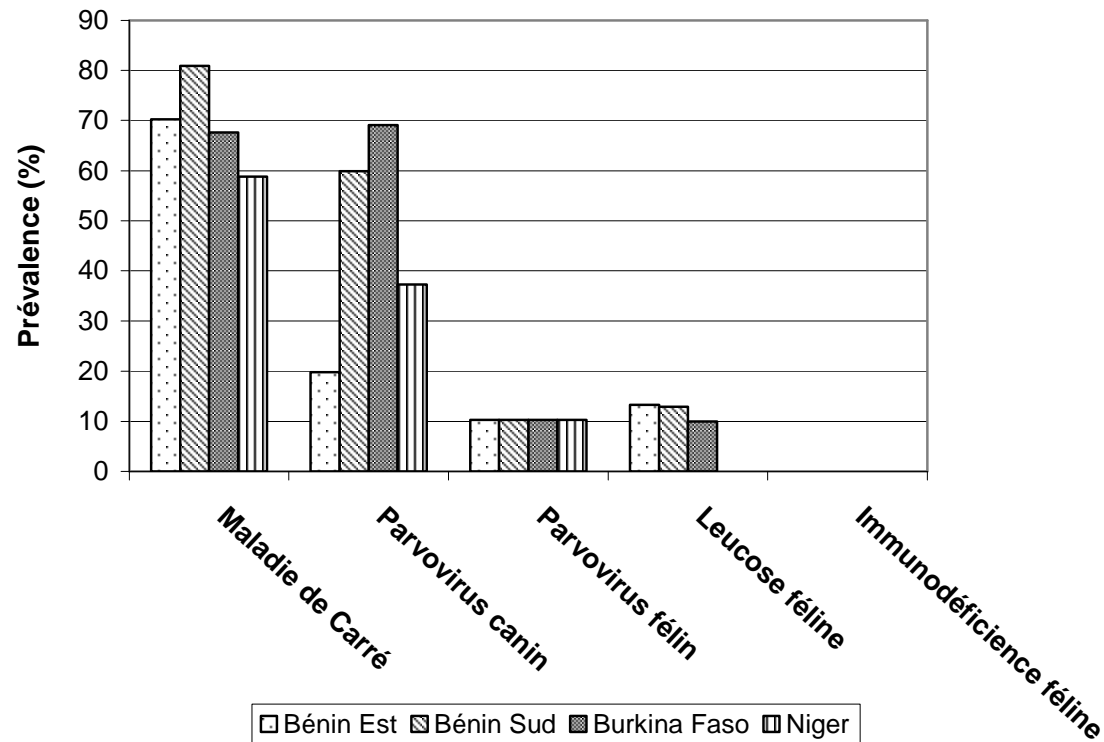


Fig. 11: Prévalence of various diseases in the dogs and the domestic cats in periphery of the Transborder Park of W: Benin, Burkina Faso and Niger (Source: Rey-Herme, 2004)

One distinguishes the epizootic and endemic diseases:

- an example of the first category is that of the flamndtbée of disease of Square in 1996, in Serengeti, Tanzania, transmitted by the sheepdogs, who caused the death of approximately a third of the population of lion (Hofmann-Lehmann *et al.* , 1996). This population of lion showed a remarkable impact strength besides by quickly covering its population with before epizootic (Kelly, 2001).

- an example of the second category is the rage which prevails in Center and West Africa in the man and the animal. This zoonose affects the domestic carnivores (table 10) and represents a risk, if not reality, at least potential, for the populations of lions in the area.

Table 10: Death rate per declared disease and leaves the rage in this mortality according to investigation
(Source: Rey-Herme, 2004)

	Burkina Faso	Benign Is	Benign South	Niger
A number of surveyed concessions	57	68	143	63
A number of declared dogs	180	150	310	90
Mortality due to the diseases (%)	39	10	22,6	50
Leaves the rage in mortalities for disease (%)	1,4	6,7	14,3	11,1

3.2. Toxicological risk

Following the Convention of Stockholm of 2001 entry into force in 2004, and more recently to the Convention of Rotterdam of 2004, the use of the pesticides is rigorously controlled, at least theoretically.

The pesticides are used to limit the agricultural losses caused by the noxious animals. At least 50 000 tons of pesticides were widespread in the African countries since long years (UNEP, 2002). With Benign, between 1994 and 2001, 2,08 and 2,36 Million liters of pesticides were widespread in each crop year (Soclo, 2003 *in* Issa, 2004). Today, the toxicological risk of the pesticides in general represents a serious threat for wild fauna, but in particular for the carnivores as the lion which are at the top of the trophic chain.

Within sight of the analyses, the use of organochlorinated pesticides (POC) to the accesses of the Protected Areas is common, although prohibited. The POC represent a danger not only for wild fauna, but also to the man. Used in the plant health treatments (Soclo, 2003 *in* Issa, 2004), the POC are toxic and persistent, their lifespan sometimes being able to reach several ten years (Jean *et al.* , 1986 *in* Zongo, 2005).

Two types of contamination can affect the lion: contamination by the watering, and the contamination by the food.

- **Contamination by the watering**

Several studies showed that the use of the POC in the outlying areas of W and Pendjari (West Africa), in particular for the culture of cotton, contaminates area water in these Protected Areas (Issa, 2002). The watering is thus a way of contamination by which the residues of the POC gain animal fabrics.

An investigation in twelve bordering villages of the rivers of the Reserve of Transborder Biosphere of W, drew up the inventory of manures and the pesticides used by the producers in periphery of the reserve. This study evaluates the degree of pollution waters and grounds of W, and the impacts of these products on the ichthyologic fauna which is used as biological indicator of the degree of pollution of the aquatic environments of the reserves of fauna. As a whole, the concentrations in pesticides in the various sampled ponds are very high, definitely higher than the standards set by the World Health Organization (OMS/WHO) (Figure 12).

Standards of WHO

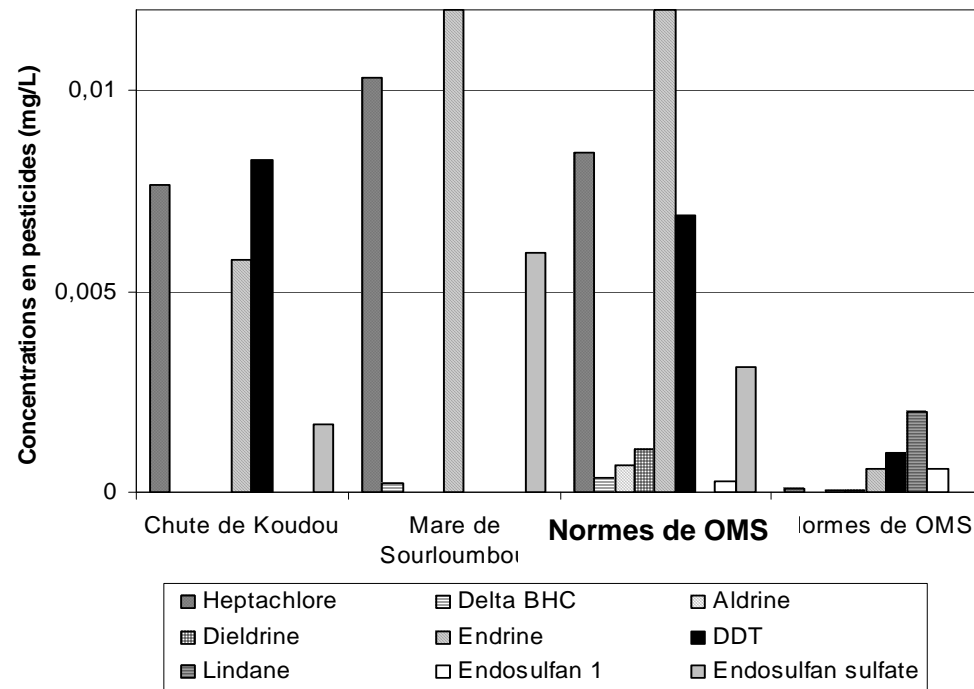


Fig 12: Results of the analyses of water samples taken in four ponds different from the National park of W (in mg/L) (Source: Zongo, 2005)

The pesticides are also used in an intentional way to poison wild fauna at end of poaching. Cases of commercial poaching are reported where the boucannés meat and the fish put on the market come from poisoning by pesticides. Allah-Demngar & Falmata (2003) observe that in Chad, in the area of Salamat, the pesticides are diverted by certain villagers who use them to drive out game. The technique is relatively simple, they pour pesticides, in particular nématocides, in the points of watering. All the species which absorb some die a few moments afterwards

- **Contamination by the food**

The contamination of the herbivores can be done by ingestion of the contaminated plants, and that of the carnivores by ingestion of the contaminated herbivores.

- Residues of the pesticides in the plants

The contents of residues of organochlorinated pesticides of the wild watery plants analyzed such as *Cyperus sp.*, *Cyperus articulatus*, *Nymphaea lotus*, *Ipomea aquatica* and *Acacia* are not detectable (Soclo, 2003). What tends to show that only the cultivated grounds (in particular cotton fields) are contaminated. The consumption of the wild plants would not be thus probably the way of the most significant contamination for the herbivores. It would be thus the water of watering which would be the principal way of contamination for the herbivores.

- Residues of the pesticides in fabrics of the animals

Issa (2004) shows that wild fauna is contaminated by the organochlorinated ones, and that it is of advantage that natural habitats (plants and water): the concentrations of the majority of the residues of the pesticides in studied animal fabrics are largely higher than those which are detected in water, the sediments and the ground (Soclo, 2003 in Issa, 2004).

The residues of pesticides such as lindane, Dichloro Diphényl Trichloéthane (DDT), its derivatives Dichloro Diphényl Ethane (DDE) and Dichloro Diphényl Dichloroethane (DDD), the aldrin, its metabolite dieldrin, the endosulfan and the heptachlore are detected in fabrics of savage animals with significant contents (Figure 13).

The species of wild fauna which were sampled in this study are the bubale, the buffalo, the céphalophe of Grimm, the harnessed guib, the hippotrague rouan, the phacochère, as well as a fish species (*Polypterus endlicheri*), whose individuals are frequently found died, floating on the area. The concentrations of various POC were found in the liver and greases as of the these species. All the sampled individuals present in their fabrics of the detectable contents of residues the organochlorinated ones being spread out, in the mammals, of 3,7 mg/kg (in the liver of guib harnessed) with 13,3 mg/kg (in the grease of céphalophe). The fish pulp as for it, presented a very strong concentration of 17,5 mg/kg (Issa, 2004).

Lipophilic compounds, the POC accumulate in greases and can remain there during all the life of the individuals. They can thus traverse the food chain and, by bioamplification, they can reach the trophic levels higher than concentrations

which can prove to be dangerous for the organizations. The lion is at the top of this food chain, it is thus particularly exposed to the toxicological risk in ecosystem WAP.

The impact of the residues of pesticides on the health and the reproduction of the mammals of the study of Issa (2004) does not have, to our knowledge, still be given. Nevertheless, other studies already highlighted the toxic properties of the POC:

- acute toxic Effects: tremors, convulsions, confusion, muscular incoordination, even died at the man (Kamrin, 1997 *in* Issa, 2004);
- Reduction in the capacities of reproduction and fertility in the mouse (Kamrin, 1997 *in* Issa, 2004), in the birds (Radcliffe, 1970, Ramade, 1974 *in* Issa, 2004), and alligators (Vonier *et al.* , 1996 *in* Issa, 2004).

It is thus very significant to carry out epidemiologic and toxicochimic explorations on the lion to determine with advantage of precision the real impact of the use of the pesticides on its statute of conservation in the area.

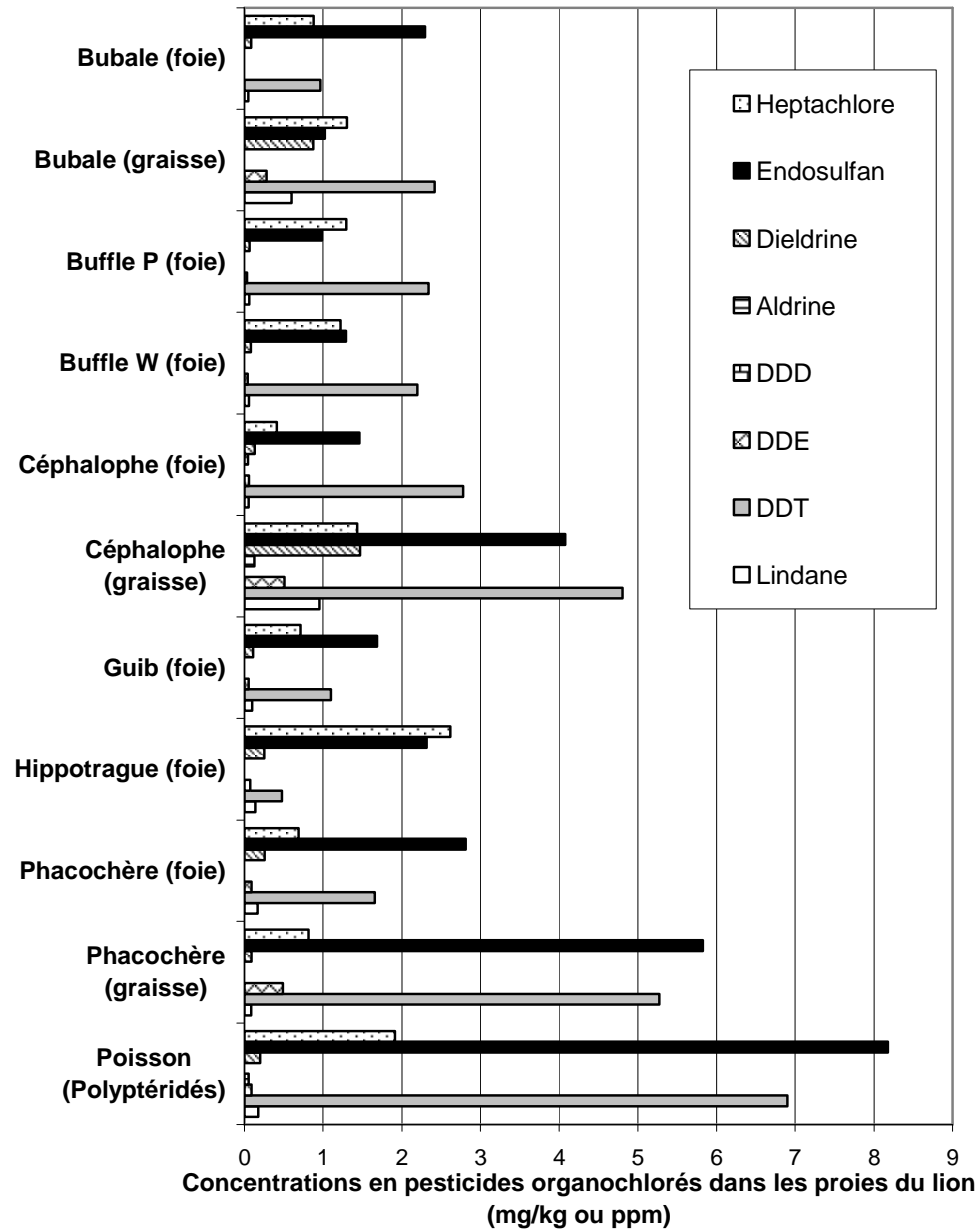


Fig 13: Concentrations of various Organochlorinated Pesticides in the liver and the grease of various wild animal species of the Reserves of Biosphere of Pendjari and W (Source: Issa, 2004)

3.3. Risk genetic

The fragmentation of the habitat, the persecution exerted by the man and in certain cases the epidemics divided the area of original distribution of the lions into various subpopulations, from which some are insulated like islands. In these small isolated populations, the rate of consanguinity can reach a level to which the performance of the population is decreased. This phenomenon was observed in the most isolated population of lions, the only population of lions of Asia in the Gir forest in India, where the males show high levels of anomalies in the spermatogenesis and the low rates of testosterone (O'Brien *et al.* , 1987, Wildt *et al.* , 1987).

In Africa, the dispersion of the adult males and the high alternation of the reproductive males in the groups of females minimize the risks of consanguinity naturally. The "natural" phenomenon of infanticide in the lion can even contribute to the strategy of survival of the species. Another strategic mechanism: the adult male lion is driven out maternal group and leaves to research a level groups females available, this mobility contributes to the genetic mixing, including at very long distances. For example, in the National park of Etosha, in Namibia, where the density of lions is estimated between 1 and 3 lions by 100 km² according to several authors, the vital field of a group of lions covers vast areas (up to 2 075 km²) and covers the vital field with other groups of lions (Stander 1991).

Long studies were led in the Area of Conservation of Ngorongoro in Tanzania. In this area, one of the populations of lions best studied shows a low level of heterozygosity in comparison with the lions of the National park of Serengeti, as well as a strong proportion of spermatozooids morphologically abnormal (Packer *et al.* , 1991). Nevertheless, the low level of heterozygosity is probably the result of the history the population of Ngorongoro which developed starting from a very small number of individuals (15), although its geographical insulation could accentuate its weak genetic variation initial (Packer *et al.* , 1991). There is certainly an effect on the reproductive performance, but the effects on the long term for these populations are not clear, since there are several examples of large cat-like which overcame such a genetic impoverishment, consequence of a fragmentation in the population or a bottleneck, and which are today still largely widespread (O'Brien *et al.* , 1985, 1990).

In the small populations of the open zones (not enclosed), the mixing ensured by the young adult males should be sufficient to ensure the hétérozygotie. A simulation of the dynamics of population and genetics of the populations of lions showed that it was only enough to some exchanges (1 every 5 years) so that a sufficient level of hétérozygotie is maintained (Starfield *et al.* , 1981). The exercise of determination of the viability of the population and the habitat (*Population and Habitat Viability Assessment, PHVA*) can help to determine guidelines in this respect.

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