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The value of wildlife

Ph. Chardonnet [1], B. des Clers [1], J. Fischer [2], R. Gerhold [2], F. Jori [3] & F. Lamarque [4]

(1) International Foundation for the Conservation of Wildlife (IGF), 15 rue de Téhéran, 75008 Paris, France
(2) Southeastern Cooperative Wildlife Disease Study, College of Veterinary Medicine, University of Georgia, Athens, GA 30602, United States of America
(3) Centre for International Cooperation in Agricultural Research for Development/Animal Production and Veterinary Medicine Department (CIRAD/EMVT), Campus International de Baillarguet TA, 30/F, 34398 Montpellier Cedex 5, France
(4) Office National de la Chasse et de la Faune Sauvage (ONCFS), 85 bis avenue de Wagram, 75017 Paris, France

Summary

The value of wildlife has been widely ignored or under-rated in the past by the international community. At most, wildlife was considered from the limited aesthetic and touristic aspects. This situation has changed somewhat. In the majority of the veterinary profession, which is largely livestock-oriented, wildlife is increasingly considered in terms of wild animal production and occupies just as relevant a position as domestic animal production. Some economists are now trying to quantify the informal nature of a large portion of the wildlife sector. The importance of wildlife to local communities is now globally recognised in community-based or participatory natural resources management programmes. The authors highlight not only the economic importance of wildlife (which amounts to billions of United States dollars world-wide), through consumptive and non-consumptive uses, but also the present and potential nutritional value, the ecological role as well as the socio-cultural significance of wildlife for human societies of both the developed and the developing worlds. Also addressed in this chapter is a discussion on one of the main threats to wildlife conservation which consists of the reduction or even retrieval of the different values wildlife can offer.

Keywords

Biodiversity – Bush-meat – Consumptive use – Ecology – Economic importance – Economy – Non-consumptive use – Nutritional value – Socio-cultural significance – Wildlife – Wildlife habitats.

Introduction

It has taken time for the international community to realise the value of wildlife. The World Charter for Nature, adopted and solemnly proclaimed by the General Assembly of the United Nations in 1982, addressed the concern of wildlife conservation without referring to the concept of wildlife value. It was only in 1992 at the International Convention on Biodiversity in Rio de Janeiro that a clear declaration of intent to secure the 'value' of the biodiversity of the Earth was made, in particular as follows:

– in the range of 'actions' planned by the Convention (158); a number of these nominally refers to the value of biodiversity (i.e.: actions 24 and 36)

– the final objective of Chapter X is 'to improve assessment and awareness of the value and importance of biodiversity'.

Several classifications are used for the values of biological resources. As a classic approach, McNeely *et al.* (85) split the values of wildlife into direct and indirect value categories as described below.

Direct values

Direct values were considered thus:

– consumptive use value: non-market value of firewood, game, etc.

– productive use value: commercial value of timber, fish, etc.

Indirect values

The indirect values were classified as follows:

– non-consumptive use value: scientific research, bird-watching, etc.

– option value: value of maintaining options available for the future

– existence value: value of ethical feelings of existence of wildlife.

These values carry different weights, which vary according to the respective interests of the stakeholders involved. Although important, virtual values, such as the ethical value, are not as powerful in terms of justification for conserving wildlife as pragmatic ones, such as economic values. Be it relevant or not, financial profitability, economic yield and environmental sustainability are often dominant values for high-level decision-makers as well as for grass-root level individuals who live in close proximity to wildlife (17). For this reason, the classification adopted here rather relies on a pragmatic approach differentiating between the following:

– the economic importance of wildlife

– the nutritional value of wildlife

– the ecological role of wildlife

– the socio-cultural significance of wildlife.

All the above-mentioned values are positive. Wildlife, however, may be seen as sometimes presenting negative or adverse values. Depredation of wildlife to people (casualties), livestock (predation), agriculture (crop damage) and natural landscape (invasive pests) are considered counter- or anti-values. However, observers may have different views of the same value: the wildlife protectionist might consider normal for the predators to prey on livestock (positive value for wildlife), while the cattle-owner would see the large predators as detrimental (negative value of wildlife).

Obviously, the current value of wildlife is important in itself. However, as time passes, the greatest value of biodiversity may lie in future opportunities brought to humankind to adapt itself to local and global changes (158).

Economic importance of wildlife

To appraise the economic importance of wildlife is as difficult in developing countries as is a classic academic exercise in developed countries. In countries of the north, the wildlife industry does not differ much from other industries with primary, secondary and tertiary sectors. In most countries of the south, the wildlife industry forms a major part of informal activities, which are neither officially registered nor even known or described in many instances. Nonetheless, in both worlds, some of the wildlife values cannot or can hardly be quantified as aesthetic, educational, ecological or ethical values. The rationale of the economic approach is therefore limited to some aspects of the entire issue.

The classic categories of wildlife economics comprise the following:

– the consumptive uses of wildlife, i.e. a number of activities whereby the wildlife resource is exploited by removing a certain quota of either live or dead animals

– the non-consumptive uses of wildlife, i.e. the activity of giving value to wildlife without removing the resource.

The entire range of wildlife activities produces revenues and brings added value which contributes to the gross national product (GNP). This added value at the national level is considered as the wildlife GNP which may be compared to the agricultural GNP and the national GNP. For 1989, the wildlife GNP varies from high levels of US$131.7 million in Zimbabwe to low levels, such as US$30 million in the Central African Republic. The respective shares of the official and informal sectors within the wildlife GNP vary considerably: in the Côte d'Ivoire, the informal wildlife sector reaches 99.5% of the wildlife GNP, while in Zimbabwe the official wildlife sector reaches 94.7% of the estimated wildlife GNP. Additionally, wildlife may be a source of hard currency. In Tanzania and Kenya, wildlife tourism holds either the first or second rank in exporting activity depending on the year (26).

In North America, programmes have been in place for many years to document or estimate the expenditure of individuals who participate in wildlife-associated recreation. This economic perspective is one of many ways in which value can be assigned to wildlife and this is a major factor taken into consideration by corporate and government policy-makers. In addition, nutritional, aesthetic, scientific, educational and ecological values may be ascribed to wildlife, but they are much more difficult to document and quantify.

The United States Departments of the Interior and Commerce surveys are conducted approximately every five years on the adult participation and expenditure associated with outdoor recreation in the United States of America (USA). In the 1996 National Survey of Fishing, Hunting and Wildlife-Associated Recreation, 38% (77 million) of residents in the USA aged 16 years old and more, participated in some wildlife-related activity (8). It was estimated that 35.2 million individuals fished, 14 million individuals hunted, 9.5 million individuals hunted and fished, and 62.9 million individuals participated in at least one type of wildlife viewing activity (8). Total expenditure for all wildlife-related activities in 1996 was estimated to be US$101 billion, representing approximately 1.4% of the national economy (8) although commercial sale of wildlife meat is not practised. By comparison, US$81 billion was spent on new cars in the USA the same year (147).

According to 'The Importance of Nature to Canadians' survey conducted in 1996, approximately 18.8 million Canadians participated in one or more wildlife-associated activities. Approximately 57% of individuals participated in watching,

photographing, studying or feeding wildlife in Canada. Approximately 18% of nationals participated in fishing and 5% hunted. The total expenditure of Canadians who participated in wildlife-associated recreation in 1996 was approximately US$4 billion (44).

Non-consumptive use of wildlife

The non-consumptive use of wildlife is mostly based on the aesthetic value of wildlife. Wildlife becomes the support of the tourism industry, as beaches are the support of the seaside tourism industry. This category of tourism is essentially based on wildlife viewing and is almost entirely part of the service sector.

Africa

A Persian word, adopted in Swahili, 'safari', has become a world-wide term used for journeys through the African national parks with the purpose of observing wildlife, landscape and local atmosphere.

Several nations in Africa, mainly in the eastern and southern parts of the continent, earn substantial income through wildlife tourism.

In Kenya, tourism is the leading foreign exchange earner and a significant portion of this tourism is wildlife-based (133). The tourism industry generated US$484 million in earnings in 1994. This income represents roughly 35% of the total foreign exchange earnings in a year. The number of visitors rose from 826,200 in 1993 to 863,400 in 1994 and most visit the national parks and reserves for wildlife safari tourism.

In South Africa, 90% of the 1,052,000 tourists registered in the country in 1995 travelled to visit the national parks and generated an economic flux of R13 million.

In Tanzania, wildlife tourism generates a global income of about US$570 million a year (E. Severre, 1999, personal communication).

Some national parks in the Great Lakes Region, such as the Virunga National Park in Zaire or the 'Volcanoes' National Park in Rwanda, earned massive income with 'gorilla tourism', especially after the publicity given to this species by the film 'Gorillas in the Mist'. In former Zaire, the number of visitors to the protected areas increased from 5,000 in 1972 to 25,000 in 1990; one third of the latter figure represents the entrances to the Virunga National Park which offers spectacular scenery and used to hold abundant wildlife before recent civil unrest in the region. In Rwanda, the income generated by the Volcanoes National Park in 1986 reached US$10 million, which represents one third origin of foreign currency earnings (135).

The situation is quite different in West and Central Africa where the protected areas are not as visited. The Djoudj National Park (Senegal), considered to be one of the best ornithological sanctuaries in West Africa, only admits about 1,500 tourists each year. The Pendjari National Park (Benin) recorded 2,000 visitors in 1991/1992 (135) and less than 500 people visit the Bouba Njida National Park (Cameroon) each year.

In Tunisia, where about 4.8 million tourists visit each year, national parks receive about 100,000 visitors, of which only 6% are foreigners (S. Darroze, 1998, personal communication).

Contrary to popular belief, wildlife tourism is not only found in Africa.

Americas

North America

Non-consumptive wildlife-associated recreation is much more significant than consumptive activity in the USA and Canada.

In 1996, nearly 63 million residents of the USA aged 16 years or more (31% of the population of the USA) participated in some form of non-consumptive use of wildlife and spent US$29 billion, which is much less than the amount which the consumptive users contribute. Expenditure was categorised as trip-related, equipment and other expenses. Trip expenditures totalled US$5.4 billion for food and lodging, US$2.9 billion for transportation and other costs such as land-use fees. Equipment rental totalled US$1.1 billion. Expenditure totalled US$8.2 billion for wildlife-watching equipment, US$900 million for auxiliary items, such as tents and back-packing equipment, and participants spent US$7.6 billion on special equipment including off-road vehicles, bikes and boats (8). Other expenditure included magazines and books totalling US$395 million, US$862 million on membership dues and contributions, US$1.3 billion on land leases and ownership and US$537 million on plantations to attract wildlife (8).

It was estimated that in 1996, Canadians spent US$1.3 billion while participating in non-consumptive wildlife-associated recreation (44); again, this is three times less than the amount contributed by consumptive users. Of that total, US$65.7 million was spent on accommodation, US$155.6 million on transportation, US$100 million on food, US$708 million for equipment and US$272.2 million on miscellaneous goods used by individuals enjoying wildlife activities (44). Wildlife viewing attracted 526,000 visitors from the USA to Canada and residents in the USA spent US$706.3 million on lodging, food, transportation, user fees, equipment and rentals (44).

Participation in most wildlife-associated recreation has steadily increased and is projected to continue to grow in the future. Between 1982 and 1995, there was an increase of 155.2% in the number of people who participated in bird watching in the USA (32), and non-consumptive wildlife use is projected to increase by 61% by 2050 (18). This tremendous increase in wildlife-associated recreation and the expenditure associated

with these activities will continue to enhance the economic value of wildlife in North America.

South America

The Galapagos Islands National Park in Ecuador is one of the most popular destinations for wildlife viewing in Latin America. The total income generated by tourism in the Galapagos Islands was US$32.6 million in 1990 and US$35 million in 1992. This is probably the most popular tourist site in Latin America (62,800 visitors in 1997). Access is now limited to prevent damage to the ecosystems of the islands.

Neotropical forests and the inhabitant wildlife are also becoming popular destinations in international tourism. Costa Rica benefits significantly from nature and wildlife tourism. This activity has become the top source of foreign exchange. In 1992, 610,093 tourists visited Costa Rica, generating US$42.1 million. However, only a small percentage of this amount is invested in the conservation of protected areas or the development of surrounding communities (36).

To a lesser extent, other rain forests show particular promise. During 1987, a total of 250 visitors to the Manu National Park in Peru generated US$125,000 in revenue (58).

Prospects are good: flooded savannahs, such as those in the Pantanal or the Venezuelan Llanos where wildlife is abundant and readily visible, are likely to become successful nature tourism centres in Latin America.

Asia

Some national parks in Asia attract as many or more tourists as parks in East Africa. In Sri Lanka, the Yala and Uda Walawe National Parks receive 250,000 visitors each year and generate US$0.6 million income. In Nepal, during the 1998/1999 season, 105,880 tourists entered the Chitwan Royal National Park and spent US$0.75 million, a high proportion of which was spent on renting elephants (*Elephas maximus*) to approach one-horned rhinos (*Rhinoceros unicornis*), tigers (*Panthera tigris*) and other spectacular wildlife (E. Wikramanayake, personal communication).

Europe

In Europe, wildlife is not the main incentive for visitors to national parks; these are actually visited more for the landscapes. In a survey conducted by the 'parc national des Ecrins' in France, among the factors which motivate the visitors, the item: 'to observe free-ranging wildlife' was ranked in fifth position, far behind 'to contemplate the scenery', 'to relax in a natural place', 'to breathe fresh air' and 'to practise a sport' (141).

However, endemic or rare wildlife species do sometimes attract tourists. In the Abruzzes National Park in Italy, which receives 2 million visitors a year on account of its great biodiversity (62 species of mammals, 230 of birds, 16 of reptiles, 12 of amphibians, 16 of fish and 2,000 of invertebrates), and mainly because of the presence of endemic species, such as the brown bear 'marsicano' (*Ursus arctos*) or the Abruzzes chamois (*Rupricapra rupicapra*) and species of wolf (*Canis lupus*) and wild cat (*Felis catus*) (138). This is also true for the Bialowieza National Park in Poland which shelters the last free-ranging European bison (*Bison bonasus*) and an important population of large predators like wolves and lynxes (*Lynx lynx*).

Consumptive use of wildlife

Consumptive use of wildlife is an ancient practice, as old as humankind and is responsible for the development of the human brain, having been the support of livelihood for most ancient civilisations and enabled survival for many, e.g. the hunter-gatherers, trappers, reindeer (*Rangifer tarandus*) herders, Inuits, etc.

The modern man progressively distanced himself from using wild animals as dependence on domesticated animals increased. However, wild animal production remains important to many developing countries and for many developed countries provides an opportunity to diversify crowded domestic animal production, or sometimes even becomes a replacement activity (Scandinavia).

Sustainable use of wildlife is fully recognised as legitimate by all international institutions and conventions. During the last World Conservation Union (IUCN) Congress held in Amman in 2000, sustainable use of wildlife was again officially reconfirmed as a way in which biodiversity could be protected and the development of rural communities could be assisted.

The classification used below was chosen for practical purposes. However, no abrupt distinction exists between hunting and husbandry and a continuum covers all wild animal production from the extensive systems to the intensive management practices.

Wildlife husbandry

The distinction between domestic and non-domesticated animals remains theoretical, as follows:

– most domestic animals may return to the wild as feral taxa, demonstrating that domestication is not a permanent state

– many wild taxa may be domesticated and perhaps all may be imprinted.

The so-called non-conventional animal productions are in fact very ancient, having been practised for hundreds of millennia, while domestic animal production (so-called conventional) has been in practice for only a few millennia.

Numerous and varied animal production systems exist for wild and domestic animals. There are grey areas where physical control of the wildlife is limited, yet wildlife products for consumption and trade are highly organised and of high quality (43).

Compared to the number of existing animals, very few are domesticated today (perhaps 20 taxa of mammals out of 4,500 and only a dozen taxa of birds out of 10,000). Some of these animals were domesticated in the past, as in Latin America, where the guinea-pig (*Cavia porcellus*) and the llama (*Lama* spp.) were domesticated by pre-Colombian civilisations many centuries ago. Historical accounts suggest that the Maya raised ocellated turkeys (*Meleagris ocellata*), collared peccary (*Tayassu pecari*) and white-tailed deer (*Odocoileus virginianus*) (118). Compared to the ancient societies, modern man has made very few attempts to domesticate new taxa.

Wildlife ranching

Reindeer herding

Reindeer herding may be comparable to cattle herding on a ranch system: for example, the Lapps of Scandinavia maintain the animals in a semi-wild state, follow the movements of their free-roaming migrating herds and round them up with snowmobiles in winter and motorbikes in summer (154).

The number of extensively farmed or range-reared deer greatly exceeds the number of fully domesticated farmed deer. Reindeer alone in Russia, Scandinavia and Alaska account for about 63% of the total numbers of farmed deer (43).

The herded reindeer population may reach 3.5 million head in four areas, as follows:

– Canada (mainly Yukon and Northwest Territories): 9,825 head (59)

– Russia: 2.5 million head (154)

– Scandinavia: 900,000 winter stock in 1989 (154)

– USA (Alaska): 25,000 in 1950 (154) (this figure is increasing).

Game ranching

Africa

In South Africa, 5,061 'exempted' game farms extend over a total surface of 10.4 million ha with an average range of 821 ha to 4,021 ha (T. Eloff, personal communication). Half of the farms are situated in the Northern Province and a rise of 5.6% was recorded in the size of the game farms between 1993 and 2000.

A total of 9,000 game ranches are registered and 4,000 integrated mixed game and cattle ranches of a total of 13,000 ranches deal with wildlife. The area covered extends over 16 million ha (13.6% of the country or 2.5 times the surface of the National Parks) (H.B. Falkena and W. Van Hoven, personal communication).

Wildlife ranching provides a good demonstration of the contribution of the private sector to conservation: there is more wildlife now in South Africa than a century ago.

Globally, the income derived from wildlife ranches is made up as follows: 80% from hunting, 10% from ecotourism and 10% from sales of live animals.

Wildlife auction sales in South Africa illustrate the true economic value of large mammals as reflected by the market value. In 1991, 8,292 animals were sold for R9 million in nine sales. In 2000, 17,702 animals were sold for R62.9 million in 48 sales. Average auction sales prices are as follows: roan (*Hippotragus equinus*) sold at R17,000 in 1991 and R83,000 in 2000, sable (*Hippotragus niger*) R25,286 in 1991 and R53,000 in 2000 (T. Eloff, personal communication).

In Namibia, a World Bank survey conducted in 1996 (17) showed that the net economic return from communal livestock farming on commercial land, at least in the more arid regions of Namibia, is almost certainly negative and that wildlife utilisation combining tourism, hunting and cropping offers significantly more favourable returns on communal land, while trophy hunting has proved to be a growing success on private farms.

In Zimbabwe, the Bojö survey demonstrated that wildlife enterprises in the large-scale commercial ranch sector were often more financially profitable than cattle enterprises (17).

A comparison between the profitability of the various ranching systems (i.e. cattle alone, mixed cattle and wildlife or only wildlife) in the midlands of Zimbabwe concluded that the most economically profitable was cattle breeding, followed by mixed cattle/wildlife (with more cattle than wildlife) and, last, husbandry of wildlife alone (78). On the other hand, in the semi-arid regions or regions with unreliable rainfall, wildlife alone provides more profit than either cattle or mixed wildlife/cattle, particularly if several species are ranched, thereby allowing uses to be made of the wildlife (hunting, tourism, cropping) (73).

Although game meat is more expensive than beef (R10.75/kg, compared to R4.6/kg in 1991), income per hectare is greater when only cattle are raised (US$10/ha for cattle compared to US$3.5/ha for wildlife), the income is similar at the beginning and then decreases significantly with the cost of cropping wildlife.

Several authors have tried to estimate the real cost of one kg of wildlife meat (24). This cost can be divided into three parts, namely: cost of cropping (variable according the means used), cost of carcass processing and salary of the farmer. For instance, in 1992, the South African company, De Beers, produced wildlife meat at R4.42/kg and the cropping cost and processing cost accounted for more or less R1 (149). A ranch in Kenya sold game meat for human consumption at about US$2/kg, and for pet food at about US$1, with the cropping cost accounting for US$0.7/kg (D. Hopcraft, personal communication).

On the other hand, the investments required to start a ranch and manage it are much cheaper for wildlife than for cattle, mainly because the infrastructure and management inputs are much less important (R. Bigalke, personal communication).

As shown by the Wildlife Reserve of Madikwe (South Africa), if the interest of the local population is taken into consideration, wildlife ranching (with multiple uses), creates more jobs and income than does cattle ranching.

South America

Wildlife ranching for selected species has a definite potential on private land in Latin America. Wild vertebrates that provide meat and pelt products could be integrated into livestock ranching in areas of traditional livestock ranching where abundant wildlife is present, such as the Chaco Region of Paraguay, or the Pantanal area in Brazil (131).

In Venezuela, the Government allows the harvest of capybaras (*Hydrochaeris hydrochaeris*) and spectacled caimans (*Caiman crocodilus*) on large ranches. The caiman harvest is limited to 15% of the population measuring over 180 cm (adult males essentially). Most of the harvest is exported for hides and a certain amount as pets. Between 1991 and 1993, Venezuela exported 24,500 caiman hides and 30,000 immature caimans for the pet trade (104). Capybara quotas are limited to between 20% and 30% of the population of individuals weighing more than 35 kg (94, 102). For private owners, the management and marketing of meat and pelts from those two species accounted for an increase of 61% in comparison with the income generated by livestock alone (69).

Green iguana (*Iguana iguana*) ranching has been attempted experimentally in Costa Rica in the Carara Biological Reserve, where more than 180,000 subadult individuals have been released to be regularly cropped at a rate of 8,000 to 10,000 individuals per year to be used for meat consumption, leather production, pet exports and tourism (73, 153).

Ranching of Psittacidae, such as scarlet macaws (*Ara macao*) or Amazon parrots (*Amazona* spp.) of commercial value is under study in several countries, for example, Argentina and Costa Rica (142, 150).

Wildlife farming

Deer farming: the most spectacular history of wild animal production

Our ancestors have domesticated all the current domestic animals. The only taxon that may be considered as approaching domestication by modern man is deer. As Fletcher states, deer is the first new domesticant of the last 5,000 years (52).

As far as is known, deer farming originated in the Far East some 3,000 years ago, probably in the People's Republic of China during the 14th-12th Centuries BC for the purposes of producing meat, velvet and musk (101). The modern deer-farming industry was initiated in New Zealand in the late 1960s and New Zealand remains the leader in this particular area (Table I).

Europe

Europe is a complicated patchwork of countries where different deer groups are farmed in a variety of ways (43). There are more than 10,000 deer farms in Europe with numbers increasing (152).

New Zealand

After rising rapidly from approximately 500,000 in 1987 to 1.4 million in 1994, the rate of growth in herd numbers has slackened to reach an estimated 1.6 million deer in 1997 (136) and 2,560,000 in 2001 (G. Asher and T. Pearse, personal communication). Close to two million farmed deer, half the farmed deer population of the world, on more than 4,000 farms bring over NZ$200 million into New Zealand every year (157). A few pioneers, such as Sir Tim Wallis, initiated the entire process of developing an industry from scratch.

The New Zealand deer farming industry chooses to continuously develop its own technology, reaching an ever-growing level of sophistication which nearly matches the proven sire programme of the dairy cattle industry, based on breeding technologies and progeny testing. Deer breeding techniques can achieve the following:

a) advance the deer breeding season

b) extend the breeding season

c) increase the number of offspring from the more valuable genetic stock

d) multiply the more valuable animals in herds at a faster rate than occurs naturally (average of three fertilised ova per hind with up to ten ova per collection).

Artificial insemination is cheap and easy but has the limitation of only representing the component of male genetic gain. Super ovulation and embryo transfer does introduce the female component to genetic gain, but only one super ovulation session is possible per season and responses vary widely among donors. Ultrasound guided transvaginal ovum pick-up (OPU) is a non-invasive (non-surgical) technique whereby eggs are collected from live hind followed by *in vitro* fertilisation and embryo transfer (129).

Research on soil and pastures, deer herd performance, animal health, veterinary issues, welfare, trace elements, deer production, new technologies and environmental aspects are all being improved on a continuous basis.

Table I
Current status of deer farming and ranching

Continent	Region or country	Main taxa raised	Stock	Source
Africa	Reunion Island	Rusa	2,000	(82)
	Mauritius	Rusa	60,000	R. Hudson, personal communication
Americas	Argentina	Red, fallow, axis	2,000	
	Brazil	Rusa	1,000	J. Schweizer, personal communication
	Canada	Wapiti, fallow, white-tail	99,000	(59)
	United States of America	Fallow, red, axis, white-tail, wapiti, sika	250,000	(46)
Asia	People's Republic of China	Sika, red, wapiti	500,000	(43)
	Far East, Commonwealth of Independent States (Russia)	Sika, wapiti	400,000	(43)
	Korea	Sika, wapiti, red	200,000	(43)
	Malaysia	Rusa, fallow	15,000	(43)
	Taipei, China	Sika, sambar, red	36,000	(43)
	Thailand	Rusa, sambar	5,000	(90)
	Vietnam	Sika, sambar	15,000	Ph. Chardonnet, personal findings
Europe	Austria	Fallow	39,600	(152)
	Belarus	Sika	1,300	(37)
	Benelux	Red	3,300	(152)
	Czech Republic	Red	9,800	(152)
	Denmark	Fallow, red	31,200	(152)
	France	Red, fallow	58,000	(152)
	Germany	Fallow	103,660	(152)
	Great Britain	Red, fallow	36,000	(152)
	Hungary	Red, fallow	1,100	(152)
	Ireland (including Northern Ireland)	Red, fallow	61,000	(152)
	Italy	Fallow, red	24,000	(152)
	Lithuania	Sika	850	(37)
	Norway	Red	800	(152)
	Poland	Red	1,000	(37)
	Portugal	Red	1,300	(152)
	Spain	Red	4,000	(152)
	Slovakia	Red	2,000	(152)
	Sweden	Red, fallow	25,800	(152)
	Switzerland	Red, fallow	7,600	(152)
Pacific	Australia	Red, fallow, rusa	200,000	(130)
	New Caledonia	Rusa	18,000	Ph. Chardonnet, personal findings
	New Zealand	Red, wapiti, fallow	2,560,000	G. Asher & T. Pearse, personal communication
Total			**4,825,260**	

Conventional breeding techniques tend to be slow and somewhat haphazard. Biotechnology-based marker assistance enables the specific selection of genes that promote 'rapid' or 'efficient' growth, 'lean carcass' or 'disease resistance' etc., dramatically increasing the speed of development (157). Biotechnology represents a range of tools and skills, including biochemistry, molecular genetics, physiology, applied genetics, molecular biology, computer science, bioinformatics and proteomics.

The search for new genes has been variously described as a 'race' or even a 'gold rush'. Gene discovery, the attribution of a function to genes and the patenting thereof has become industrialised. The genes themselves have already become a valuable sort of currency or bargaining chip (157).

Australia

About 1,200 deer farms operate in Australia (130).

People's Republic of China

Currently over 500,000 deer are raised on farms in various parts of the People's Republic of China, mainly for antlers in velvet (101), as follows:

– 350,000 sika deer (*Cervus nippon*)

– 150,000 red deer (*Cervus elaphus*)

– 1,500-2,000 white-lipped deer (*Cervus albirostris*)

– 1,200-1,500 sambar deer (*Cervus unicolor*).

Much of the deer industry is based on feedlot management with a 'cut-and-carry' feeding system, and is almost entirely focused on the production of velvet antler for the local traditional medicine trade.

Canada

In 1997, nearly 100,000 cervids (*Mazama* spp.) were farmed, with a total livestock value of CDN$488.7 million and a fencing and facilities investment of CDN$208 million (59).

Other wildlife farming

Africa

Economic and financial analyses both indicate that private wildlife ranching is more profitable than official ventures, whereas wildlife domestication emerges as most profitable locally. Small-scale farming is more profitable than large-scale farming. In the financial analysis, small-scale grasscutter (*Thryonomys swinderianus*) farming shows the best returns, followed by poultry and rabbit farming. Considering the relative returns of crops and wildlife, the grasscutter compares favourably to the most profitable cropping activities. Encouraging such an activity in rural areas would enhance the income-earning capability and increased protein intake of rural dwellers (17).

The grey-breasted helmet guinea-fowl (*Numida meleagris*) is raised by villagers in several countries of West Africa, such as Burkina Faso and Benin. A successful attempt to breed the double-spurred francolin (*Francolinus bicalcaratus*) has succeeded in Benin (45).

Ostrich (*Struthio camelus*) and Nile crocodiles (*Crocodylus niloticus*) have become classic productions in South Africa and Zimbabwe since the beginning of 20th Century.

South America

Wildlife farming is an emerging industry in South America.

The economic value of wildlife has generated many initiatives of wildlife farming in Latin America. During the last century, South American furbearer rodents such as the chinchilla (*Chinchilla laniger*) and nutria (*Myocastor coypu*) were domesticated for the pelt and fur industry. Nowadays, efforts are being made to develop captive husbandry of wild mammals. In the majority of cases, rearing game is not the best way of providing meat to rural populations in tropical countries, but it is a valuable source of profit if sent to urban markets where the products fetch the highest prices (49). In São Paulo, for instance, it is estimated that 100 metric tonnes of wildlife meat from game farms from capybara, collared peccary or Amazon turtles (*Podocnemis expansa*) are consumed in restaurants specialised in game which are encouraging the growth of an emerging wildlife industry in Brazil.

A large number of South American rodents are being farmed. Those that produce the highest economic returns are nutria and chinchilla, the industry of which developed in the 1920s. About a million nutria pelts were produced from farming in the 1980s. Moreover, about 250,000 chinchilla pelts were produced in 1994, providing an income of US$5.5 million (124). However, most of the farms of this furbearer rodents are based outside South America.

The paca (*Agouti paca*) is probably one of the most sought after mammals in Latin America due to the popularity and tenderness of its meat. As a result, several attempts have been made to farm this animal in captivity (134). However, its aggressive behaviour and low productivity have limited the technical development of captive husbandry (104). Some authors have mentioned *Dasyprocta* rodents as possible candidates for the development of small-scale farms (74).

The capybara is probably one of the mammals of greatest interest for wildlife production in Latin America, due to its high reproductive turnover, elevated weight (50 kg), and the possibility to exploit both meat and hide simultaneously. The feasibility of raising capybaras in captivity has been demonstrated by several authors (57, 100, 104). The price of the meat in urban areas of Brazil is at least four times higher than that paid for the meat of domestic pigs. In the State of São Paulo alone, two tonnes of capybara meat are marketed each month. Moreover, the hides are of good quality for tanning and marketing. Some authors claim that agouti (*Dasyprocta* spp.) farming could be developed for meat production. However, little research has been conducted to date on the captive husbandry of these tropical rodents (74).

The collared peccary has been considered an interesting species for captive breeding since it was thought to present a rapid growth rate, similar to that of *Suidae* (49). As a result, collared peccaries are being farmed experimentally in Brazil, Peru, French Guyana and Colombia with considerable success.

Export bans imposed by the international community forced the biomedical research industry to seek alternative sources of live primates. As a result, some South American countries, such as Peru, are breeding primates from the species *Saguinus*, *Aotus* and *Saimiri* in close captivity or in semi-natural conditions on islands, to provide experimental animals for biomedical research (7, 104).

Amazon turtles are being reared in Brazil for commercial production, after the Government of Brazil, encouraged by a successful programme for the conservation of *Podocnemys expansa*, allowed the use of 10% of the offspring produced annually to be used for farming. As a result, 43 turtle farms in Brazil are producing a total of 340,000 animals in captivity which are sold in urban centres in Brazil (104).

The spectacled caiman is bred on commercial farms in Colombia. In 1994, there were more than 84 registered farms. Nevertheless, the cost effectiveness of these ventures is jeopardised by the instability of the international pelt market and the low price of caiman hides compared to other crocodilian species (143).

Initially designed for meat and egg production, iguana farming developed well during the past decade in Central America (73, 147). However, private farmers soon discovered that the most profitable option for iguana and small reptile farming was the export of 'exotic' pets to Europe, the USA and Japan. This has become the principal goal of current iguana farms in Central America.

Asia

Deer farming is popular in Asia. Crocodile farming is developing, with nearly 20,000 head raised in the sole Samutprakan farm in Thailand. Butterfly farming is thriving in South-East Asia and Papua New Guinea. Other controversial farming enterprises concern tiger and bear in the People's Republic of China.

Europe

Unlike deer, which are raised principally for meat production, several indigenous wildlife species are farmed for hunting purposes (restocking or releases). Among these, the brown hare (*Lepus europaeus*), wild rabbit (*Oryctolagus cuniculus*), pheasant (*Phasianus* sp.), partridge (*Perdix* and *Alectoris*), mallard (*Anas platyrhynchos*), quail (*Coturnix coturnix*) and wild pigeon (*Columba palumbus*). The wild boar (*Sus scrofa*) is raised both for hunting (in enclosures) and venison.

Most countries produce game to satisfy domestic consumption, but some export their production, namely: hares (Central Europe: Hungary, Poland, the Czech Republic and Slovakia), pheasants and partridges (Belgium).

This sector is relatively well developed. A study conducted in 1994 in France (9) on legally gazetted wildlife farms found that in 1991 populations (in brackets: production figures in thousands) were as follows: 2,878 pheasant (12,000), 1,429 wild boar (62), 1,380 brown hare (100), 1,190 partridge (5,000), 553 wild rabbit (100), 516 mallard (752). However, the true numbers are far in excess of these figures, as much of the production is derived from eggs (several hundred thousand mallard hatched on private land for release into the wild).

Besides those indigenous species, an increasing number of exotic species is being farmed for meat and/or products and for tourist purposes (South American camelids, crocodiles, bison, ostrich and other struthionids) and sometimes for habitat management (South American camelids). This form of farming is still marginal; the study mentioned above recorded 28 farms breeding 269 South American camelids, 20 bison farms with 324 animals and 25 struthionid breeding establishments with 603 birds.

Farming of marginal species

Snakes

Snake breeding seems to be practised in Vietnam, approximately 50 km from Hanoi. Snake meat is highly appreciated and, in some cases, the eggs are also consumed (19).

Frogs

Imports of frogs' legs by the members of the European Union between 1988 and 1992 amounted to a yearly average of a little more than €29 million. These frogs originated mainly from Indonesia, but also from the People's Republic of China, Turkey and Vietnam. Belgium, Luxembourg and France account for 80%-90% of total imports (60). There is also a large demand in the USA (98). Although the frogs' leg market is supplied almost exclusively from wild frogs, commercial frog breeding is developing. The main species bred commercially are as follows: *Rana catesbiana*, *R. pipiens*, *R. tigrina*, *R. esculenta*, *R. ridibunda*, *R. hexadactyla* and *Lexadactyla ocellatus*. Not only frogs' legs and bodies but also frogs' skins have a market (97, 98).

Frogs are reared in many developing countries, such as Brazil, the Philippines, Thailand, Indonesia, the People's Republic of China, Bangladesh, Vietnam and also in Europe: Spain (89, 123), Italy and Turkey.

Snails

Snails are farmed industrially throughout the year in Flanders (Belgium); some farms produce 15,000 snails weekly. With *Helix aspersa maxima*, the Flemish snail farming method requires 15 g feed (containing 25% chalk and 10% sand) to obtain a live weight of 25 g in four months (38).

A small-scale snail-farming sector has been developed in West Africa (Benin and Ghana, in particular) not only to supply the market with snails of the genus *Achatina* and highly popular *Archachatina*, but also to preserve them (61). In the Côte d'Ivoire, for instance, a survey performed over 15 months in Abidjan, indicated that about 452 tonnes of fresh *Archachatina ventricosa* and *Achatina achatina* were traded on the local markets (10).

Insects

The rearing of blowflies to produce maggots used in therapy to clean wounds is going to develop. The rearing of these flies was practised before and numerous references to general maggot rearing in the older medical literature are available (132).

Butterflies, especially bird-wings, are ranched by villagers, both in Papua New Guinea and Irian Jaya and marketed overseas (91).

Wildlife hunting

Hunting is an historical and cosmopolitan activity. It is probably as old as humankind and it is practised across the world. A major part of the animal world is involved, with a wide range of taxa belonging to mammals, birds, reptiles, amphibians, molluscs and fish. All sorts of people hunt, from specialised hunters (hunter-gatherers, professional hunters in agro-societies, etc.) to non-specialised hunters (agro-hunters, breeder-hunters, urban hunters, etc.).

Given the variety of situations, the purpose of hunting is not unique. Reasons for hunting vary, from subsistence to commercial, to leisure. This classification has been used here to present a brief summary of the value of wildlife hunting.

Subsistence hunting

In Africa, associations of hunters play an important role in the community. As with other secret societies, they use their own language, wear their particular clothing with talismans and amulets, play their own music and respect their own rites in all circumstances of life. Hunters play the role of an interface between the bush and the village, nature and the culture. During ceremonies, masks representing animals are the expression of the anti-world made of 'genies' of the bush and they illustrate an image complementary to the ideal social behaviour of moderation and reflexion, the genuine qualities of culture and civilisation. These masks represent both the dangerous sides of the bush and the assets of the bush on which society depends: food, raw materials, knowledge and human fecundity (29).

As in many parts of the world, hunting remains an important subsistence activity in Latin America, providing a large proportion of the meat eaten by rural populations. Despite the nutritional importance, the study of hunting in the neotropics has been largely ignored for decades. Only in the last decade have researchers interested in tropical resources focused their attention on the ecological and socio-economical importance of wildlife (14, 103, 104, 119, 121).

Redford and Robinson reviewed 22 studies of subsistence hunting in neotropical forests, showing that Indians and colonists of European descent harvest different sets of game, the former selecting a much greater variety of species (117). Mammals and birds were the animals most harvested, particularly among Indian hunters. Indians took a higher average number of animals per consumer per year than did the colonists. However both hunters converged in the choice of their favourite game. For Indians, primates were clearly the most frequently harvested mammalian order, followed by rodents, ungulates, edentates and carnivores. For colonists, rodents were most popular, followed by ungulates and then primates a distant third (116).

The number of animals taken by subsistence hunters can be very large. In 1980, the number of mammals killed in the Brazilian Amazon alone (2,847,007 people in an area of 3,581,180 km^2) resulted in the harvesting of 14,030,050 individuals. If birds and reptiles are added to this figure, the number of game killed per year could reach more than 19 million individual animals (116). The total production of wild meat for the entire Amazon Basin is valued at more than US$175 million per year (7).

In the South Pacific, particularly in the Southern islands, Tuamotu and the Marquises, young sea birds and eggs, mainly *Sterna fuscata*, are collected regularly (125).

Commercial hunting

Commercial hunting can be of different forms and scales, namely: from surplus offtake from subsistence hunters to organised commercial exploitation of certain species for their meat, teeth, horns, skins, pelts, furs or live animals.

Commercial hunting has the advantage of generating significant income and work for many people involved in the trade of valuable wildlife products, particularly if intended for the international market. However, very often the prices of those items are unstable and are dependent on fashion or international economy and this may reduce income and generate severe instability to the local economies involved.

Sport hunting

Sport hunting is performed by millions of hunters around the world (10 million in Europe alone), but tourist hunting by foreign hunters travelling to other countries must also be taken into consideration. People have hunted as a sport for millennia. Today, this activity is a full sub-sector of the tourism industry and plays an important role in some countries and societies, while it is opposed in others.

Africa

Of fifty countries in Africa, about twenty have developed a tourism industry which includes hunting (the number fluctuates with countries opening or reopening hunting and others closing access to hunting). Sport hunting in Africa is up-market, the number of hunters is limited (about 10,000 per year), and the market is limited although income is substantial. The biological impact of sport hunting is small due to the limited number of hunters and also because the animals hunted are only mature males. The hunters most often look for trophy animals, which are usually only old males.

In Zimbabwe, safari hunting accounts for the bulk of revenue earned in communal areas (17). In Tanzania, the sport hunting season in 1998/1999 yielded US$9.6 million to the State, in direct taxes alone (Table II) (E. Severre, 1999, personal communication).

Table II
Partial data on tourism hunting in Southern Africa

Country	Number of foreign hunters per year	Yearly turnover (US$)	Jobs in the sector	Number of organisations	Number of areas
Botswana	150 to 200	20 million	More than 1,000	17	15
Namibia	2,000 to 3,000	26.7 million	2,125		400
South Africa	4,000	30 million	5,000-6,000		
Zambia		12 million			
Zimbabwe		70 million			

Source: Safari Club International (African Chapter, personal communication)

In Tunisia, sport hunting includes indigenous species like wild boar, hare, partridges, pigeons and doves, as well as migratory birds, such as thrush, wild pigeon, quail, duck or waders. This activity earned an income of 1,734,000 Tunisian dinars in 1997-1998 and 1,576,500 dinars in 1998-1999 (approximately US$1,452,000 and US$1,320,000 respectively) (S. Darroze,1998, personal communication).

Wildlife hunting presents some ecological advantages compared to livestock. Wildlife can be profitably stocked at a significantly lower rate than that required for cattle, due to the high values associated with hunting safaris (28). In a given region, hunting may be a strong incentive for maintaining the natural habitat rather than transforming it for farming or husbandry. In this case, the hunted game plays the role of an umbrella species for the entire biodiversity. In many instances, former game reserves set aside by sport hunters are now famous national parks.

Americas

United States of America

In the 1996 survey conducted in the USA, 14 million people (7% of the population) aged 16 years and more, participated in hunting a variety of game animals. Of these hunters, 11.3 million pursued large game such as deer, bear, elk and wild turkey, and lower numbers of hunters pursued small game, furbearers and migratory birds. Hunters took 223 million trips, hunted 257 million days, and their expenditure totalled US$20.6 billion (20.4% of total wildlife-related activities). This represented an increase of US$6.1 billion of the total hunting expenditure compared to 1991, with adjustments made to account for inflation. Hunting activities provided US$16.1 billion in household income, US$3.1 billion in State and Federal tax revenue, 704,000 jobs, and an economic multiplier effect of US$61 billion (8). Many of the economic benefits derived from hunting had a positive impact on rural areas where farm economies are depressed at times.

In the USA, hunters pursued game on public and privately owned lands in their resident State, as well as in other States. Approximately 17% of hunters used public land only, 30% used public and private land, 51% used private land only and 2% used unspecified land (8). User fees associated with private land can be a significant source of land-owner revenue in some areas. In 1986, the net income for ranchers in Utah who charged land fees to elk and deer hunters amounted to US$160,663 (72). The vast majority of hunters in the USA (86%) hunted only in the State of their residence, while 9% hunted in other States as well as their own, and 5% hunted only in other States (8).

Hunting expenditure was categorised as trip-related expenses, equipment or other hunting costs. Trip-related expenditure comprised food and lodging which totalled US$2.5 billion, transportation amounting to US$1.8 billion and other costs, such as guide fees, land-use fees and equipment rentals totalling US$864 million. Equipment expenditure comprised hunting equipment which totalled US$5.5 billion, auxiliary supplies, such as camping equipment, binoculars and hunting clothes which totalled US$1.2 billion and special equipment, such as campers and trail bikes totalling US$4.5 billion. Other hunting expenditure included magazines, books, membership dues and contributions totalling US$355 million, land leases totalling US$3.2 billion and permit fees that totalled US$700 million (8).

Hunting activity generates sources of revenue for wildlife management agencies in addition to fees paid for hunting permits. In the USA, Federal aid is granted to States and territories through an excise tax on hunting equipment and ammunition through the Federal Aid in Wildlife Restoration (Pittman-Robertson) Act. Pittman-Robertson funds provide financial support for the selection, restoration, rehabilitation and improvement of wildlife habitat, wildlife management, research and the dissemination of information produced by the projects (156). Funds are derived from an 11% Federal excise tax on sporting arms, ammunition and archery equipment, and a 10% tax on handguns (156). These funds are apportioned each year to individual States and territories using a formula based on the total land area and number of licensed hunters in the State (156). Each State must match the Federal dollars in a ratio of 1:3, that is, for every US$3 of Pittman-Robertson Act funds received by a State, US$1 of State money is added. From

1937 to 1985, the Pittman-Robertson Act generated over US$2 billion for the wildlife of the country (156), and produced approximately US$120 million annually in the 1980s (33). The estimated Pittman-Robertson Act apportionment of Federal aid for the 2002 fiscal year is approximately US$132 million (148).

Canada

A 1996 survey on the 'Importance of Nature to Canadians' stated that approximately 5.1% of Canadians participated in hunting wildlife in Canada (44). The total estimated expenditure of hunters was approximately US$824 million, with an average yearly expenditure per hunter estimated at US$692 (44). Of the total hunting expenditure for 1996, US$39 million was spent on accommodation, US$166.5 million on transportation, US$99.4 million on food, US$383 million on equipment and US$136 million on miscellaneous expenditure (44). A model to determine the estimated benefits from moose (*Alces alces*) hunting in Canada showed that US$125 to US$175 was collected per hunting trip (126). In Canada, a small proportion of mature animals from deer farms go to the hunt ranch market, with prices in excess of US$20,000 paid by hunters wishing to take a trophy animal (59).

Latin America

Sport hunting in Latin America is an activity limited to middle-class urban populations (104). Mainly birds, such as pigeons and doves (*Zenaida* spp., *Columba fasciata*), waterfowl (*Dendrocygna* spp., *Anas* spp.) and lagomorphs (*Sylvilagus floridanus*, *O. cuniculus* and *Lepus* spp.) are involved. In some areas of Venezuela, the income received from waterfowl shooting during an entire season can exceed US$2 million (35).

Trophy hunting exists in Argentina, Cuba, Venezuela and Mexico for introduced red deer but it is not as widespread as in Africa. Local cervids, such as the white-tailed deer, are proposed in Costa Rica or Mexico (150) and exotic antelopes have been introduced to Argentina and Cuba for that purpose. Collared peccary, white-tailed deer and desert bighorn sheep (*Ovis canadensis*) are commonly hunted in Mexico. Large felid hunting such as for puma (*Felis concolor*) or jaguar (*Panthera onca*) used to be common in countries, such as Bolivia, Brazil, Paraguay and Venezuela, for controlling cattle killers, but only puma hunting in Argentina is currently authorised officially (4, 68).

Australasia

Some sport hunting has developed in the temperate regions of Asia, while the activity is rare in tropical Asia.

In Australia and New Zealand, few indigenous game species exist. However quite a number of exotic game species have been introduced and are hunted heavily to keep numbers to an acceptable level in terms of competition with economic activities and mitigate ecological impact on the original habitats of native species.

Europe

About 10 million sport hunters prevail in Western, Central and Eastern Europe.

Eastern Europe

Approximately 200 hunting enclosures exist in Belarus, the Czech Republic, Estonia, Latvia, Lithuania, Poland, Slovakia and Hungary, covering a total area of about 80,000 ha with about 50,000 animals, mostly red deer, fallow deer (*Dama dama*) and mouflon (37). However, there is also much hunting of free-ranging wild boar, brown bear, roe deer (*Capreolus capreolus*) and red deer, as well as chamois in the mountain ranges.

Western Europe

In Europe, hunting is the most important use of wildlife. This activity is practised as a recreational activity more than as a sport, the objective being the conviviality more than the harvest of a trophy or of meat. Large game, as well as birds and migratory fowl, are hunted throughout the area.

There are still significant communities of hunters in all the countries of Western and Central Europe. Their numbers are often comparable to those of the permit holders of collective or individual sports such as football or tennis (111). A survey conducted in 1995 by the Fédération des Associations de Chasseurs de l'Union Européenne (FACE: Federation of Associations for Hunting and Conservation of the European Union) in twenty countries in Europe gave an indication of the number of hunters, trends and how representative they were of the population (Table III).

Table III shows a steep decline in the numbers of hunters which is particularly marked in the Latin countries of Southern Europe. This trend was confirmed in France by the last national survey in 1999; the number of hunters has decreased by 22.7% over the past fifteen years. This survey also showed an ageing in the population of hunters; the medium age was 50 years in 1999 compared to 45 in 1984 (80).

These changes can perhaps be explained by both the decline of small game (rabbit, hare and partridge) which represented the bulk of the species hunted in these countries, but also by the loss of 'rurality' due to rural exodus. The latter led to a break in the transmission of the taste for hunting from father to son which remains the main recruitment path for new hunters. Today, 73% of the French hunters are sons of hunters or belong to families of hunters (80). The urban anti-hunting sentiment of ecologists helped to sever the rural roots of the neo-city dwellers.

Table III
Number of hunters, trend and rate in the population
(83, 111)

Country	Number of hunters	Trend	Quantification of the trend	Rate in the population
Austria	110,000	+/=	5% in 10 years	1/72
Belgium	29,000	=		1/348
Denmark	177,000	↑/=		1/29
Finland	300,000	↑	46% in 25 years	1/17
France	1,650,000	↓	2% per year	1/35
Germany	326,000	↑/=		1/247
Greece	293,000	↑↓		1/35
Hungary	50,000	↑	5-6% per year	1/206
Ireland	120,000	=		1/30
Italy	895,000	↓	10% per year	1/60
Luxemburg	2,500	=		1/160
Netherlands	32,000	=		1/454
Norway	170,000	+/=		1/25
Poland	99,000	↑	100% in 25 years	1/389
Portugal	243,000	=		1/40
Slovenia	23,000	=		1/84
Spain	1,000,000	↓	5% per year	1/39
Sweden	320,000	↑	20% in 25 years	1/27
Switzerland	30,000	=		1/230
United Kingdom	600,000	=		1/58
Total	**6,469,500**			

+/= : stable or slightly increasing
= : stable
↑/= : slightly increasing
↑ : increasing
↓ : decreasing
↑↓ : decreasing dramatically

The anti-hunting sentiment is not the same in all countries of Europe. In Scandinavia, the number of hunters is actually increasing. A survey performed in 1995 established that the perception of hunting by the public was quite positive in Sweden: 92% of the public supported traditional subsistence hunting by natives, 81% hunting for meat and recreation and 33% hunting for recreation and sport. Only 3.9% opposed all three types of hunting. It is worth noting that the USA, where the same survey was conducted, followed the same pattern as Sweden, the figures being 91%, 73%, 40% and 4.4%, respectively (64).

The quantity of wildlife harvested by hunting is very difficult to appraise, except for some species submitted as hunting quotas, such as roe deer or red deer in France; hunters usually dislike disclosing their hunting bags. However, in some countries, statistical studies provide an idea of the volume involved. In France, the hunting bags in 1998/1999 for 39 hunted species or groups of species were estimated and compared with the results of a similar inquiry performed fifteen years previously. For instance, the results showed that the six species of small game hunted in 1998/1999 were wild pigeon (5,169,000 individuals harvested), pheasant (5,661,000), thrush (4,583,000), wild rabbit (3,209,100), red partridge (*Alectoris rufa*) (1,732,000) and grey partridge (*Perdix perdix*) (1,453,800). They also indicated both a change in the rank of the species and a decline of some species over the last fifteen years. The estimated bag in 1983/1984 gave the following results: thrush (13,183,000), wild rabbit (6,155,000), pheasant (6,155,000), wild pigeon (5,761,000), grey partridge (2,181,000) and hare (1,584,000) (80). In regard to big game, the hunting bags in 1999/2000 were as follows: 408,627 for roe deer, 306,829 wild boar and 33,307 red deer (47).

The socio-economic impact of hunting is important. It has been estimated that, in the European Union, hunting generated a financial flux of about €9.88 billion and about 100,000 jobs (111). In France, in 1992, the value of this sector represented €1.95 billion and 23,000 jobs, which corresponded

approximately to the socio-economic 'weight' of the film industry (€1.95 billion and 24,800 jobs) (109).

In Portugal, it was calculated that the hunting of the red partridge alone generated between €0.31 and €0.38 million per year (53).

Demographic control

Another form of exploitation of wildlife is the control of expanding wildlife populations. The sustainability of the system is not an issue, as the purpose is to limit the growth of the population for ecological reasons.

Farmers in Australia have always regarded kangaroos as a pest, damaging crops and competing with sheep. Every year, the Federal Government authorises a certain number of kangaroos to be eliminated (5.6 million animals in 1999 compared to 885,000 in 1975); these figures do not take into account the animals killed by farmers and poachers, possibly totalling 9 million a year (140).

Several attempts have been made to limit the population of wild rabbits in Australia: physical measures (destruction of warrens, erection of rabbit-proof fences, rabbit netting, shooting), fumigation with chloropicrin and phosphine, poisoning with sodium monofluoroacetate (poison 1080), release of viruses such as the myxomatosis virus (the propagation of which was stimulated by the introduction of some of its vectors, the European rabbit flea [*Spilopsyllus cuniculi*], and a Spanish arid-adapted flea [*Xenopsylla cunicularis*]) or, more recently, rabbit haemorrhagic disease (rabbit calicivirus disease). As all of these attempts were unsuccessful in sufficiently limiting the population, a research programme on immunocontraception, using the myxomatosis virus as a vector, is currently being developed. Simultaneously, two to three million wild rabbits are harvested each year. All the products are used: the meat is consumed locally (about 1,800-2,000 tonnes per year) or exported, mainly to Western Europe and the USA; 200 tonnes of dried rabbit skins are used to make felt hats or other garments. The annual wholesale value of these wild rabbit products, including exports, was estimated in 1991 at about AUS$9 million (155).

In New Zealand, millions of exotic animals have been and are still being eliminated. These introduced taxa threaten the indigenous, and sometimes endemic, taxa mainly by destroying their habitats.

Wildlife products

Live animals

The preceding section illustrated the importance of live animal sales for the wildlife ranching industry in Southern Africa. In Canada, selected wapiti (*Cervus canadensis*) male individuals have sold for as much as CDN$135,000 for a half share (59).

Live trapping of primates was common during the 1960s and 1970s to provide the international market of biomedical research with experimental animals. Between 1964 and 1972, more than 50,000 primates were exported to the USA each year from Peru and Colombia. Most of the profit from this activity remained with animal dealers, and the profit for the trapper was often very small (8% of the final price) (103). Today, the biomedical research industry has shifted to other ways of obtaining primates, such as those which have been bred in captivity.

Reptiles and amphibians

Reptiles are increasingly sold as pets in developed countries. The royal python (*Python regius*) is one of the most appreciated snakes because of its lack of aggressiveness. Some West African countries (Ghana, Togo, Benin), specialise in the trade of this species. Togo exports 50,000 pythons a year. In Ghana, since the ban of the export of the grey parrot (*Psittacus erithacus*), the royal python has become the top wild species export as far as foreign currency earnings are concerned. Between 1991 and 1995, for instance, Ghana exported 102,578 live royal pythons for an amount of $US512,890; this figure represented 47% of the total income of the wildlife exported during this period. To protect this resource, python farms have been developing in Ghana since 1991. These farms are rather reproduction centres where gravid females caught in the field, lay their eggs before being released. They produced 30,000 young snakes in 1994. Of the offspring born in captivity, 90% will be exported and 10% will be released (106).

Many countries in Latin America are exporters of large quantities of small species of reptiles and amphibians for the American and European pet trade. During 1996, the exports of reptiles and amphibians from Nicaragua represented 70% of the animals exported from that country. This activity generated more than US$1.5 million per year. Species concerned by this trade are amphibians of the *Agallychnis* or *Dendrobates* genus, or reptiles, such as green iguanas, snakes (*Boa constrictor*, *Lampropheltis triangulum*) and small reptiles such as *Basiliscus* spp. or *Scleropus malachiticus* (73).

Live birds

Export of birds for the pet trade is widespread in Latin America. This affects mainly the Psittacidae (*Amazona*, *Ara*, *Aratinga*), *Ramphastidae*, *Icteridae* and *Fringillidae* families. The monetary value of parrot exports is significant. Between 1982 and 1986, the estimated total value of exports from Latin America was US$1.6 billion. The net profit made by middlemen was probably greater. Argentina exported more than 660,000 birds during this period (142). The national pet market in Latin America is also considerable. However, the precise impact and extent of this market are difficult to evaluate (7).

In Senegal, the law has set an annual export quota for 28 species of birds. This quota has remained the same since 1982, namely: 1,614,000 birds (96). Despite this law, the offtakes are very high. Numerous losses are claimed to occur along the trade chain from the field collector to the importer. It has been said that for 10 million exported birds, about 50% might die during the process. However, many of the exported birds are extremely abundant and considered as pests.

Products harvested on living animals

Velvet

Velvet (growing antlers) is cut on live cervids every year. Using genetic knowledge, biotechnology should allow the continued and scientifically-based development of a pharmaceutical industry. Deer antler and by-products are already in demand in traditional oriental markets and are emerging as powerful and effective food and health supplements in western cultures, with new applications to canine and equine veterinary medicine (157).

In Canada, in 1997, the antler harvest reached 50 tonnes for a total value of CDN$7.13 million; the principal market for the wapiti producers is for velvet antler with a market remaining strong as new heights are reached in velvet production (up to 18.2 kg velvet per head); there has been a strong local market with a massive influx of oriental people into Vancouver raising velvet prices as high as CDN$260/kg to as low as CDN$45/kg for the poorer, overmature material (59).

The People's Republic of China yields approximately 2.5 kg/stag per year from sika stags and over 7 kg/stag per year from wapiti-type stags (43).

The Republic of Korea is the major international market for velvet antler.

Australia produces 20 to 25 tonnes of velvet each year (130).

New Zealand is now the first modern producer of velvet in the world.

Russia has been producing velvet as traditional medicine for centuries.

Semen

Semen is another animal product that is collected without destroying the individual.

In Canada, selected wapiti semen sales at auction in 1997 have exceeded CDN$4,500 per straw (59).

Musk

The production of deer musk in the People's Republic of China was 1.4-1.7 tonnes a year in the 1950s and early 1960s for a harvest of 280,000-340,000 musk deer. Due to the high price of musk, the harvest increased to 500,000 annually during the 1960s. As a consequence, the population decreased from an estimated 3 million in the 1950s to approximately 1 million in the 1970s (101).

The production of civet (*Viverra civetta*) musk for the perfume industry is an ancient practice and is mainly performed in Ethiopia.

Venom

The production of snake venom is well established in Brazil by the Butantan Institute of São Paulo, which has made this activity its primary source of income. The Institute provides volunteers with catching equipment, transport boxes and detailed instructions. The snakes, mainly *Bothrops jararaca* and *Crotalus terrificus*, are displayed to visitors and are kept for venom production to be used in the manufacture of anti-snake-bite serum for the pharmacological industry (124). The same practice exists in Vietnam, and many other countries around the world where poisonous snakes are present.

A Red Cross snake farm has been in operation in Bangkok since 1923, producing antivenom serum.

Products from dead animals

Meat

Meat is the most popular of the animals products world-wide. A special chapter has been devoted to meat which is derived from a wide range of taxa, with beef and chicken being the most common. Besides mammals, birds and fish, meat also comes from amphibians, reptiles and insects. In Tunisia, more than 400 tonnes of snails (three species of the genus *Helix*) and a mean of 40 tonnes of sparrows and starlings are collected and exported every year. In 1997/1998 and 1998/1999, the value of these exports were: 3,499,500 Tunisian dinars (US$2,930,500) and 4,981,691 Tunisian dinars (US$4,171,700), respectively (S. Darroze, 1998, personal communication).

Pelts and furs

Traditionally, communities in the Andes have always used the wool from domestic (llamas and alpacas) or wild camelids such as the vicunya (*Vicugna vicugna*) or the guanaco (*Lama guanicoe*) (20). The value of the pelts almost brought those two species to the verge of extinction. In Argentina, the legal harvest of guanacos is a multi-million dollar industry: from 1976 to 1979, 223,610 pelts valued at US$5.6 million were exported (55). The wool from living sheared vicunya is currently worth US$500/kg on the Peruvian market. Efforts to safeguard this Andean herbivore and maintain a sustainable harvest by local communities are being undertaken in several countries in South America, such as Peru, Argentina and Chile;

conservation is linked to economic utilisation because of the unique capacity of these animals to adapt to extreme environmental conditions and their important resource potential for the very poor local peasant populations from the Andes.

The commercial exploitation of wildlife for the pelt and fur trade was very important during 1950s and 1960s, mostly affecting spotted felids, otters and reptiles. However, since the creation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1973, the exploitation of these species was reduced substantially (103, 104). Commercial trapping for fur is, nonetheless, still a very important activity in North America and Russia. American mink (*Mustela vison*) are mostly farmed nowadays.

The collared peccary is an important resource for subsistence food, local meat sales and the international pelt exports in Peru. Despite representing 34% of the meat consumed locally in Iquitos (Peru), the leather from this mammal is valued (a pair of peccary gloves currently retail in Europe at around US$125). Peru is the only country in South America that currently authorises the export of peccary hides. The total profits earned by all sectors of peccary pelts from Loreto in the Peruvian Amazon are approximately US$1,621,500 annually, of which 5% are earned by the rural hunters, 12% by the national pelt industry and 83% by the international leather industry. The total annual value of the peccary pelt trade is estimated at US$4,868,500, of which 1.5% are accounted for by the rural sector, 11.1% by the urban sector in Peru, and 87.3% by the international sector (15).

The spectacled caiman is probably one of the most exploited species of reptile for the leather industry in Latin America. Between 1983 and 1988, an average of 26,000 skins were exported to Japan and the USA each year. In fact, most skins come from wild harvests and only a small quantity comes from 'ranching' (124). Besides caimans, the most heavily exploited lizard in Latin America is the teju (*Tupinambis rufescens* and *T. teguixin*). The joint exploitation of spectacled caiman and teju hides represented more than 20% of the world trade of the legal exports of reptiles in 1990 (104). Between 1975 and 1986, over 16 million skins of *Tupinambis* spp. were exported legally from Argentina. This trade earned the national economy millions of dollars, and had a considerable impact on rural populations from northern Argentina where this activity became an important source of income (51).

Skins of lizards, crocodiles, alligators and snakes are very widely produced world-wide, both for national trade (alligators in the USA), but most are destined for export.

The market for ostrich skins from farmed animals continues to grow.

Nutritional value of wildlife

The word 'wild meat' is used to designate meat from wild animals, keeping in mind that terms vary widely according to regions and cultures (venison, game meat, bush-meat, *nyama*, *caza*, *gibier*, *viande de brousse*, etc.).

Wildlife has been a source of food for human beings since the earliest times. This ancient and currently flourishing meat industry may be considered as both a wild animal and domestic animal production activity. As with the livestock sector, the wildlife meat industry is composed of production systems, processing methods, marketing techniques and consumption modes, traditions and innovations, successes and setbacks.

Meat production from wildlife is very diverse; two extremes would be that of the modern deer farming schemes in New Zealand and the informal traditional bush-meat sector in Africa. In developed countries, meat is usually understood as coming from domestic animals, while the so-called game meat is considered a festive dish or delicacy. In developing countries, meat may originate from both domestic and wild animals and in many instances the latter is more important than the former.

A controversial battle against bush-meat has been initiated by lobbying groups, such as the North American-based so-called 'Bush-meat Task Force', to prevent or restrict people in Africa from consuming the meat of wild animals. Surprisingly, these groups oppose the use of a renewable natural resources such as wildlife and recommend livestock as a substitute (with the destruction of wild habitats), while they do not oppose the exploitation of non-renewable natural resources such as fossil water or petrol. Beyond sovereignty of countries and people, the approach of these groups tends to impose the views of uninformed developed societies on developing cultures, and to substitute indigenous traditional diets with exotic foreign regimens. The debate is ongoing, however, as Adams and Hulme say, bush-meat is not one thing but many, and it is not a simple policy choice that can be accepted or rejected (1).

The wildlife share in human diet

Historical trend

Our ancestors, pre-historical men, relied entirely on wildlife (wild fauna and flora) for their survival. During the first 2.5 million years at least, humanity lived literally 'from hand to mouth'. However, the populations of these hunter-gatherers decreased progressively by a half at the beginning of the Christian era, and are now restricted to a few 'refuges'. The culture of forest hunters is still alive with the Mbuti, Akka, Efe, Baka etc., while the culture of steppe hunters survives with the Boshiman, the Hadza as well as the Inuits in the Arctic, etc. These livelihood systems are not specialised and their opportunism in hunting, fishing and harvesting implies coping with seasons and hazards. They are also nomadic with low

human densities. The diet is composed of a wide range of living beings, from vegetable products and small animals, usually collected by women, to large animals usually cropped by men. These non-specialised hunter-gatherers eat a very high quantity of game meat (approximately 100 kg per person per year), matching or even surpassing the meat consumption levels of Europe and North America. They are sometimes named 'societies of abundance' by ethnologists. However, this abundance deals with wildlife and not with material possessions, which are always modest.

As a general rule, the share of wildlife in the human diet has progressively diminished, with nevertheless some notable exceptions: the remaining hunter-gatherer groups still rely primarily on wildlife, as do many forest ethnic groups; some modern societies also make important use of their wildlife resources. For example, Sweden furnishes 80% of the meat produced in the country with moose meat. While the wildlife share was shrinking, the share of domestic animals was increasing and simultaneously the resulting agricultural and pastoral encroachment has progressively degraded natural habitats for wildlife. Recent developments may change the picture in the future for both the north and the south, as follows:

– in countries of the north, livestock surpluses (offer exceeds demand in terms of dairy and meat products) create a need for diversification of animal industry with some room being made for wild animal production

– in countries of the south, the difficulties faced by classic livestock husbandry practices may encourage new practices, including systems based on wild animal production.

An interesting hypothesis developed by John Fletcher, the pioneer of modern deer farming in Europe, considers that human anatomy and physiology have been shaped by eating the lean meat of wild animals and that fatty meat of domestic animals is not adapted to our body. The relatively recent (a few millennia ago) consumption of domestic animals did not allow time for the human biology to adapt itself to a new diet. One of the justifications given by Fletcher comes from the high occurrence of heart and metabolic diseases of nutritional origin.

Africa

A comprehensive study of game meat consumption in sub-Saharan Africa was conducted in 1997 (27). The data collected from 50 countries were provided by 105 different sources and gave the following results (Table IV):

– the total production of bush-meat for sub-Saharan Africa would have been about 1.23 million tonnes in 1994 for 577 million people, or 2.1 kg of bush-meat available per person per year

– the relative importance of bush-meat in continental sub-Saharan Africa compared to domestic animals and fish varies between 6% (Southern Africa) and 55% (Central Africa) of total meat consumption.

The importance of bush-meat as a source of food and income differs considerably according to each country (17).

Inhabitants of West and Central Africa especially, but not exclusively, have a long tradition of relishing bush-meat as a food resource. In the past, bush-meat used to be the most common source of animal protein particularly in rural areas, but also in large cities with several million inhabitants, such as Kinshasa where 80% of the animal protein consumed came from wild fauna (W. von Richter, personal communication). In this part of the continent, bush-meat is still the preferred meat. Trade in bush-meat represents a massive market, the financial value of which is difficult to appraise due to the often illicit and usually informal nature of transactions. However, several studies provide reliable figures which reveal the importance of bush-meat for the consumptive use and economy of some countries. For instance, the consumption of bush-meat has been estimated at about 105,000 tonnes in Liberia where game meat represents 75% of the meat eaten, 83,000 tonnes in the Côte d'Ivoire (49), 51,000 tonnes in the Central African Republic (40) and 17,000 tonnes in Gabon (75); the corresponding financial values are US$42 million, US$117 million, US$40 million and US$50 million,

Table IV
Relative importance of game meat in sub-Saharan Africa in 1994
(27)

Ecological region	Population (millions)	Game meat production		All meat production	
		Total (metric tonnes)	Average/person (kg/person/year)	Total (metric tonnes)	Average/person (kg/person/year)
Savannah	344	405,421	1.2	4,857,133	15.2
Savannah/forest	163	533,763	3.3	1,571,732	9.7
Forest	54	287,225	5.3	418,527	7.8
Islands	16	3846	0.2	378,029	22.7
Total	**577**	**1,230,255**	**2.1**	**7,225,422**	**12.5**

respectively. In Benin, this value reaches US$20 million (56). For some countries, the game meat market carries substantial weight in the national economy: in the Central African Republic, for example, the meat market value represents about 2.5% of the GNP (48).

Consumption of bush-meat is particularly high in the forested countries of coastal and central parts of West Africa. It has been estimated that 70% of the population of Ghana eats bush-meat, while wildlife species constituted the main source of animal protein for rural communities (146). Introduction of bush-meat to Yaoundé (Cameroon) has been controlled at a daily level of 2,288 kg (yearly average for 1995-1996); the annual consumption would be approximately 3 tonnes (70). People in the city of Bangui alone consume 9,500 tonnes annually (40). Bush-meat is appreciated in countries of the Sahel too, although consumption is lower in these countries. The annual consumption of game meat per capita (all species included) has been estimated at 17.2 kg in Gabon, i.e. 1.7 to 1.8 times more than the consumption of beef (26), 14.6 kg in the Central African Republic (40), 7.8 kg in the Côte d'Ivoire (21) and only 3.7 kg in Burkina Faso (159).

In East and Southern Africa, bush-meat has virtually been ignored for decades, although consumption is widespread. In many countries two situations co-exist as follows:

a) The official sector: a small amount of game meat is cropped on license and is sold in butcheries as gourmet food at relatively high prices which are not affordable to the majority of people. In Zimbabwe for example, a rough estimate of the official value of large mammal bush-meat is less than US$1 million per annum (17).

b) The informal sector: large quantities of bush-meat are obtained illegally and sold cheaply enough to be consumed by the low-income rural and peri-urban people. In the same country as above, Zimbabwe, food surveys at a grass-root level show very high levels of wildlife meat consumption (more than 40 kg per person per year in the mid-Zambezi Valley) (F. Murindagomo, personal communication; E. Ballan, personal communication).

The sustainability of bush-meat production must indeed be seriously considered in terms of management. A rough breakdown helps to distinguish situations with and without problems in terms of long-term wildlife conservation, as follows:

– pest animals are to some extent controlled by the production of bush-meat (e.g. most rodents and quelea birds [*Quelea* spp.]), and their conservation status is good

– some taxa can withstand a high level of hunting pressure (e.g. bushpig [*Potamocherus* spp.], bushbuck [*Tragelaphus scriptus*], some duikers [*Cephalophus* spp.]) and are not generally threatened by population decreases

– some taxa are more sensitive than others to consumptive uses (e.g. medium-sized antelopes and manatee [*Trichechus* spp.] and are a matter for concern.

With human demography and urbanisation, the demand for bush-meat appears to stimulate the offer and certainly does have an impact on wildlife populations. For example, a survey carried out in the periphery of Minkebe Reserve in Gabon concluded that the quantity of blue duiker (*Cephalophus monticola*) harvested varied between 213 and 284 kg/km^2/year while the theoretical maximum sustainable yield of the taxon was only 99 kg/km^2/year (113).

Bush-meat often contributes to compensate the damages caused to agriculture, livestock and people by problem animals, i.e. animals that conflict with human interests. However, the compensation from meat from culled animals often remains lower than the cost of losses, which may be high with animals such as elephants (*Loxodonta africana*) (67) (Table V).

Table V
Real agricultural losses caused by elephants in some particular regions
(67)

Country (site)	Year of study	Agricultural losses due to elephants (%)
Gabon (Gamba)	1996	0.75
Gabon (Gamba)	1998	0.3-6.2
Ghana (Red Volta)	1996	8.6
Malawi (Kasungu)	1981	6.3
Malawi (Liwonde)	1997	8.8
Mozambique (Maputo)	1996	10.2
Uganda (Kibale)	1996	21.0
Zimbabwe (Binga)	1994	11.7
Zimbabwe (Sengwa)	1994	5.4

Americas

Few data exist on commercial meat hunting in neotropical forests, since many subsistence hunters often sell a portion of their harvest if it has a high market value. With development and closer links between forest communities and external markets, the desire to commercialise subsistence hunting to increase purchasing power is strong and game is often sold rather than consumed (103, 116, 120). In other continents, game is usually cheaper than the meat of domestic animals in areas where wildlife is abundant, such as in the Amazon Basin. However, this situation is reversed in areas where wildlife is scarce and is considered a luxury. In Iquitos (Peru), wildlife meat is sold at the same price as domestic meat. On the other hand, in urban areas of Brazil, capybara or peccary meat can be sold at 4 to 5 times the price of domestic pig meat (100).

According to data collected in different studies (103), the nutritional input of subsistence hunting in Latin America is variable. Among populations of European origin, consumption varies between 3.6 and 299 g meat/day/person (average 72 g/day/person) and between 0.7 and 45.9 g protein/day/person (average 12.9 g/day/person). Hunting provides approximately one-third of the protein consumed in neotropical forests. The remainder is derived from fish and domestic animals. Consumption among Indian populations in neotropical forests is significantly higher (reaching 186.6 g meat/person/day and 137 g protein/person/day).

Some documented cases in Latin America tend to demonstrate that, before the arrival of Spanish conquerors, wildlife was managed quite sustainably. The commercial exploitation of wildlife came with the introduction of firearms and trade by European settlers. As an early example of wildlife management, the Incas sustainably captured vicunya in large numbers, killing males and older females and releasing the younger females (118).

Asia

Most people in the Far East are very fond of wildlife meat. Elsewhere in Asia, some religions prohibit the consumption of all or part of the wildlife resources, especially in countries like India or Malaysia.

The People's Republic of China is known for consuming the entire range of wildlife (either wild or farmed animals). As seen previously, cervids carrying large antlers portray a special image of health and wealth. Muntjac deer (*Muntiacus reevesi*) which have small antlers are numerous in the People's Republic of China and are hunted mainly for their meat. They were harvested at the rate of about 800,000 individuals per year from the 1960s to the 1980s. Despite this high harvest, the current stability of their population is due to an increase in secondary forest and bush, due to logging activities (101).

Australasia

Indigenous wild animals of Australasia are traditionally hunted and, in some instances, as is the case for some species of kangaroo, their abundance is controlled to favour the production of domestic animals. Exotic animals often become invasive; they are hunted for different purposes: sport, demographic control and meat production. In Australia 1,000 tonnes of venison are produced annually, of which exports account for 80% (130).

A similar situation occurs in New Caledonia where introduced rusa deer (*Cervus timorensis*) and feral pig thrive. They are so heavily hunted that they are considered as the meat of the poor (25).

Europe

Europe is the largest importer of game and venison in the world (total: 53,000 tonnes per year, including birds, deer, wild boar and hare) of which the European Union consumes 92%. Two countries, New Zealand and Poland, account for 18,000 tonnes of those exports to Europe. Domestic production of all game in the European Union amounts to 96,000 tonnes per year, of which 18,000 tonnes are exported (152).

High prices for venison offered on the German market in the 1970s were instrumental in developing the world trade of this product (43). In 1994, the purchases of venison in Germany (deer and wild boar) reached 36,000 tonnes (a consumption level of 0.5 kg/person/year. Deer farms supplied 1,000 tonnes, hunting accounted for 16,000 tonnes and 20,000 tonnes were derived from imports (110).

The highest consumers of venison in Europe come from Sweden (110). Scandinavia produced 6,970 tonnes of meat from herded reindeer in 1989 (154), to which the yearly harvest of nearly 200,000 moose must be added.

In 1991, the consumption of wild meat in France averaged 0.4 kg/person/year of which 75% were consumed locally: farmers and liberal professions eat the most, middle-income executives and liberal professions buy the most (farmers do not buy the wild meat they eat), 55- to 65-year-olds eat the most while 34- to 45-year-olds buy the most, families without children eat and buy the most (145).

In France, the volume of game meat was estimated in 1991 at about 37,000 tonnes, of which 23,800 tonnes were supplied by hunting, 2,900 tonnes by farming and 10,300 tonnes from imports, amounting to a total value of €41,561,565.77 (9).

In 1988, a national survey evaluated the global rate of consumption (i.e. the number of people having eaten game meat at least once during the year) at 59.8% (a potential market of about 22 to 24 million consumers over the age of 18). The same study identified different consumption patterns according to the relationship of the consumer with hunters. Consequently, hunters and their close relatives would eat 4.3 kg/person/year, people acquainted with hunters 1.3 kg/person/year and people without any connection, 0.7 kg/person/year. The study also detected heterogeneity in the frequency of consumption according to the species: pheasant was ranked first, before roe deer, hare, wild boar, wild rabbit, wild pigeon, partridge and duck (108).

In France, consumer surveys and market studies showed that game meat is associated with the adjectives 'noble, wild, traditional and natural' and that it has a festive or ceremonious connotation (110).

The wildlife potential as food supply

Except for a few minerals (e.g. salt), humankind makes his living out of the biodiversity of the Earth, i.e. from either plant or animal living organisms. Wild flora is used across the world (fruits, grasses, herbs, roots, leaves, mushrooms, etc.). For instance, 85 wild plant species are used by the Bushmen (29). Wild fauna is also utilised extensively by either of the following:

– vertebrates: both terrestrial and aquatic mammals, birds, including eggs, reptiles including turtles, lizards, eggs, etc. and amphibians (e.g. frogs)

– invertebrates: gasteropods (e.g. snails), insects (e.g. termites, caterpillars) including products such as honey.

The choice of the species depends on the socio-cultural (including religious), ecological and geographical context.

Vertebrates

Mammals

Large mammals

As large mammals are often among the most spectacular, harvesting these species for meat is publicised more widely than for other species. Nearly all large mammals may be hunted for human food supply. From elephants to gazelles, from wild bovids to wild suids, even carnivores in some situations, all taxa may become sources of meat for some people. A few species are eaten in nearly all world regions, mostly the large herbivores (such as antelopes and cervids). Most inhabitants of India do not eat wild bovine meat, while Muslims do not consume wild porcine meat. Many ethnic groups, in both Asia and Africa, do not like wild equine meat.

In South America, most of the mammalian biomass is composed of peccaries (white-lipped and collared peccaries), cervids, tapir (family: Tapiridae) and large rodents, which are hunted intensively (116).

Castro *et al.* evaluated the annual consumption of primates in the sole Department of Loreto in the Peruvian Amazon at 370,000 individuals, with the most popular genera being *Cebus*, *Lagothrix*, *Ateles* and *Alouatta* (22).

The use of the American manatee in historical times, by native Americans for instance, is well documented. Meat was valued for its tenderness and bones were used for ritual purposes. Since the introduction of firearms by European settlers, this species was hunted extensively for export to new colonies. During the 19th Century manatee meat was marketed commercially in the Guyanas and the Amazon and hides were used for making machine belts and water hoses (103).

Small mammals

Of all the meat of mammals, rodent meat occupies a special place. Being by far the most important taxonomic group within mammals, rodents are not surprisingly a major food supply, despite poor publicity.

A survey conducted in the Upper Congo area showed that Rodentia accounted for 40.4% of species consumed, far in advance of artiodactyla (28.5%), primates (19.1%) and others, including carnivora (12.1%) (31). From other studies which provided the weight of game meat eaten in various countries, it is possible to calculate the ratio (as a percentage) of rodent meat consumed in relation to total meat consumption by dividing the quantity (gram per capita eaten per day) of rodent meat consumed by the total quantity of game meat. This ratio reaches 18.3% in Nigeria, varies from 5.5% to 25% in Gabon according to the area, is between 20% and 48.8% in Togo and ranges from 31.5% to 35% in the Côte d'Ivoire (159).

In South America, four species of large rodent are hunted intensively for meat (116). One of these, the capybara, is hunted in the Llanos of Venezuela and Colombia to provide the traditional market with salted dry meat for Easter. Perceived as competitors for livestock, they were pursued and the meat consumed and hides utilised for leather production. Since 1968, this exploitation has been recognised by the Government of Venezuela which established an exploitation programme in private lands and an average of 400 tonnes of capybara meat are consumed annually. This consumption is during the Easter period, since capybara meat was permitted for consumption during Lent by a decree of the Pope in 17th Century (74).

Both micro- and megachiropters (bats) are captured for food. In the Pacific region, flying foxes (family: Pteropodidae), usually the only indigenous mammals present on islands, are traditionally hunted, with customary rules as far as indigenous people are concerned. They are an important source of food for those tribes living far from the sea, and they play an important role in ceremonies, such as the annual yam fest.

Birds

While only a dozen taxa of birds are domesticated in the world, thousands of wild birds are hunted in various situations: temperate or tropical, developed or developing countries, rural or urban environments, poor or rich social status, etc. Nearly all birds are harvested, from the large species such as ostriches or bustards (*Otididae*), to the small passerines. In many instances, relatively high recruitment rates compensate for hunting offtake. In some instances, however, the crop must be well under control to make hunting sustainable; this is the case for endemic island birds such as Pacific pigeons (*Ducula* spp.).

Reptiles

A good number of turtles and tortoises are collected for food, as are the eggs in some cases. Some of these reptiles are farmed.

Podocnemys expansa is the largest of the riverine turtles and lives in the waters of the Amazon and Orinoco Rivers. The meat and eggs of this turtle was the favourite diet of the original inhabitants of the Amazon Basin. During the colonial period, eggs played an enormously important role in obtaining oil for lamps to be used in the colonial cities of the Amazon, such as Iquitos or Manaus. It is thought that more than 50 million eggs were harvested per year for that purpose (103).

The green iguana and the spiny tailed iguana (*Ctenosaura similis*) are consumed for their meat and eggs in several parts of Latin America and particularly in countries of Central America. More than 150,000 iguana are eaten annually in Nicaragua (50, 73).

Crocodiles and caimans are hunted primarily for their skins. However, the meat is also eaten and, depending on the success of marketing efforts by farmers, can compensate for the decrease in skin prices.

Invertebrates

Gasteropods

Various species of edible snails are consumed throughout the world such as *Helix pomatia* in Europe (widely eaten in France, Belgium and southern Portugal), *Achatina fulica*, *Pomacea canaliculata*, *Plia ampullacea* and *Bellamia javanica* in Indonesia (128), *Achatina* sp. and *Archachatina* sp. in West Africa and *Helix* sp. in the USA (R. Thompson and Sh. Cheney, personal communication), etc.

Insects and spiders

It has been estimated that 1,386 insect species are still used world-wide for human nutrition (112).

South America

In Oaxaca (Mexico), insects constitute an important part of the diet of some rural communities. Eaten daily in some regions, insects are roasted, fried or incorporated in a ragout dish. A total of 78 species of the edible insects eaten in Oaxaca were analysed for nutrient composition, namely: *Anoploura*, *Diptera*, *Orthoptera*, *Hemiptera*, *Homoptera*, *Lepidoptera*, *Coleoptera* and *Hymenoptera*. The dry basis protein content ranged from 4.2% (several species of grasshopper [*Oxya* spp.] to 77.2% in a caterpillar. The amino-acid profile of these insects was compared to pre-schooler and adult requirements; in a few cases, deficiencies of tryptophan and lysine were recorded. The calorie contribution varied from 293 to 762 kcal/100 g (114). In Ecuador, 83 edible species are listed; none of these are a main dish, but many insects are used to complement other animal protein sources of the diet. The most common edible insects belong to the *Coleoptera* and *Hymenoptera* species which are consumed either in the larval or adult stage (105).

Asia

In the People's Republic of China, the most important food insects are the ant species (*Polyrrhachis vicina*), and the honey bee (*Apis mellifera* and *A. cerana*); other insects, such as larvae of *Bombycis* and the bamboo weevil are also consumed, but only in restricted areas of the country (84); some species are eaten for medicinal purposes (41). In Irian Jaya, villagers manage the sago palm (*Metroxylon sagu*) to increase the production of palm worms (larvae of the beetle *Rhynchophorus ferrigineus papuanus*) (112). In Japan, the most popular edible inset is a grasshopper, *O. yezoensis* or *O. japonica*. The larvae and pupae of a wasp (*Vespula lewisi*) are consumed in considerable amounts. Pupae and female adults after oviposition of *Bombyx mori* are also eaten. In addition to these insects, the larvae of cerambycid beetles are eaten in the countryside. Larvae of the dobsonfly (*Protothermes grandis*) (*Neuroptera*) have been consumed as a traditional medicine (93). Some spiders are consumed by members of ethnic communities in north-east India, Papua New Guinea, the Trobriand Islands, the Central Australasian desert and New Zealand (92).

Africa

Caterpillars of various butterflies are eaten widely in Africa. In the Democratic Republic of the Congo, for example, one tenth of families consume caterpillars (87). In the Central African Republic, caterpillars are an important part in the diet, principally during the rainy season; it was estimated that the consumption of caterpillars in the capital, Bangui, was 3.5 kg/person/year and that these insects represent 17.3% of the expenditure for game meat, just behind blue duiker (19.2%) and monkey (19%) but far more popular than antelope: red-flanked duiker (*Cephalophus rufilatus*), bushbuck and sitatunga (*T. spekei*) (13.9%) and buffalo (*Syncerus caffer*) (8.5%). The value of caterpillars consumed yearly in the entire country (approximately 8,000 tonnes) was roughly estimated at US$6 million (40).

Winged forms of termites, palm worms, grasshoppers and locusts are also consumed widely and frequently.

Ecological role of wildlife

Broadly speaking, the variety of life in itself has an enormous ecological value. The diversity of taxa and ecosystems influences the productivity and services provided by the ecosystems. When the diversity of taxa in a given ecosystem evolves as a consequence of extinction or introduction of taxa, the capacity of the ecosystem to absorb pollution, maintain the fertility of soils and microclimates, purify water and provide other ecological services changes as well (158).

As is the case for every form of life, wildlife is closely connected to the environment. Being dynamic, it interacts continuously with all the components of the entire ecosystem and has to be

taken into account by managers who make the natural resources management sustainable. This creates a difficult challenge as they usually have to deal with short-term issues (R.G. Bengis, personal communication).

The following examples will illustrate some ecological roles, either positive or negative, of wildlife in several components of ecosystems, such as habitat and other animal species, or in ecosystems in general.

Ecological role of wildlife in natural habitats

Wildlife has an obvious direct effect on the physiognomy of habitats. The role of the elephant in African savannahs has been studied in depth; when a megaherbivore such as the elephant disappears from regions within its original distribution area, the ecosystems tend to change: open habitats become subject to bush encroachment and eventually turn into forests (137). This encroachment can cause the disappearance of some savannah species but also allows the forest wildlife to thrive. In Europe, the wild rabbit plays a similar role, although to a lesser extent. A decrease in the wild rabbit population in the south-east of France has resulted in the closing of the *garrigue*, which could be one of the reasons for the increasing number of forest fires during the summer.

In addition to this global impact on bush encroachment, wildlife can interact with the evolutionary adaptations of some trees. In Sweden, for instance, some species belonging to the birch family (*Betulacae*) have developed antiherbivore chemical defences, notably phenolics and isoprenoid resins, in response to winter browsing by mountain hare (*Lepus timidus*) and moose (107).

Wildlife also plays an important role in seed dispersal. Birds, particularly migratory species, can carry seeds in their feathers or in their digestive tract over very long distances, even from one continent to another. Monkeys and bats are responsible for the translocation of various fruit-bearing species of tree through their faeces. In Africa, elephants disseminate many seeds of trees over extensive distances, both in the dry savannahs and in moist forests. In the Taï forest (Côte d'Ivoire), 30% of the woody vegetation is disseminated by elephants (3); in the Waza National Park (Cameroon) elephants are responsible for the occurrence and development of *Balanites aegyptiaca* in the 'yaérés' (flood plains of the Logone River). The transit of seeds in the intestine could even facilitate germination. This has been observed since the early 1930s by numerous authors in various ecosystems, namely: the Sudanian savannah in Burkina Faso (66) and Benin (139), high altitude moorlands, montane forest, arid bushland and mixed forest in Kenya (76, 151), dry forest in Uganda (81), primary forest in the Côte d'Ivoire (3) and dry savannah in Chad. As shown by the examples of the forests of Taï (Côte d'Ivoire), Lopé, Booué (Gabon), Aberdares (Kenya), it is possible that the disappearance of elephants leads to a drastic decrease of the trees on which they feed (3, 99, 151).

Finally, some species have a vital role for the pollinisation of certain plants. This role is widely recognised for numerous taxa of insects and birds, but less for bats, although the only family (*Phyllostomidae*) which feeds on nectar is responsible for the fertilisation of more than 500 species of plants.

Besides these positive impacts, wildlife can also have adverse effects on habitat, although only a limited number of species are considered to have dramatic effects on the environment.

The same species as those described previously as being beneficial for the habitat can be responsible for degradation. In the savannahs of Southern Africa where animal communities tend to be dominated by a few large species, such as hippopotamus (*Hippopotamus amphibius*), buffalo, zebra (*Equus burchelli*), wildebeest (*Connochaetes taurinus*) and especially elephant, elephant densities need to be held below about 0.5 animals per km^2 to keep the existing woodland canopy cover intact (this level is far below current densities recorded in many of the national and safari parks of the region) (34). In 1991, these parks were estimated to carry from 0.25 to 2.12 animals per km^2 (17). In some cases, the destruction of the habitat by elephants can even jeopardise the survival of sympatric wildlife species. In the Waza National Park (Cameroon), for instance, the destruction of *Acacia seyal* by elephants near the ponds where the animals gather at the end of dry season, endangers the survival of the giraffe (*Giraffa camelopardalis*) which rely on this tree. In the Chobe National Park (Botswana), the indigenous Chobe bushbuck (*Tragelaphus scriptus ornatus*) was feared to become extinct as a result of elephants altering the vegetation structure along the Chobe River (11).

Smaller species can also have a significant impact on habitat. In the Kerguelen Islands where the species was introduced, the wild rabbit eradicated the Kerguelen cabbage, the azorelle, and favoured the development of the acaena which nowadays forms monospecific moors covering entire areas of vegetation (12). In the town of Yaoundé (Cameroon), the large trees used as dormitories by hundreds of fruit-bats are dying, probably because of the combined action of their excretions and the damaging effect their claws have on the bark.

Other negative ecological effects on habitat include damages caused directly by large herbivores, such as elephant, hippopotamus and buffalo in Africa, wild boar, red and roe deer in Europe and small species (quelea bird, grasscutter and baboon [*Papio anubis*] in Africa; rabbit, beaver [*Castor fiber*] or vole in Europe), not to mention the human casualties in rural communities. However, most damage occurs in agricultural landscapes, usually considered as 'modified ecosystems', where people and not wildlife play the dominant ecological role and have the most powerful impact in the long term. Some indirect but more pernicious ecological effects on human utilisation of habitat may also occur. For instance, when the sea lion (*Phocoenoides dalli*) was reduced by fur-traders around the Aleutian Islands, the population of sea urchins increased and subsequently wrack production was depleted.

Overgrazing or overbrowsing by wildlife occurs sporadically. Without mention of enclosed areas, unfenced natural habitats may be subject to overgrazing if natural cycles are left unmanaged or if external factors, such as human disturbances, are allowed. The population crash of the elephant and other herbivores in the Tsavo East National Park (Kenya) was a result of the discrepancies between the carrying capacity which had been reduced by severe droughts and the overabundance of wildlife due to mismanagement practices. Nevertheless, since indigenous wildlife is the product of co-evolution of both the animal community and the environment, overgrazing remains much more uncommon with wildlife than with cattle. This explains the development of multispecies wildlife enterprises in Southern Africa. By managing the entire cohort of indigenous wild herbivores, instead of implementing a monospecific livestock-raising scheme, ranchers keep all options open. While they take economic advantage of a range of wildlife values, they maintain the natural habitats and biodiversity in its entirety. Furthermore, they favour indigenous taxa, which are much more well adapted to their environment and vice-versa, than cattle, which are an exotic species, and consequently do not always adapt to the environment.

However, the impact of wild (compared to domestic) herbivores on the environment, associated with the unique effects of different species of herbivore, is thus more likely to be a question of extent rather than anything more fundamental (34). Over a period lasting twenty-six years in Zimbabwe, Brian Child proved that not only the meat production potential of cattle and wildlife ranching is similar but also that rangeland impact is largely a function of the stocking rate of herbivores (28). The income from cattle is directly related to the secondary production of beef, whereas income from wildlife is derived first from safari hunting, second from tourism, third from meat and fourth from the sale of live animals for restocking purposes. Consequently, a lower and thus more conservative stocking rate may be maintained with wildlife to the benefit of the environment. Furthermore, in semi-arid environments at least, vegetation changes are unreliable indicators of rangeland degradation, while rates of soil loss and changes in soil chemistry and physical properties may be more reliable (30).

More specifically, wildlife species may have either a positive or adverse general ecological input. Dams built by beavers, for instance, have two beneficial consequences for the environment. Firstly, by preventing the water from running, the dams increase the temperature of the water in summer; this has repercussions on the entire aquatic trophic chain (plankton development is stimulated, yielding nutrients for the remainder of the chain, to the fish). Secondly, dams regulate the water flow, thereby minimising the intensity of floods and leading to the reconstitution of the ground water; this, in consequence, results in the continuous irrigation of the surrounding habitat (6). On the other hand, the wild rabbit, because of its burrowing and feeding behaviour, enhances the process of erosion both by the wind and the run-off water; this finally leads to complete desertification of the environment (12).

Wildlife can be also used to assess the quality of the environment. Some species, sometimes called 'indicator species', reveal the health status of the ecosystem. This is, for instance, the case for all predators, and notably birds of prey, situated at the top of the trophic chain, which can highlight environmental problems that occur at the lower levels, such as poisoning, pollution and disease. Some aquatic species, such as the otter or the trout (*Salmo trutta*), are considered to be the best indicators of good-quality water. Indeed, trout has been used for years in city tanks to test the quality of the water distributed.

Ecological role of wildlife on animal communities

Wildlife is involved in all the types of relationships that exist between animal species going from parasitism, where one species, the parasite, relies completely on its host(s) to survive, to symbiosis in which each 'partner' takes advantage of the other, passing through commensalism in which one species benefits the other. Detail will not be given here of the first adverse relationship, although, as is the case for all animals, wildlife species harbour many parasites which are specifically adapted to them or which are shared with domestic animals. Nonetheless, note should be made that given the co-evolution of wildlife with local parasitism, resilience of wildlife is more efficient than that of cattle (e.g. in Africa, resistance of wildlife to trypanosomiasis, warthog [*Phacochoerus aethiopicus*] and bushpig to African swine fever, zebra to African horse sickness, etc.). However, as far as external factors are concerned, both indigenous (wildlife) and exotic (livestock) taxa are expected to be similarly sensitive (e.g. in Africa, both suffer severe repercussions from an exotic disease such as rinderpest or less so from other exotic diseases, such as foot and mouth disease).

The examples of true symbiosis are scarce. Nevertheless, the well-known association between the honey badger (*Mellivora capensis*) and the honey-guide bird (*Indicator indicator*) can be mentioned here. When the bird discovers a hive, it guides the honey badger to the hive by demonstrating a particular behaviour (specific chirps) until the badger digs up the hive. The bird can then eat some of the honey and the bees which it would not have been able to do without the assistance of the honey badger. This, however, is not true symbiosis as the badger can find the hives without the guidance of the bird (42).

Cases of commensalisms are more common. The couples shark-remora or herbivores-oxpecker are obvious but are not isolated examples. This type of beneficial association can be noted relatively frequently in the field. For instance, the bushbuck is often observed following monkey bands to eat the fruit that they have dropped on the ground; fish of the genus *Labeo* are commonly seen in the middle of herds of hippopotamus; they use the dung as an important nutrient; numerous species take advantage of the branches broken by elephants to feed on.

The beneficial role of scavenger species for the elimination of dead animals and carrion is perhaps more obvious. All these species, regardless of their position in the animal realm (insects, such as beetles; birds, such as vultures or crows; or mammals, such as hyaenas or jackals) play a very important ecological role by limiting or avoiding the propagation of diseases and recycling nutrients which cannot be used by other species.

Predators, which give priority to diseased, old or weak animals, can also be considered to play a positive role in the dynamics of the choice of their prey. They not only limit the development of potential epizootics but also contribute to the improvement of the genetic diversity among the herbivore communities.

By killing the old males, which in many species are dominant, these predators allow new and young individuals to mate. Nevertheless, the beneficial role of predation has to be mitigated as, in certain situations, it can jeopardise the survival of certain species. In the Bou Hedma and Sidi Toui National Parks (Tunisia), the predation by jackals on the fawns of the scimitar-horned oryx (*Oryx dammah*), is considered to be on the point of seriously endangering this species which was reintroduced to the area in 1985.

Moreover, in regard to habitat, wildlife may sometimes play other negative ecological roles on the animal components of the environment. It is now widely recognised that exotic taxa have to be managed carefully to avoid the detrimental effects to the environment, especially to endemic flora and fauna. Particular caution needs to be exercised for fragile ecosystems (e.g. strictly rain-dependent areas or islands). Invasive species have been considered to be one of the principal threats to biodiversity to the point that 2001 was declared by the IUCN as 'the year of invasive species'.

The following examples illustrate the impact of exotic taxa on indigenous wildlife. The American mink, introduced into Europe for the fur industry in the 1920s (86) and released into the field, whether voluntarily or otherwise, is responsible for the steep decline of the populations of European mink (*Mustela lutreola*) due to competition for shared food resources, transmission of Aleutian disease against which the European mink has inadequate resistance and intraspecific aggression (88). In the same way, the introduction of American species of crayfish, such as *Ocronotes limosus*, *Astacus leptodactylus* or *Procambarus clarkii* into rivers in Europe, has endangered local species, namely: the white-clawed crayfish (*Austropotamobius pallides*) (5). In Australia, the wild rabbit which was introduced in 1880 by Europeans and the red fox (*Vulpes vulpes*) introduced later to control the rabbit population, are thought to be responsible for the disappearance of several indigenous species. No known native mammal has become extinct north of the range of the rabbit since European settlement. In the central deserts of Western Australia, extinction of native mammals occurred after the rabbit arrived but before the fox became established in that area. Interspecific competition could explain the impact of the wild rabbits; they could have evicted burrowing native mammals from their burrows and deprived others from the best feeding areas. For instance, the decline of the burrowing rufous hare-wallaby (*Lagorchestes hirsutus*) in the western deserts in the 1930s coincided with the first major eruption of rabbits in that area (155).

Socio-cultural significance of wildlife

The perception of nature (including wildlife) depends on the social context, including all the usual components of human sciences. In a short address such as this one, a manichean approach cannot be avoided in such a complex analysis, which inevitably characterises the situations as, for example, comparing urban to rural situations, north to south, ethnic groups to each other, or one religion to another. The wide range of thousands of case studies has been divided into two broad groups, the so-called 'developed' and 'developing' countries.

Place of wildlife in the developing world

Wildlife as a resource

The concept of resource differs among cultures but some convergence does exist. Interestingly, in different cultures and languages, the same word is used for live and dead wild animals, which demonstrates a human-centred perception of nature and emphasises the value of wildlife as a resource for humankind, as follows:

– in many areas of Africa, the word 'nyama' means wild animals (either live or dead)

– in the English-speaking world, the word 'game' designates both dead and live wild animals

– in the French-speaking world, the same happens with the word 'gibier' (game)

– in the Spanish-speaking world, the word 'caza' means game and hunting.

In most developing countries, wildlife provides primary resources such as food, tools, clothes, medicine, recreation, etc. (Table VI).

Wildlife provides some important components of traditional medicine. Iguana consumption is very significant in Central America and in some parts of the Amazon. Both species of iguana (*Iguana iguana* and *Ctenosaura similes*) have been hunted and trapped for human food since ancient times. In Central America, a highly organised iguana industry operates in and around urban centres, since the flesh is credited with medicinal properties and iguana soup is served on a permanent basis since it is thought to cure ailments such as anaemia or

Table VI
Some traditional non-food utilisations of wildlife in West Africa

Species	Utilisation	Countries
Grasscutter	Burned hair used as a healing medicine	Several
Ostrich	Grease used for the treatment of rheumatism	Northern Cameroon, Mauritania
Baboon	Snout used in maceration to cure bites of scorpions	Burkina Faso
Duikers	Horns often used to make amulets and for the treatment of headaches	Burkina Faso
Chevrotain	Hair used in plaster to heal burns	Gabon
Civet	Skin obviously much used by the traditional doctors given its frequency on the markets	Several
Hyrax	Pellets used against epilepsy and gynaecological diseases and also to make perfume	Several
Elephant	– Sperm used to cure sterility or impotence	Burkina Faso, Mali
	– Placenta used for sterility, to help delivery or against abortion	Mali (Gourma)
	– Dung in decoction used in bath to treat meningitis, measles, chickenpox, tuberculosis, dermatosis, mental diseases	Northern Cameroon
	– Urine to cure: hepatitis, asthma, rheumatism, kidney pains	Mali
	– Skin used for: dermatosis ear pains, lightwounds, malaria, measles, meningitis	 Northern Cameroon Mali
	– Marrow used for back pains and rheumatism	Northern Cameroon
	– Ivory powder used for rheumatism	Northern Cameroon, Mali (Gourma)
Bushbuck	Horns often used to make amulets and for the treatment of headaches	Burkina Faso
Hedgehog	Bile used to cure earaches	Burkina Faso
Hippopotamus	– Skin used to make very strong ropes	Central African Republic
	– Grease used as a fuel	Central African Republic
Roan antelope	– Pulverised horn in scarification in the left flank to cure painful spleen	Burkina Faso
	– Ground bones to strengthen the teeth and/or the bones of children	Burkina Faso
Manatee	Grease used to cure otitis	Several
Lion	Ground bones used to strengthen the bones of children	Burkina Faso
Aardvark (antbear)	– Right front leg used as a screen against bad spells	Burkina Faso
	– Intestine used to treat gastric ulcers or in a mixture used to wash babies to allow them to become good traditional wrestlers	Burkina Faso
Porcupine	– Intestine used to make poison for magic, the poisoning of arrows and ponds	Burkina Faso
	– Spines used to make amulets	Burkina Faso

impotence. Moreover, iguana meat and eggs are the traditional Easter substitute for red meat. Therefore, hunting is more intense during this period which corresponds to the laying season. Armadillos (*Dasypus* spp.) are an important source of food in Latin America (103, 117); however, despite their nutritional and cultural value, these animals have become key species as laboratory animals in research against leprosy, since they are the only species, apart from man, that are susceptible to this disease.

For some civilisations, wildlife offers more than a single resource and supports the entire livelihood of the society. Reindeer provide the basis for the livelihood of the Lapps of Scandinavia as well as for various groups of people in Russia and Siberia (154).

Very often, wildlife is also ambivalent: besides providing positive goods, it is also a negative resource or a non-asset, through human casualties (accidents which wound or kill people), depredation to crops, predation on domestic animals, destruction of houses and crop stores. The importance of depredation is not necessarily linked to the size of the depredator. In Gabon, for instance, the number of overall complaints about grasscutters far surpasses those about any other animal species, including the elephant (79). With human demography, agriculture encroachment and competition for space, wildlife conflicts increase and control of problem animals becomes a major issue.

Wildlife to structure societies

In Africa, the links between wildlife and man are often very close and the distinction is not always clear. However, for many ethnic groups some men have the capacity to transform themselves into animals and some animals can become men. In many instances, tribes, family groups, and even individuals, have guardian spirits which are a specific animal. To meet one's own taboo animal is a sign of bad omen. The supreme

godliness is often the 'master of wildlife'; responsible for the richness in game, and is subject to complex hunting rites. The hunters are regarded as having extraordinary magical powers, such as understanding the language of animals and trees and even being able to become invisible (29).

In many traditional societies, if wildlife is a common property, it is not however a free-access resource. Making use of wildlife depends on people in powerful positions in the society, such as spirit mediums, imams, traditional rulers, etc., who have strong rights on the way live and dead animals are treated. Nevertheless, traditional rules are frequently being weakened by the emerging modern world, and in many instances the new generations are abandoning the customary rules.

In most pastoralist societies, livestock is prominent and wildlife has an accessory role in livelihood, to the point that even when wildlife appears to be more profitable than cattle, pastoralist societies are not inclined to switch entirely from livestock farming to wildlife ventures because they place a high value on livestock for cultural and social reasons (17).

Finally, wildlife may play a role in political matters. In Polynesian cultures for instance, native wild birds play a prominent role in the incarnation of gods, as symbols of political power (cask of rulers) and economic power (currency), as ceremonial signs (festive, burial ceremonies). Images of birds are represented in tattoos, while bird names are used extensively for designating sites or people (125).

Non-tangible power of wildlife

In Africa, nature is considered as much alive as humankind; wildlife is regarded as living daily with people: it 'speaks' to them and exerts an influence on them (29).

In animist cultures, the spirits of the household, the village and the cultivated fields are often benevolent (if they are treated properly by man). To the contrary, the spirits of the bush, i.e. the non-human side of the world, are often unpredictable, sneaky and nasty (especially when they are disturbed in their resting sites). The bush is wild nature, situated outside the fields and considered as a threat. In many instances, for the peasant, clearing the bush is equivalent to cleaning the environment.

In Africa, some 'taboo' or 'holy' species, cannot be eaten, killed or even seen by some ethnic groups, or by certain people of designated sex or age, for cultural reasons. The Bafia tribe in south Cameroon, for instance, cannot look at the tortoise. On the other hand, the products and by-products of most of wildlife species have been used widely for millennia by the tribes in Africa for ritual, religious or medicinal purposes.

Some species carry a bad image in the collective consciousness. In northern Cameroon, the black rhinoceros subspecies (*Diceros bicornis longipes*), although seriously endangered and on the verge of extinction, is reputed to blow fire through the nose and to transmit leprosy in its saliva (G. Seignobos, personal communication).

Position of wildlife in the developed world

Positive value of wildlife

For the 'modern city dweller', nature is generally perceived as positive. Another approach with positive and negative aspects was perceived in the past, and now only concerns those rural dwellers who live in and with nature on a daily basis.

The value of wildlife in countries of the north is mostly based on the millions of people who participate in wildlife-associated recreational activities and on the money they spend in pursuit of these activities. Expenditure of individuals who participate in consumptive and non-consumptive wildlife-associated recreation often serve as a criterion to estimate wildlife values. Consumptive uses of wildlife in the industrialised world include sport hunting, fur trapping, wildlife farming of privately owned cervids or furbearers and scientific research. Non-consumptive uses include wildlife watching and feeding wildlife at home, viewing in parks and recreational areas, amateur and commercial photography, and cinematography.

Wildlife may constitute a motivation for humans to protect the ecosystem. The 'use it or lose it' controversial concept of wildlife management is intended to make use of the diverse functions of wildlife to provide stakeholders with incentives to conserve this heritage. Comparative values make wildlife competitive with other forms of land use which are more destructive to the environment. In other words, by making wildlife profitable, the incentive for conservation becomes stronger than the motivation for destruction. By doing so, every wild taxon is not intended to create profit, otherwise the non-valuable species would disappear. If managed sustainably, one taxon or a group of taxa, would be able to pay for the others: flagship species or emblematic species are expected to attract sufficient income to justify the conservation of the environment to the benefit of all other living beings, as well as the landscape and the traditional way of living of local communities. Management measures implemented for the conservation of a single species, called 'flagship or umbrella species', can benefit the entire ecosystem by including other wildlife species.

However, human management is far from being the panacea. Wildlife conservation policies and wildlife management strategies are capable of changing the ecological role of wildlife by modifying either the animal population itself (structure and abundance of the entire animal community or of a specific animal population, behaviour, etc.) or the environment (access to key resources, such as water and food, to key habitats, such as swamps or forests, etc.). During the last century, biodiversity conservation became a science, but if the ecological mechanisms of wildlife conservation are progressively

explained, the practical guidelines remain largely to be explored. *Ex situ* methods of wildlife conservation are certainly an important method of saving species on the verge of extinction. They do not however provide any solution to the problems of securing habitats, which are the unavoidable environment of wildlife. *In situ* approaches, on the other hand, tackle both animal and habitat problems, and may depend on the value of wildlife to encourage stakeholders to reach the long-term goal of conserving overall biological diversity. Nevertheless, setbacks of *in situ* enterprises may appear dramatic with a risk of local or even global taxon extinction.

Negative value of wildlife

As is the case in developing countries, modern societies tend to accept wildlife for the positive aspects. Negative perceptions rise and become very strong when wildlife is considered to be in conflict with human interests.

Depredation to crops

In Europe, several wildlife species are responsible for significant damage, both to crops (wild boar, wild rabbit, hare, wild pigeon) and to regenerating forests (cervids). For this reason, some of these species are gazetted as 'pests' and can be destroyed outside the hunting season. A survey conducted in 24 countries in Europe (the 15 countries of the European Union, and the Czech Republic, Hungary, Lithuania, Norway, Poland, Romania, Slovakia, Slovenia and Switzerland) in 1999, showed that damage to agriculture is generally compensated in France, Luxemburg and Hungary or in certain conditions in all the other countries, except Ireland and the United Kingdom where no compensation is paid. On the other hand, the depredation to forests is only refunded systematically in Hungary and the Czech Republic and is subject to specific conditions in Austria, Germany, Belgium, Finland, Luxemburg, Portugal, Lithuania, Norway, Romania, Slovakia and Switzerland. Hunters are required, alone or in partnership with the State, to provide compensation in 60% of the countries which offer compensation for agricultural depredation and in 77% of those which pay for forest damages (77). The amount refunded can be very high; in 2000, the amount reached €20,062,290.66 in France (paid by hunters to compensate) for the depredation to agricultural crops made by wild boar and cervids (Office National de la Chasse et de la Faune Sauvage, personal communication).

In Australia, consumption of forage by wild rabbits results in reduced livestock numbers, lower wool clip per sheep, decreased lambing percentages, reduced weight gain, increased fragile wool threads and earlier stock deaths during droughts. At the end of the 1980s, the cost of losses in production was estimated to be AUS$20 million a year for the pastoral districts of South Australia and AUS$115 million annually for the national wool industry (155).

Predation on livestock

In Europe, the large predators, such as the bear, wolf or lynx, are regularly responsible for attacks on sheep and even cattle. This predation is not tolerated by the shepherds when a species, which had disappeared for years, returns naturally (such as the wolf in the French Alps) or is reintroduced (such as the brown bear in the central Pyrenees). In regard to depredation to crops, the predation on livestock is refunded in most of the European countries, in accordance with various procedures, as follows: in Northern Europe, a grant is paid in accordance with the number of carnivores present on the territory; in Western Europe, damages are refunded through LIFE-Nature projects. Damages in 1997 were evaluated as follows:

– total damage by the bear was €8,640 in Austria, €31,510 in France, €130,870 in Greece, €33,600 in Italy and €70,562 in Spain

– the cost of damage per bear was, respectively, €346, €3,501, €1,091, €448 and €882

– total damage by the wolf was €151,690 in France, €708,330 in Greece, €1,095,164 in Italy, €407,010 in Portugal and €173,970 in Spain

– the cost per wolf was, respectively, €,792, €2,833, €2,434, €1,163 and €1,160 (54).

In 2000, only for France, the refunding of predation by the wolf, lynx and reintroduced bears (central Pyrenees) reached €413,530 (Office National de la Chasse et de la Faune Sauvage, personal communication).

Socio-economic impacts

The red fox is responsible for the dissemination of an epizootic of rabies in Central and Western Europe, which started in western Poland in 1935. In France, the disease affected the country between March 1968 and December 1998, generating a high number of lethal cases in domestic animals (1,038 dogs, 1,801 cats, 3,667 cattle, 2,438 sheep and goats, 442 horses, 20 pigs and 11 other domestic animals) (2) and a massive number of human cases. Eradication took thirty years and was essentially based on the oral vaccination of foxes (Agence française de sécurité sanitaire des aliments-Nancy, personal communication).

The European badger (*Meles meles*) was first implicated in the maintenance and transmission of tuberculosis (*Mycobacterium bovis*) to cattle in the south-west of England in the early 1970s, following investigations by the Ministry of Agriculture, Fisheries and Food. Continued outbreaks of tuberculosis in cattle herds in England have been shown to be associated with pockets of infection in wild badgers. The disease, which seems to have stabilised in the badger populations, has not been eradicated to date (39).

In France, the wild boar is probably responsible for the resurgence in 1993 of brucellosis in domestic pigs, after a period of absence lasting twelve years. A total of 29 foci were recorded between 1993 and the end of 2000 (of which 9 occurred in 2000). Confirmation of 25 foci was made isolating *Brucella* (a single case of *Brucella melitensis*, which was probably transmitted by sheep and 24 cases *B. suis* biovar 2, a serotype known to circulate in the field between the wild boar and the hare populations). Serological surveys performed on hunted wild boars showed that approximately 30% of the animals tested were seropositive. Given the false-positive reactions, it is estimated that between 15% and 20% of the wild boars in France are carriers of *B. suis*. The role of the hare in the occurrence of the disease in France is not clear although the responsibility of this species was established without doubt in Switzerland, the Ukraine, Croatia and Denmark in a region in which there are no wild boars at all (62).

Vehicle collisions

In France, the population increase and geographic spread of wild ungulate populations, accompanied by the steady rise in car traffic, have led to a strong increase in collisions involving roe deer, wild boar and red deer on roads and motorways. A survey conducted by the Office National de la Chasse et de la Faune Sauvage, the French National Agency responsible for wildlife and hunting, showed that, within a period of ten years, the number of collisions had multiplied by three or four, and the figure was higher in certain parts of the country (95). The same observation was made in the USA where growing white-tailed deer populations have caused an increasing number of collisions with car traffic in urban and suburban areas (127).

Wildlife and society

City dwellers and rural people tend to view nature with different perspectives. After generations of living restricted to cities, people are prone to develop the perception of nature of an outsider. The 'Bambi syndrome' is one expression of a common attitude, mostly among urban people inclined to humanise and even regard animals as sacred, despite avoiding facing the facts and realities of nature. With urban demography overtaking the rural environment, city dwellers often tend to impose their views on communities that live in rural areas, considering nature as a place for leisure, to be maintained by farmers. With this approach, wildlife may eventually find new grounds to thrive.

In France, the defence of hunting as a guarantee of a certain quality of life (rurality) generated the creation in 1989 of a political party called the 'CPNT' (Chasse, Pêche, Nature, Traditions: Hunting, Fishing, Nature, Traditions). In 1999, with 6.77% of the votes, the CPNT ranked seventh in the European Parliamentary elections, just after the Communist Party from which it was separated only by 600 votes, but ahead of the Nationalist Party (5.69%). The CPNT obtained six seats in the European Parliament. After this promising result, the CPNT was integrated into the French political landscape and presents candidates at each consultation of the electorate.

Hunting is instrumental in creating and maintaining the social links between people. A national survey conducted in France in 1999 confirmed that 80% of hunters do not hunt alone, 34% hunt with their family and 51% with friends (80). The collective practice linked to some types of hunts, such as driven hunts or hunts with hounds, is a pretext and a means for creating conviviality. The organisation of the hunts and the receptions which follow for invited or honorary members who are not yet included in the community, are occasions to make contact with people from different cultural or social spheres (115).

In Western Europe, the return of the large predators reunited people who usually had very different cultural and/or socio-professional backgrounds. In the French Alps, for instance, the wolf succeeded in creating a link between hunters and shepherds. The reintroduction of the brown bear in the Central Pyrenees had the same result in France and in Spain.

However, some traditional enemies as opposed as protectionists and hunters can come together to preserve wildlife. This is the case in France for reporting poisoning by agricultural pesticides which indifferently kill game species, such as wild boar or partridges, and protected species, such as raptors.

Conclusions

Threatening the value of wildlife

The erosion of biodiversity as a whole is a threat to the value of wildlife. The diverse sources of erosion may be organised in two groups, as follows:

a) indirect threats through habitat degradation

b) direct pressure on wildlife.

Indirect threats

In many industrialised countries, such as those in Western Europe, radical changes in agricultural landscapes occurred during the 20th Century and appear to be the most important factors that explain the decline, not only of the birds characteristic of open fields like the grey partridge, the European quail (*Coturnix coturnix*), the skylark (*Alauda arvensis*) or the little bustard (*Tetrax tetrax*), but also of species dependent on the hedgerows which were destroyed to enlarge the fields, such as the kestrel (*Falco tinnunculus*), the turtle dove (*Streptopelia turtur*), the red-backed shrike (*Lannius collurio*) and the ortolan bunting (*Emberiza hortulana*).

In the steppe regions of Eastern Europe, the conversion of semi-natural grasslands to arable agriculture over the last 25 years has been the primary cause of the drastic decline in steppe bird species such as the steppe eagle (*Aquila nipalensis*), the pallid harrier (*Circus marourus*), the sociable plover (*Chettusia gregaria*) and the black lark (*Melanocorypha yeltoniensis*) (144).

In North America, the transformation of native habitats to agricultural land has probably had a greater impact on populations of neotropical migratory birds than any other human activity (122).

Wildlife can be used to enhance the returns from the land, in addition to other land uses. In many instances, hunting leases earn more income than timber exploitation. Banning of hunting would remove this key incentive for forest conservation.

In the developing world, hunting is not only important as a source of food, but is also of value in controlling crop depredators and as a source of income. Hunting may also have conservation benefits. It is one of the few ways in which local communities can derive benefits from wildlife, and by offsetting some of the direct and indirect costs of forest conservation, communities thus have an interest in the conservation of natural habitats (13, 16).

In very few countries, such as Zimbabwe, increasing empowerment and effectiveness of local communities ensure more active participation in the benefits from and control over wildlife resources, although revenue distribution at the district and local levels remains controversial. In most countries, however, this is not the case and wildlife remains under custodianship of the Government with little or no motivation for local people to conserve this heritage. This lack of community participation was realised at a late stage. Insufficient revenue sharing and inequitable distribution of funds discourage people living in proximity to wildlife from taking any form of conservation approach.

Macroeconomic issues may have a severe impact on wildlife. In sub-Saharan Africa, the decrease in price of industrial crops, such as coffee or cotton, is known to increase the level of wildlife cropping for bush-meat (79). In industrial countries, heavily subsidised livestock and agriculture industries tend to increase pressure on natural habitats in countries of the north, while discouraging indigenous productions in countries of the south.

The deterioration of tools used for work (damaged roads, poorly maintained lodges, etc.) has had a negative effect on the tourism industry in Kenya, and consequently on the wildlife industry, including the conservation status of the entire wildlife sector (17).

Misconception of legal framework often has a responsibility in the preservation of wildlife values.

In Namibia for example, the legislation presented an obstacle to communities aspiring to gain income from wildlife in communal areas as locally game-cropped meat could not be sold legally and communities could not claim revenue from those who utilised it. The establishment of communal conservancies in Namibia now allows the communities to use wildlife as a development tool.

In Slovakia, the hunting rights belonged to the soil users (state organisations and agricultural co-operatives until the fall of 'real socialism'). These organisations exercised their rights themselves or rented the hunting grounds out to hunting associations. The hunting rights are now bound to the soil ownership practice again. This modification led to a degradation of the quantity and the quality of game through the increase of hunting bags for ungulates to compensate for damages, and to an increase in the poaching and marketing of game meat. The global cost of hunting increased, causing a change in the social structure of hunters to the detriment of the less well-to-do strata. The tensions between hunting and the protection of nature became more intense (65).

In very few countries, such as South Africa, legislation and institutions have transformed the role of wildlife from a state-owned treasure to be preserved and isolated in protected areas into an active resource, controlled and utilised by landholders. Wildlife has increased significantly on commercial farmland as safari hunting, live animal sales and tourism were incorporated into the farm systems, while in communal farming areas, awareness has markedly increased the contribution of wildlife.

In most of the countries of the European Union, game has the status of *res nullius*, i.e. nobody's property. In Italy, game is *res publica* (State property). Even in the countries where game is *res nullius*, most of the modern laws have imposed obligations on people who hunt wildlife. For example, hunting rights are legally linked to an obligation to manage the territory, the game and the wildlife in general (Austria, Germany, Denmark, Greece, Italy, Luxemburg, Netherlands, Portugal, Spain and Sweden). On the other hand, this duty does not exist in Belgium, Finland, France (except in Alsace-Lorraine and for the incorporated communal hunting associations), Ireland and the United Kingdom (23).

A study conducted by the World Bank in Kenya demonstrates that the investment of returns from wildlife and tourism in job creation and social welfare projects is the most successful system of distributing revenues (17).

Among the macroeconomic distortions, control over the resources at the district rather the local level has contributed to the wide divergence between national and individual interests. Safari hunting accounts for the bulk of revenue earned in communal areas. A ban on imports of hunting trophies, particularly from elephant, would have a very negative impact on community wildlife schemes (17).

Direct threats

Excessive harvest of wildlife depletes the wildlife resource when the level of exploitation overtakes the recruitment rate. Excessive harvest may be either legal or illegal, as follows:

– legal, when the management scheme is inappropriate or ineffective

– illegal, uncontrolled, poaching means mismanagement of the resource.

Unmanaged hunting may have detrimental effects on wildlife. Some hunting studies in South America conclude that many of the largest mammals and birds are hunted preferentially and represent a large proportion of the forest biomass which, therefore, might decrease under severe hunting pressure (116, 119). Moreover, the species most favoured by hunters such as agoutis (*Dasyprocta* spp.) and peccaries (*Tayassu* spp.) play an important role in pollination and seed dispersal, which suggests that when and/or where they are overexploited, their disappearance might change the composition of the forest.

Enhancing the value of wildlife

Conservation and development

One of the main threats to wildlife lies in the attitude of some extremist lobbying groups that promote the strict preservation of wildlife, which tends to remove all socio-economic value from wildlife. However, the debate should not be trapped in a conflict between advantages and disadvantages on the sustainable use of wildlife. Opposing conservation value to development value is a dead-end discussion. A complementary approach allows conservation issues to meet with development concerns. The old-fashioned philosophy of conservation of nature and wildlife is a defensive attitude which attempts to protect nature against the consequences of development, while the modern conservation of biodiversity is a voluntary approach which intends to match the needs of people for biological resources while securing the long-term survival of the biological richness of the Earth (158). This information is valuable to managers responsible for designing or modifying wildlife management areas.

Despite the differences in the two activities, it is important to view consumptive and non-consumptive uses of wildlife together and not as separate entities. Many individuals participate in both forms of wildlife-associated recreation and wildlife recreation areas often generate revenue from both consumptive and non-consumptive wildlife users simultaneously. Habitat improvement and other management techniques that benefit game species generally benefit non-game species as well. It has been determined that areas with increased non-consumptive wildlife use will often have increased hunting activity where this is allowed. Likewise, areas with increased hunting activity have increased non-consumptive activities (63). Before wildlife preservationists condemn wildlife producers, one should remember that 'it takes two hands to clap'. The small wildlife world should rather look for an alliance in the battle to conserve its value to wildlife. The conservation war is not against development.

Animal production and quality

Animal production may be seen from two sides, as follows:

– domestic animal production, which is the most well-known and widely accepted in industrialised countries

– wild animal production, which is the most ancient, although presently the least recognised in developed countries, from prehistoric times, through ethnic groups of hunter-gatherers, to modern wildlife ranchers and hunters.

Both animal production systems are valuable, should not be opposed and, rather, should be complementary according to the cultural, social, economic and biological contexts.

The food quality concern is already an issue of importance in the developed world, while this is not yet so in many countries of the developing world. In terms of quality, wildlife offers significant opportunities to the animal industry. Consumers of wildlife meat demand a high-quality product that is fresh, 'food safe', traceable, produced in an environmentally and ethically acceptable manner and sold at competitive prices (157). The wildlife industry has a reputation for good all-grass farming, in a clean, 'green' environment. Research in environmental technology should be promoted to ensure that this reputation is deserved, otherwise the wildlife markets will be jeopardised. Furthermore, as far as the organic/genetic engineering conflict is concerned, wildlife has a better image for the consumer than domestic animals. In addition, the wildlife industry still presents a large margin of progress in this regard: 'the wild animal productions can go from silver to gold, then from gold to diamond '(157).

Wildlife and security

As human needs and biodiversity are so interwoven, the conservation of wild fauna and flora should legitimately be considered as an element of national security: it is recognised that national security means much more than military security and that ecological components must also be fully and properly addressed (158). Some issues have already been addressed, such as access to water, others not, such as biodiversity management, not because they are not as important, but because they have not yet been recognised despite their evidence: the conservation of the value of biodiversity aims at maintaining nature as the foundation of human life and living resources, essential elements for development.

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La valeur de la faune sauvage

Ph. Chardonnet, B. des Clers, J. Fischer, R. Gerhold, F. Jori & F. Lamarque

Résumé
Jusqu'à une époque récente, la communauté internationale a largement ignoré ou sous-estimé la valeur de la faune sauvage. Dans le meilleur des cas, les animaux sauvages étaient réduits à un intérêt esthétique ou touristique. Cette situation a désormais changé. Dans la profession vétérinaire, dont la majorité est essentiellement tournée vers les animaux d'élevage, la faune sauvage est de plus en plus considérée du point de vue de la production animale et occupe, à cet égard, une place presque aussi importante que celle des espèces domestiques. Certains économistes s'efforcent actuellement d'évaluer l'activité informelle que représente une grande partie du secteur de la faune sauvage. L'importance de ces animaux pour les communautés locales est aujourd'hui universellement reconnue dans les programmes de gestion des ressources naturelles fondés sur l'implication de ces collectivités ou encourageant leur participation. Les auteurs soulignent non seulement l'importance économique de la faune sauvage (qui représente plusieurs milliards de dollars US dans le monde), dérivée de son utilisation à des fins de consommation ou pour d'autres usages, mais également sa valeur nutritionnelle présente et potentielle, son rôle écologique ainsi que son importance socioculturelle aussi bien dans les pays développés qu'en développement. Les auteurs mentionnent également l'une des principales menaces qui pèsent sur la faune sauvage et sa protection, à savoir la réduction voire la destruction des différentes valeurs qu'elle peut représenter.

Mots-clés
Biodiversité – Écologie – Économie – Faune sauvage – Habitats sauvages – Importance économique – Signification socio-économique – Utilisation à des fins autres que de consommation – Utilisation à des fins de consommation – Valeur nutritionnelle – Viande de brousse.

■

El valor de la fauna salvaje

Ph. Chardonnet, B. des Clers, J. Fischer, R. Gerhold, F. Jori & F. Lamarque

Resumen
Hasta hace poco, la comunidad internacional tendía de manera bastante general a ignorar o subestimar el valor de los animales salvajes. En el mejor de los casos, su importancia residía únicamente en su dimensión estética o turística. En cierto modo, esta situación ha cambiado. Dentro de la profesión veterinaria, en su mayor parte centrada esencialmente en el ganado, la fauna salvaje se ve cada vez más como un factor de producción animal tan importante como los animales domésticos. Algunos economistas intentan ahora cuantificar el volumen de actividades dedicadas a esos animales que se canalizan a través de la economía sumergida. En todo el mundo, los programas de gestión de los recursos naturales basados en la actividad comunitaria o concebidos con métodos participativos reconocen la importancia que reviste la fauna salvaje para las comunidades locales. Los autores destacan no sólo la importancia económica de esos

animales por sus usos para el consumo o de otro tipo (que se cifra a escala mundial en miles de millones de dólares) sino también su valor nutritivo real y potencial, su función ecológica y su significado sociocultural para las sociedades humanas tanto desarrolladas como en desarrollo. Los autores se detienen también a examinar uno de los principales peligros que amenazan la supervivencia de los animales salvajes, a saber: la minusvaloración o incluso destrucción del valor que pueden ofrecer esos animales.

Palabras clave
Carne de monte – Diversidad biológica – Ecología – Economía – Fauna salvaje – Hábitats de la fauna salvaje – Importancia económica – Significado sociocultural – Uso para el consumo – Uso para fines distintos del consumo – Valor nutritivo.

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