Distribution and status of elephants in West Africa (1)

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Summary. — The taxonomy of West African elephants is reviewed and their distribution during 1976-1984 studied in a biogeographical context. At that time they inhabited roughly 232,000 km² which represent only about 6-7 % of the area they had occupied at the turn of the century. The diminution of elephant range was greatest in the Sahel and Guinean Savanna Zone of which only about 2.8 % and 2.3 % respectively are still inhabited by elephants as compared to 6.7 % in the Sudanian and 16 % in the Guinean Forest Zone. The reasons for the decline of elephants in West Africa are analysed. Elephants are fragmented into some 80 separate populations of which many are small and menaced. In 1984 only about 50 % of the total area of distribution had National Parks, Game or Forest Reserve status. However, only about 12 % of the Forest elephant's range has been set aside for conservation as opposed to 63 % for the Savanna elephant.

Accepting the inaccuracies of elephant censusing, surviving elephants in West Africa were estimated at roughly 17,600 of which about 5,200 were considered to be Forest elephants. Of these only about 11,500 (3,500 Forest and 8,000 Savanna elephants) live in or arround National Parks and Game Reserves. Conservation and chances for survival of elephants are discussed country by country.

Résumé. — La taxonomie des éléphants d'Afrique occidentale et leur répartition pendant 1976-1984, ont été étudiées dans un contexte biogéographique. Ils occupaient alors à peu près 232 000 km², soit 6 à 7 % environ de la surface qu'ils avaient occupé au début du siècle. La réduction de l'aire de répartition des éléphants a été plus importante dans le Sahel et la Zone de savane guinéenne, dont seulement environ 2,8 % et 2,3 % respectivement sont encore habités par des éléphants, tandis que 6,7 % le sont dans la Zone de savane soudanienne et 16 % dans la Zone de forêt guinéenne. Les causes du déclin des éléphants en Afrique occidentale ont été analysées. La population d'éléphants est fragmentée en quelque 80 troupeaux distincts dont beaucoup sont petits et menacés. En 1984, environ 50 % seulement de l'aire de répartition avaient le statut de Parc National, de Réserve de faune ou de Forêt classée. Cependant, environ 12 % seulement de l'aire de répartition de l'éléphant de forêt avait été mis de côté pour la conservation, par rapport à 63 % pour l'éléphant de savane.

Compte tenu des inexactitudes du recensement, les éléphants qui survivent en Afrique occidentale sont estimés à environ 17 600, dont environ 5 200 ont été considérés comme des *éléphants de forêt*. Seulement environ 11 500 de ceux-ci vivent dans ou aux environs des Parcs nationaux et des Réserves de faune (3 500 *éléphants de forêt* et 8 000 *éléphants de savane*). La conservation et les chances de survie des éléphants sont discutées pays par pays.

(1) Dedicated to H.R.H. Prince Bernhard of the Netherlands.

INTRODUCTION

Strangely the former abundance of elephants in West Africa and their subsequent rapid decline has so far drawn little if any scientific attention. A first attempt to assemble all existing information on elephants in West Africa, and to determine their conservation status was made wthin the framework of the IUCN/SSC Elephant Survey 1976-1979 (Douglas-Hamilton 1979 a, b). The present investigation is based on this survey, but is adding much historical and more detailed local information covering also the years 1979-1984. Further up-dating thereafter is required.

The situation of elephants in West Africa is different from that of elephants in Central, Eastern and Southern Africa, in that they have come early under far greater pressure from human populations competing for space and altering elephant habitats. The survey suggests how elephant populations in other parts of Africa may develop under mounting human pressure.

The survey also compares Forest and Savanna elephants which both occur in West Africa. Distribution and population status are considered separately for each of the two subspecies ; this requires careful study of past and present habitat conditions for elephants, i.e. biogeographical zoning of their ranges. The ecology and behaviour of the two subspecies vary greatly ; and this difference needs to be correlated to the impact of development and the prospects for their future conservation.

BIOGEOGRAPHICAL ZONING

Distribution and survival of elephants in West Africa are clearly related to the existence of fairly undisturbed forest and savanna habitats. However, Forest elephants sometimes occur also in areas of forest mosaic or moist savanna, but which have historically supported moist types of closed forest. If one attempts to use biogeographical criteria for distinguishing the ranges of Forest and Savanna elephants it is therefore not sufficient to consider only present habitat conditions. It is necessary to take into account the historical regression of the forest zone as a result of climatic changes and human influences.

In classifying vegetation zones in relation to elephant distribution we use therefore the criterion of vegetation climax as has been applied by Sommer (1976). The Guinean Zone is thus understood to comprise that area in which due to climatic conditions the vegetation climax is either evergreeen or moist semi-deciduous forest without any grass cover. The Sudanian Zone is characterized by a climax vegetation of more or less dense woodland with grass cover. Further to the north with rainfall below 600 mm, the vegetation cover diminishes to bush savanna or scrub steppe, constituting the Sahel Zone. Fig. 1a provides a key for the vegetation types which predominate in the different biogeographical Zones mapped in Fig. 1b.

The *Guinean Forest Zone* includes both lowland evergreen rain forest and moist semi-deciduous forest at low and medium altitudes, often intermingling with each other, and forming a closed canopy. Annual rainfall in the coastal lowland varies between 2,200 and more than 4,000 mm, but decreases to 1,400-1,600 mm in the northerly areas. The Guinean Forest Zone, although historically much larger, at present extends from eastern Sierra Leone through Liberia and Ivory Coast to western Ghana. It is separated by the "Dahomey gap" from the Biafro-Congolese forest block, which begins east of Porto Novo on the boundary of Nigeria and extends as fas as Uganda.

The present northern limit of the Guinean and Biafran forest zones is shown in Fig. 1b, although this is difficult to define due to the rapid transformation of forest into agricultural lands. On the basis of this limit, the Guinean Forest Zone comprises an area of approx. 395,000 km² which is approx. 9.2 % of West Africa south of the Sahara. More than 90 % of this area, however, has been logged or otherwise interfered with by man.

Radical ecological changes of the forest zone occur in all West African coastal countries. In Sierra Leone almost all moist forest has been removed. Only remnant patches of rainforest survive, totalling about 4 % of its original surface. In Liberia the once continuous forest zone has been separated into two distinct blocks by agricultural development along the main route from Monrovia to the Nimba Country. In Ivory Coast and Ghana the forest zone has become the major area of economic development with an ever increasing network of roads, on either side of which the forest is cleared for settlement and agriculture. The forest zone of Nigeria has been drastically reduced during the last twenty years and almost entirely transformed into degraded secondary forest and palm bush land. Only in the eastern region, adjacent to Cameroon, remain some forest areas important for the conservation of Forest elephants.

The only large areas left, of undisturbed primary rain forest, are to be found in Liberia on the upper reaches of the Mano and Lofa rivers, and between the Cestos and Cavally rivers, and in Ivory Coast between the Cavally and Sassandra rivers. In Ghana there are only very small areas of primary forest left, on the Bia river and east of the lower Tano. Fig. 2 shows that these areas contain the greater part of the remaning range of Forest elephants and are vital for the survival of this elephant subspecies in West Africa.

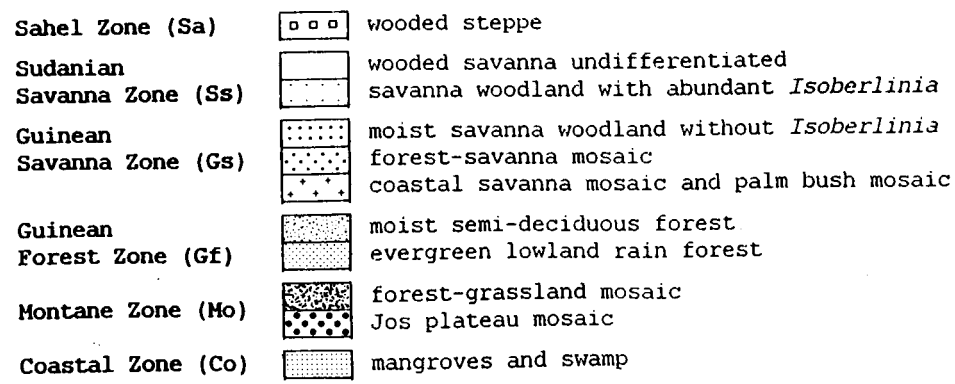


Fig. 1 a. — Classification of vegetation type.

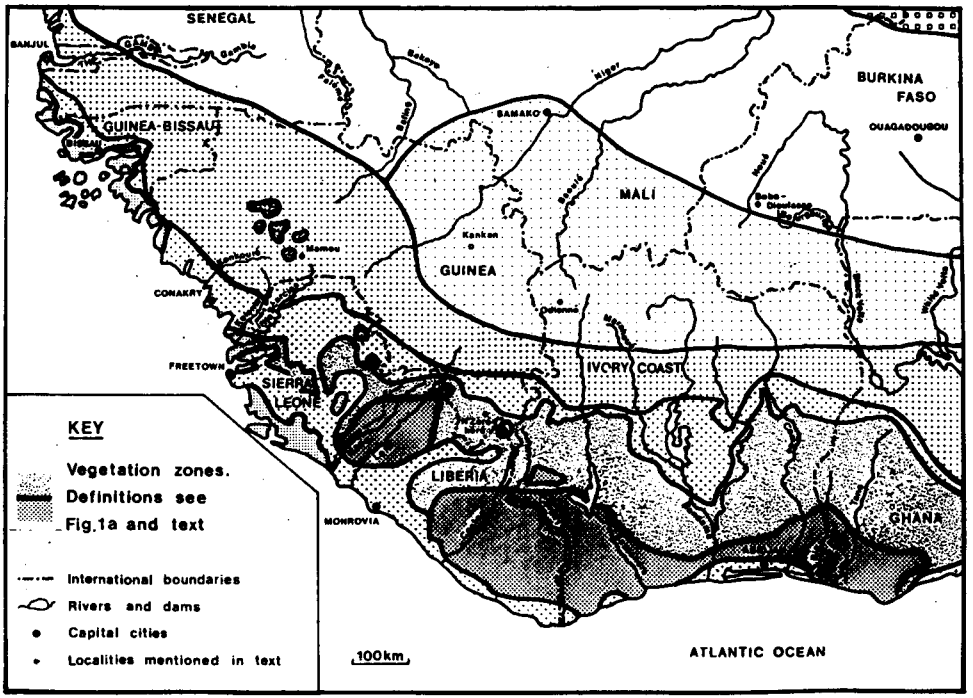


Fig. 1 b. — Biogeographical Zones of West Africa.

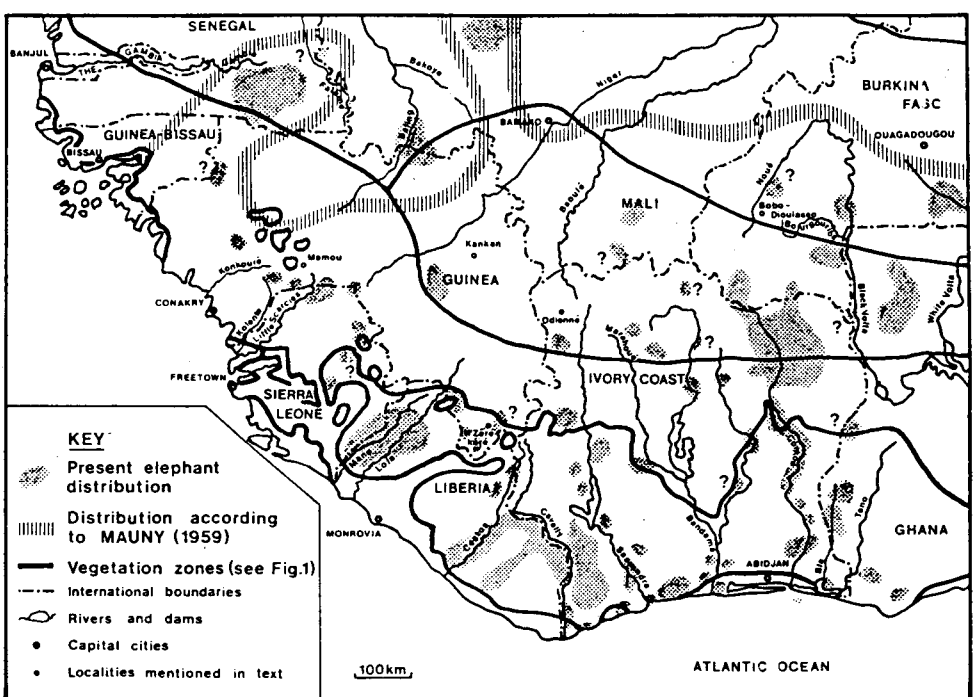


Fig. 2. — Past and present distribution of elephants.

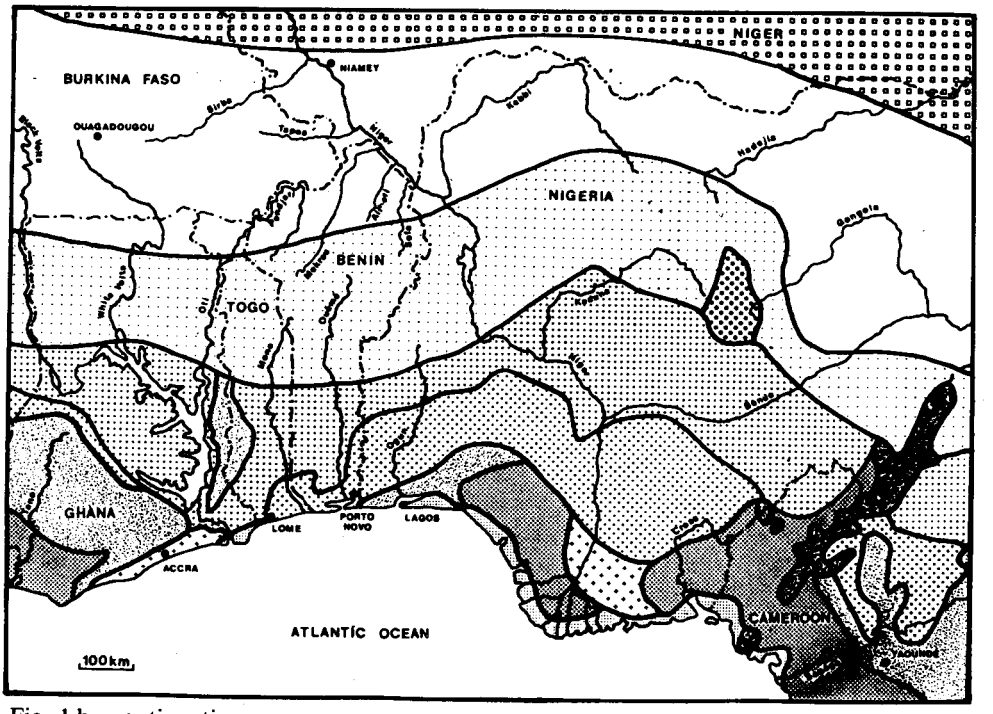


Fig. 1 b, continuation.

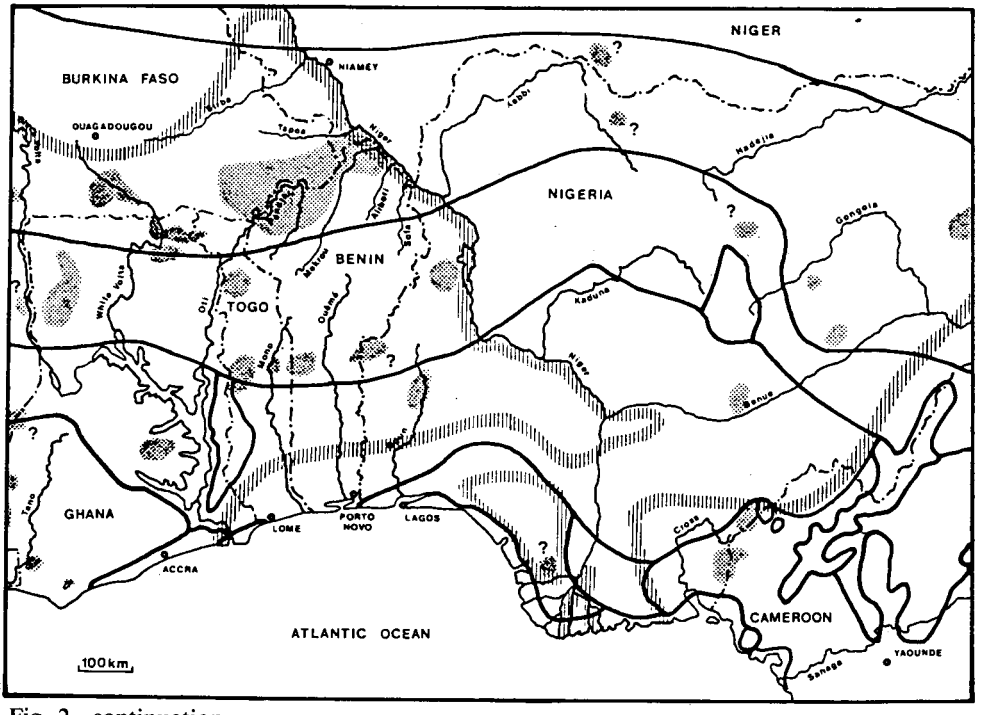


Fig. 2, continuation.

The *Guinean Savanna Zone* comprises in the south a forest grassland mosaic. Further north this mosaic opens up into relatively moist woodland savanna of varying tree and shrub densities with very tall grasses, interspersed with patches of moist forest along rivers but also upland. Annual rainfall in this zone is nowhere less than 1,200 mm. Terminology on this zone varies. French authors refer to the southern part of it usually as the "pre-forest" or mesophil zone, having been derived only recently from the closed forest belt. The northern part of this zone is usually included by these authors in the Sudanian Savanna Zone, whereas English authors refer also to parts of the Sudanian zone as Guinean Savanna. It is in fact difficult to draw a distinct limit between the moist Guinean and the drier Sudanian Savanna Zone to the north, the transition from one to the other being a gradual one. The influence of man has obviously changed micro-climatic conditions in this transitional zone, allowing the Guinean Savanna Zone to be invaded by many woodland species such as *Isoberlinia doka*, *Monotes kerstingii*, *Terminalia macroptera* etc. Therefore this zone often has floristical features of the Sudanian savanna, interspersed with the fire resistant trees typical of the Guinean savanna, like *Daniella olivieri*, *Lophira lanceolata*, *Philostigma thoningii*, *Borassus aethiopium* etc.

As explained above we regard it useful to separate the two savanna zones according to their presumed vegetation climax as shown in Fig. 1. Both savanna zones would develop a dense woody vegetation cover if fire and other man-made influences were entirely excluded. Whereas the drier Sudanian savanna would become a deciduous woodland in which there would always remain a grass cover, the Guinean savanna would develop into a semi-deciduous moist forest without grasses. What is here referred to as Guinean Savanna Zone is therefore presumed historically to have been moist forest which may be regarded also as original habitat of the Forest elephant.

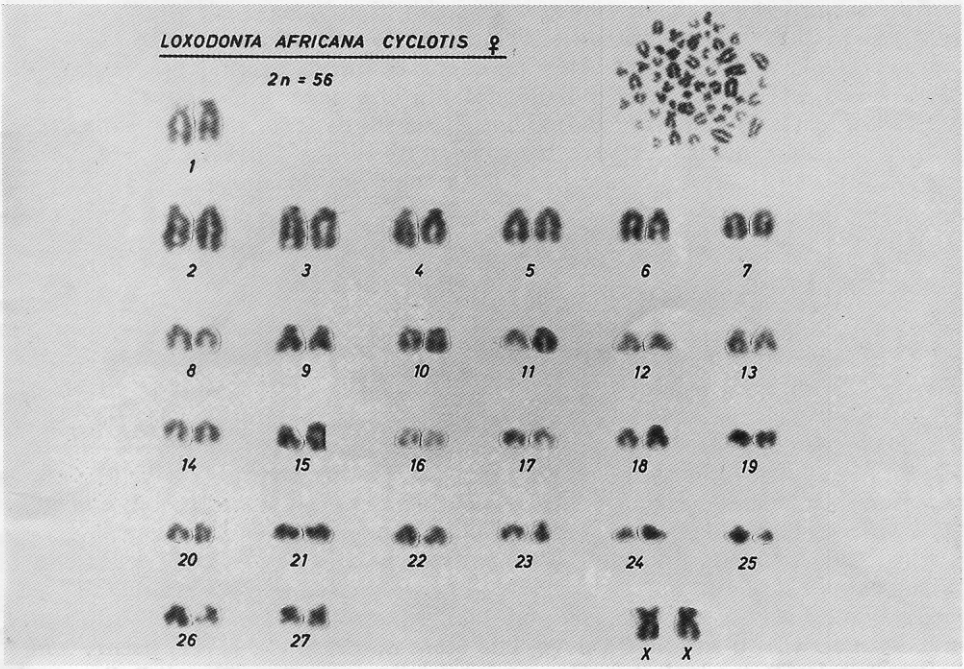
The Guinean Savanna Zone extends from the estuary of the Saloum river in Senegal through all of West Africa as far as western Uganda, interrupted only by the Cameroon highlands. The West African part of this zone has a surface of approx. 796,000 km^2 which is approx. 18.5 % of West Africa south of the Sahara. It is thus much larger than the still forested zone of West Africa.

The *Sudanian Savanna Zone* comprises in the south woodland predominated by *Isoberlinia*-trees. Although floristically poorer it resembles physiognomically the miombo woodland of East Africa. Towards the north, the Sudanian savanna becomes drier and owing to inhabitation and animal husbandry for many centuries, vegetation here has been profoundly modified, stands of original climax woodland having become very rare.

Annual rainfall in the southern part of the Sudanian Zone ranges between 1,200 mm and 900 mm, whereas in the northern parts it may be as little as 600 mm.

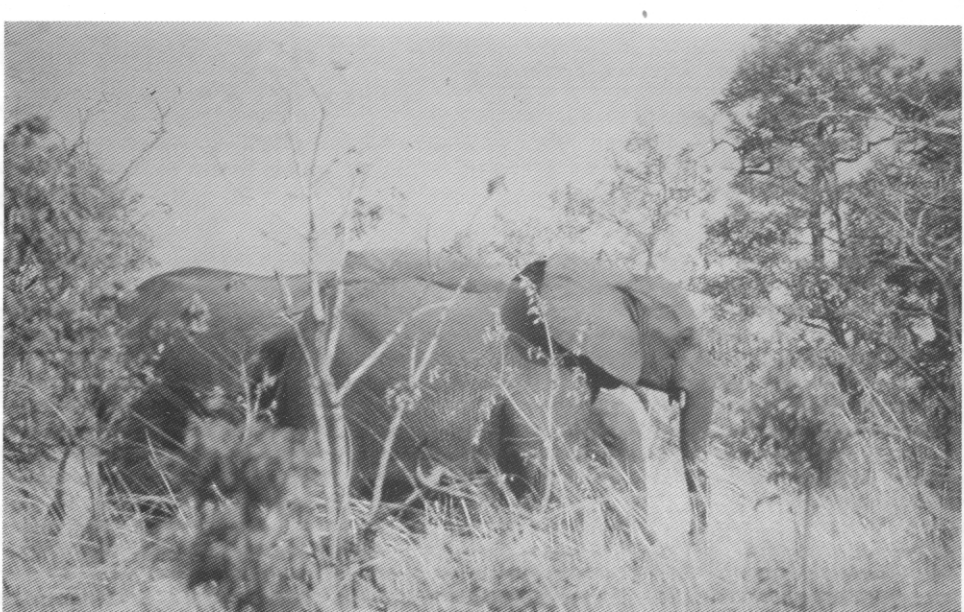
This zone extends from Senegal to Ethiopia, the *Isoberlinia*-savanna woodland being restricted from eastern Guinea and Mali to northwestern Uganda. The West African part of this zone comprises approx. 1,683,000 km^2 which represents 39 % of West Africa south of the Sahara.

The *Sahel Zone*, transitional between the Sudanian savanna and the Sahara desert, comprises *Acacia*-bushland which, towards the north, diminishes into scrub and sparsely wooded grasslands. It is characterized by extreme differences between rainy and dry seasons and the associated change from extensive green pastures to barren dust soil. Annual rainfall in the south may be as much as 600 mm.



Ph. I. — Caryogramme of *L.a.cyclotis* (Photo : G. Marx)

Ph. II. — Typical Forest elephant, *L.a.cyclotis,* from Ivory Coast (Photo : G. Merz).



Ph. III. — Savanna elephants in the Pô National Park, Burkina Faso (Photo : B. Bousquet).

Ph. IV. — Savanna-forest intermediate type elephants in the Comoé National Park, Ivory Coast (Photo : J. Gilbert).

Historically the vegetation in this zone was very much more abundant providing quite suitable habitat for elephant, as the numerous specimens of elephant bones in this zone have shown (Krumbiegel 1943, Mauny 1957). Now however, very few areas in this zone are still inhabited by elephants. The Sahel Zone is expanding in many areas to the south and is thus beginning to affect important elephant ranges further south. It approximates 1,350,000 km which are 31 % of West Africa south of the Sahara.

TAXONOMY

In his monography on the African elephant Krumbiegel (1943) has reviewed also the history of its taxonomy. Whereas early naturalists and writers clearly distinguished between Asian and African elephants, knowledge of the latter got more and more obscure during the middle ages resulting in a taxonomic confusion of the two species. Thus the African elephant was virtually rediscovered only in the last century when generic specificity as *Loxodonta africana* (Blumenthal, 1797) F. Cuvier, 1927, was attributed to it. The discussions about different species and subspecies of the African elephant however, have continued until recent times. Ansell (1971) has reviewed these and given a synopsis of the Genus *Loxodonta* suggesting its taxonomic division into a Forest elephant *(Cyclotis)* section with 2 subspecies *(L. a. cyclotis, — a. pharaohensis)* and a Savanna elephant *(Africana)* section with 4 subspecies *(L. a. africana, — a. knochenhaueri, — a. orleansi, — a. oxyotis)*.

Although the original description of the Forest elephant by Matschie (1900) was lacking morphological criteria and measurements, specific craniological, osteological and odontological differences between *cyclotis* and *africana* elephants do exist, which according to Frade (1935, 1955) and others, warrant species status. Any field worker who has observed and studied Forest elephants will tend to agree with this, mainly because of their different body proportions and carriage as well as their ecological and etho-sociological characteristics. However, the geographical distribution of *cyclotis* is not at all distinct. Along the entire northern limit of the moist forest zone with its gradual transition into open savanna woodland *cyclotis*-type elephants intergrade with *africana* elephants giving rise to morphologically intermediate forms of elephants.

Backhaus (1958) has shown how greatly the external features of Forest elephants, including the form of ears, the position, size and curving of tusks, and the number of toes, vary at the Elephant Domestication Station at Gangala-na-Bodio in northern Zaire in the transitional zone between rain forest and savanna. This station was originally founded and developed at Api in the central part of Zaire and there the captive elephants had typical *cyclotis* features (see Fig. 1 in Allen (1937) and Photo No. 16 in Krumbiegel (1943). When it was realized that the Forest elephants are not ideally suited for domestication purposes, the station was transferred in 1927 to the fringes of the forest zone. Blancou (1958) reported morphological intergrading of elephants also from the northern transitional zones of former French Equatorial Africa, now Cameroon and the Republic

of Central Africa. Sikes (1964) observed the same in Nigeria and Roth and coll. (1984) discussed the intergrading of Forest and Savanna elephants in detail for Ivory Coast.

Whether such intergrading is associated with interbreeding of *cyclotis* and *africana* forms is not known, but highly probable. Pl. I shows that the numbers and macro-morphology of the chromosomes of the typical *L. a. cyclotis* are identical with those of other African elephants (Benirschke 1971). Elephants with typical *cyclotis* features also do occur at times together with larger *africana*-type elephants in the same herds (Pfeffer 1960). This study shows that through all of West Africa there were areas in which the distribution of elephants was contiguous from the rain forest biome through moist forest into savanna woodland. In some of these areas there is still seasonal south-north movement of elephants from the forest into the savanna zone and vice versa. If there were natural interbreeding, genetic material of the *cyclotis* elephants would thus be dispersed far beyond the limits of the forest zone accounting for morphologically intermediate elephants in the transitional areas.

Similarly difficult is a delimitation of *cyclotis*-distribution towards the west in Guinea and Senegal and in the "Dahomey gap" between the Guinean and Biafro-congolese rain forest blocks in Togo and Benin. Tab. 1 shows that little museum material has been collected from these areas, but observations and reports from these countries suggest similar intergrading between *cyclotis* and *africana* type elephants as in the northern forest-savanna transition zone. Although *cyclotis*-distribution is now certainly disrupted in Benin and Togo (see below) specimens in the Berlin Museum and information collected locally during this study suggest that typical *cyclotis* elephants probably did occur in the south of these countries and that an isolated population of intermediate type elephants still exists in the central part of them.

A number of different *cyclotis*-subspecies were described between 1906 and 1914. Their validity was examined in detail by Allen (1937) who came to the conclusion that "there isn't any ground as yet for believing that *(L. cyclotis)* breaks up... into geographical races within its rather limited range in the rain forest". However, all of the described and examined *cyclotis* material originated from Central Africa and no craniometric comparisons were ever made between West and Central African Forest elephants. From field observations there is no doubt that the West African Forest elephant occurring in the Guinean rain forest block from Sierra Leone to Ghana, is a typical *cyclotis* form ; but a morphological quantitative study would be of particular interest with a view to the early separation of the Guinean and Congolese rain forest blocks and the consequent isolation of the West African *cyclotis* elephant. Unfortunately Tab. 1 shows that presently available museum material of West African elephants hardly permits such study, leaving the question of any possible evolutionary modification of the West African *cyclotis* elephant open.

Hunters have claimed since the turn of the century the existence of dwarf elephants in the rain forests of Central, but particularly also West Africa (Büttikofer 1970, Bell 1923, Christy 1924). Based on a captive elephant imported by Hagenbeck from the French Congo, Noack (1906) described such a "Pigmy elephant" as *L. pumilio* in 1905. Although Allen (1937) has shown that Noack's type individual continued to grow to normal Forest elephant size after it had arrived in the New York zoo, the dispute over the "Pigmy elephant" continued

Country	Museum material collected			Measurements/descriptions					Ref.
	type	locality	museum	body	feet	tusks	photo	oth. (*)	
Mauritania	.	.	.	x					1
Senegal Gambia	mount	Potdor	Cabinet du Rois de France					x	2 3
Mali	.	.	.					x x	4 5
Guinea - B. Guinea - C.	. .	. .	. .					x	6
Sierra Leone	10 skulls 1 foetus 4 molars	Gola forest Gola forest Lib. frontier	London London London	xx		x		x	7.8 9 9 9.12
Liberia	? skulls	?	Phila-delphia	xx		xx		x	13 14.16
Ivory Coast	10 skulls 1 skull 1 skull	Tai N.P. S.W. Region ?	Abidjan Dakar Paris	x x	x x	x	x x		17.9 9 9 9.15
Ghana	2 skulls 1 skull 2 jaws	Ashanti Winchi ? ?	London London London					x	8 9 9 19
Togo	2 skulls 1 skull 3 skulls 1 foetus	Sokodé Tamberma ? ? Sio River	Berlin Berlin Berlin Berlin						2 20 9 20
Benin	.	.	.					x	9
Burkina Faso	.	.	.				x		9
Niger	.	.	.					x	5
Nigeria	1 skull 2 skulls 2 skulls	Benue Riv. Kamberri ? Cross River Rio del Rey Tibeti	London London Berlin	xx		xxx	x	xxx	2 9 2 10.21-23

(*) published references with general morphological and detailed geographical information

TABLE 1. — Museum material and measurements from West African elephants.
References : (1) Laborie (1928) cited by Joleaud (1932), (2) cited by Frade (1935), (3) Buffon (1837) cited by Krumbiegel (1943), (4) Barth (1837) cited by Krumbiegel (1943), (5) Tanoust (1930) cited by Joleaud (1932), (6) Gromier (1936), (7) Dollman (1935), (8) Morrison-Scott (1947), (9) present study, (10) Rowland Ward (1910), (11) Haywood (1933), (12) Merz and Roth (1984), (13) cited by Kuhn (1965), (14) Büttikofer (1890), (15) Bell (1923), (16) Allen (1937), (17) Merz (1982), (18) Pfeffer (1960), (19) Short (1983), (20) cited by Krumbiegel (1943), (21) Christy (1924) cited by Krumbiegel (1943), (22) Rosevear (1953), (23) Happold (1985).

NOTE : After compilation of Table 1, M. Alain Gérard Seck has kindly informed that the collection of IFAN in Dakar contain 2 skulls from Mauritania (Sélébali) and 28 skulls from Ivory Coast (Bouaflé and Daola) ; 2 skulls from Senegal (Niokolo Koba) are at the Department of National Parks in Dakar-Fann.

until recent years. Petter (1958) examined a series of skulls which were ascribed to the "Pigmy" elephants, but found no feature which would have distinguished them from young *cyclotis* skulls. In fact, in most of them the sutures were not yet ossified classifying them as immature. Only four represented apparently fully adult animals despite their small size and therefore Petter (1958) did not rule out altogether the occurrence of dwarf elephants. Pfeffer (1960) studied the question of Pigmy elephants in Ivory Coast and came also to the conclusion that "Pigmy" elephants do not occur as a distinct species, although particularly small individuals of Forest elephants may well be found.

This conclusion is borne out by Merz' (1982) study of the Tai forest elephants in the Ivory Coast in which he has measured a large number of front foot prints in order to deduct from them approximate body size. 45 % of the prints measured between 20 and 25 cm and 39 % between 30 and 35 cm in diameter, giving mean circumferences between 63 and 79 cm and 94 and 122 cm respectively. Applying an average index of 1 : 2.3 for foot circumference : withers height the average Tai forest elephants appeared to be below 2.00 m but with a maximum of an average 2.40 m. The Tai elephants therefore fall clearly within the range of shoulder height of the Forest elephant with many individuals being as small as the postulated "Pigmy" elephant. A typical female *cyclotis* elephant in the Abidjan zoo depicted in Pl. II grew from about 1.40 m in 1978 to more than 2.00 in 1988.

Taxonomic determination of West African Savanna elephants proves even more difficult than that of Forest elephants due to the non-availability of museum material. Krumbiegel (1943) and Ansell (1971) suggested that the range of the Sudan elephant, *L. a. oxyotis* (Matschie 1900), including the synonymous *L. a. rothschildi* Lydekker 1907 described from the "French Sudan south of Lake Chad", extends through northern Nigeria as far west as northern Sierra Leone where Haywood (1933) recorded a large as well as a small form. The elephants of the western shores of Lake Chad have been reported to have particularly large feet, according to Sikes (1964) 127 cm and more in circumference. This is considered to be an adaptation to the continued standing in shallow marshes. The Gourma elephants in Mali are also known to be rather large (Barth 1837), cited in Krumbiegel (1943) and may be falling within the *oxyotis* subspecies. The external features of elephants in the Pô National Park of Burkina Faso and the Comoé National Park in the Ivory Coast are documented in Pl. III and Pl. IV. The latter are already intergraded with Forest elephants and intermediate elephant types are frequent. To compare these with *cyclotis* elephants of the Tai National Park, Gilbert (pers. com.) measured a large series of front foot prints using the same method as Merz (1982). 58 % of the prints measured between 25 and 35 cm and 35 % between 35 and 45 cm giving mean circumferences between 79 and 141 cm respectively. Applying a slightly reduced index of 1 : 2.2, withers height of the Comoé elephants was between 1.80 and 3.10 m, showing that some of the intermediate types fall within the size of large *cyclotis* elephants, but others clearly exceeding it.

Impressive elephant trophies have been collected by French and British sportsmen also from West Africa. Rowland Ward recorded in his 6th Edition (1910) an elephant of 3.32 m shoulder height shot by Capt. W.P. Pearse and tusks of 2.40/2.35 m weighing 45 and 65 kg respectively, obtained by Maj. C.E. Palmer, both from Sierra Leone. For Nigeria tusks of 2.10/1.83 m weighing 30 and 27 kg

respectively were recorded by Capt. G.C. Kelly. However, there is no doubt that big tuskers are now very rare indeed, maximum tusks weights seldom exceeding 20 kg.

In the most westerly part of the Sudanian Savanna Zone, i.e., in northern Guinea, western Mali, Senegal and Mauritania, the subspecific status of elephants is indeterminate as Krumbiegel (1943) and Ansell (1971) have already found. Senegal's elephants had early a reputation for being small (Buffon (1837) cited by Krumbiegel (1943) and the relic elephants of Mauritania are also reported to be of small size by various authors ("2.40m" according to Laborie (1928) cited by Joleaud (1932). Unfortunately no photos nor skull material of these elephants exist. Their small size is considered to be either a result of dwarfing under very harsh conditions and insular isolation or due to a phylogenetic link to the Northwest African antique elephants. This leads to the question of the phylogenetic relations between these, *cyclotis* and *africana* type elephants which is of particular interest in the context of the taxonomy of West African elephants.

Prehistorically elephants occurred throughout the West African continent from the Guinean to the Mediterranean coast, until the present-day Sahara desert evolved and separated elephants in the north from those in the south. The persistence of elephants in Northwest Africa until the 6th century AD was studied by Joleaud (1932), Arambourg (1952) and others. They were smaller than the typical Savanna elephant, dependant on moist forest or shrub habitats, and seem to be more closely related to the Forest elephant. For this reason Ansell (1971) grouped the extinct *L. a. pharaohensis* Deraniyagala, 1948, syn. — *berbericus* Seurat, 1930, together with *L. a. cyclotis* in a *Cyclotis* section (see above).

Cyclotis elephants are generally regarded as the more original form from which the Savanna elephant has evolved as a more differentiated and adapted animal. This view corresponds with the rule that evolution tends towards bigger rather than smaller species, and the reduction of the number of toes is more frequent in the Savanna elephant. It is substantiated by Azzaroli (1966) who has shown that the cranial characteristics of *cyclotis* seem to relate more directly to the *Steganopoda* as the ancestors of both Asian and African elephants.

Given these facts two phylogenetic hypotheses are possible :

— The African elephant originated as a forest animal in Central Africa from where it adapted phylogenetically to more open moist habitats, extending its range all through Western Africa towards the north ; only where arid savanna and grassland evolved, mainly towards the northeast, east and south, did it adapt to these ecological conditions.

— The African elephant originated as a medium size animal of moist open forest/shrub habitats extending its range from the north all over Africa ; where confronted with dense humid evergreen forests or with semi-arid savannas the elephant adapted to these two ecological situations by evolution of small, even dwarf forest forms as well as large and even giant savanna forms.

The evolutionary processes have, however, nowhere been so confined as to effecting genetic speciation.

PAST AND PRESENT DISTRIBUTION

The distribution of elephants at the beginning of this century was reviewed by Engell (1911) from accounts of early travellers and naturalists. Mauny (1957) has mapped the range of elephants in West Africa about fifty years later. Both of their accounts were compared with the information on distribution in 1976-1984, shown in Fig. 2 in relation to the biogeographical zones discussed above.

Guinean Forest Zone.

Elephants occuring in this zone are considered to represent typical *L. a. cyclotis* as discussed above. Around the turn of the century they were still distributed over the entire forest zone and only little affected by local human settlement. In **Sierra Leone** elephants still roamed the Peninsula of Freetown in 1882 (Dolan 1933). However, due to relatively early intensive exploitation of the rain forest, originally covering some 70 % of this country, Forest elephants diminished early. Today last remnant populations of Forest elephants are restricted to the Kangari Hills Forest Reserve, the Tonkoli-Tama and the Gola Forest Reserves (Teleki 1980). These populations are all separated from each other and even in the Gola forest elephants appear to be split up into 2 or 3 isolated herds (Merz and Roth 1984). Only the northern Gola elephant herd might still have contact with the larger elephant population of the Mano-Lofa area in **Liberia**. In this country, located entirely in the forest zone, forest transformation was less rapid and little local ivory was traded. As a result relatively important elephant populations have survived until today in the northwest between the Mano and Lofa rivers and in the east between the Cestos and Cavally rivers (Verschuren 1979, 1982).

The northeastern elephant range extended in 1966 still across the main road from Gbanga to Voijama and to the Guinean border (Frank 1980). In 1980 it appeared to be limited in the north to Guma and the Wologisi Range, sporadic elephants occurring as far south as Cape Mount County and the Kpo Range in the west (Roth 1980). The eastern range which is entirely separated from the northwestern by the wide strip of intensive agricultural development between Monrovia and the Nimba County, is broken up into several distinct elephant areas, the most important ones being the Cestos and the Sinoé river systems and the middle Cavally river where sporadic contacts still exist with elephants in southwestern Ivory Coast (see below).

Guinea comprises only a relativly small area of true rain forest adjacent to Liberia which so far has only been little affected by agricultural development. In this area, the N'Zere Keré district, Forest elephants are still found in several scattered populations (Conde 1980). In **Ivory Coast** Forest elephants occurred virtually anywhere in the extensive forest zone (with the only exception of the coastal area around Abidjan) until the early sixties when heavy forest exploitation and large scale agricultural development of this zone was initiated. As Roth and coll. (1984) have shown, elephant distribution was broken up by this development into more than 26 separate and isolated relic Forest elephant populations, of which the most important ones occur in the southwestern region between Cavally and Sassandra rivers, north of Fresco and on the lower Comoé river. **Ghana** comprises rain forest only in its southwestern part, in which Forest ele-

phants were widely distributed until the fifties when intensive development started (Merz 1976). Today remnant populations occur only in the upper Bia river system, on the confluents of the lower Tano river, and in the Kakum and Assin-Attandanso forest area north of Cape Coast (Sikes 1975, Martin 1977, 1979, 1982).

East of the Volta river, through **Togo** and **Benin**, the climate has historically always been drier not allowing for the development of rain forest. It is therefore unlikely that this part of the Guinean coast was recently inhabited by the typical Forest elephant although elephants did occur historically in the southern part of these countries (see above).

East of Porto Novo, in **Nigeria**, begins the Biafro-congolese rain forest block and thus the historical range of the Central African *L. a. cyclotis* (see above). Allison (1943) described the distribution and status of Forest elephants in the Ondo Province west of the Niger river during 1936-1943. Their range, although reduced, had changed little since the beginning of the century, movements occuring to the north into savanna of Owo and Ifon. However, "the ivory trade had as disastrous an effect on them as the (previous) slave trade on humans", resulting in near extinction of elephants in Benin State. According to Sikes (1964) and Happold (1980, 1985) elephants have persisted only in small numbers in the Benin State and possibly in the Niger delta until the sixties, but Petrides (1962, 1980) found no evidence of survival of Forest elephants there. The only area in which they might still occur are the most easterly parts of the Nigerian forest zone bordering Cameroon. Here, two remnant populations still existed in 1977, probably contiguous with Forest elephants in Cameroon (Agbor 1977).

Guinean Savanna Zone.

As explained above this zone must be regarded in part as historical range of the Forest elephant which is well borne out in Nigeria where a specimen of *L. a. cyclotis* was collected as far north as Lakota on the confluence of the Niger and Benue rivers (Christy 1924). Accordingly Sikes (1964) defines the northern limit for *L. a. cyclotis* in Nigeria as being approximately 9°N which puts most of the Guinean savanna into the range of this subspecies. The observations of Roth and coll. (1984) in Ivory Coast confirm the occurrence of small *cyclotis*-type elephants as far north as 7-8°. For the purpose of this study we therefore classify the elephants of this zone as Forest elephants, stressing however that these constitute a transitional form between the two subspecies (see above). Around the turn of the century such elephants occurred everywhere along the transitional zone between moist forest and savanna woodland, i.e. from the Gambia river to the Benue valley, as shown in Fig. 1a. Much of this zone has since been completely opened up into a man made moist savanna with forest patches often constituting the last refuges of forest wildlife.

In **Senegambia** these transitional elephants were still abundant in the southern part of the Casamance, at the beginning of the century. Their range extended to the upper and middle reaches of the Gambia river. According to Brewer (1979) the last elephant in **Gambia** was officially shot in 1913, and by the middle of the century the northern limit of these transitional Forest elephants ran through **Guinea-Bissau**. Elephants in this country were reported sporadically in the northeastern border areas, West of Gabu-Boé and south of Bafatá-Xitole until the seventies. The war of independence and hostilities between the two Guineas in

1962 is believed to have caused their decline (Almeida 1980). Only recently however, the survival of elephants was reported also from the central part of the country (De Olivera Costa 1984). In **Guinea** elephants were exterminated on the Futa Djallon plateau and north of it already well before the fifties. East and south of this moist high plateau, elephants were still present until the fifties, but the construction of the railway line from Conakry to Mamou in the twenties had already split this population up into a northern and a southern herd (Gromier 1936). South of this line elephants are reported to have survived east of Telimélé and on the upper Koukouré in the Monts Balandougou Forest Reserve (Lamotte 1980). South of this line elephants were still common in the thirties on the upper Kora and Kolente and the Laka and Pinseli rivers which they followed seasonally downwards to the Great and the Little Scarcie rivers in Sierra Leone (Gromier 1936). Some of these elephants are reported to have survived north of the boundary in two or three different localities in the Medina Oula and Marela districts and the Pinseli Forest Reserve as well as south of the boundary on the Little Scarcie river. Another surviving population of the transitional type in **Sierra Leone** inhabits the area northwest of the Loma mountatin massif which seems to serve seasonally as their refuge (Merz and Roth 1984). In **Ivory Coast** elephants of the transitional type were common over large parts of the Guinean savanna zone until the fifites (Roure 1962). Today there remain only some 4 to 5 relic populations in the Sangbé mountain area, in the Marahoué valley and in isolated forests in the Bouaké and Dimbroko districts (Roth and coll. 1984). In **Ghana**, elephants of the transitional type have probably only survived west of Lake Volta (Asibey 1981). In central **Togo** and **Benin**, elephants were still common until the fifties. Thereafter they still occurred sporadically as far south as the humid forest range west of Atakpamé in Togo (Dubreuil 1980), along the Nigerian border at Savé and even around Abomey in Benin (Sayer 1976, Worou 1981, Sayer and Green 1984). Today these elephants are restricted to the Fazao mountains, the Abdoulayé and Monts Kouffé Forest Reserves which are situated north of what is shown in Fig. 1b as Guinean Savanna Zone. Because of their recent historical distribution south into the moist zone we include these remnant populations nevertheless in the transitional category. There might very well be seasonal interchange between the above-mentioned scarcely inhabited localities, these constituting thus possibly one contiguous elephant range. In **Nigeria**, the Guinean Savanna Zone, comprising large parts of the Niger and Benue valleys, was still abounding with elephants in the first decade of the century (Bunsuru 1959). However, by the early fifties elephants north of the Niger and Benué confluence were already largely exterminated with the exception of about 4 or 5 isolated populations (Rosevear 1953, Priestley 1962, Sikes 1976). By 1978 there remained only two relic populations : on the upper Ogun river and in the Pai Game Reserve north, of the Benué valley (Happold 1980, 1985).

Sudanian Savanna Zone and the Sahel.

Elephants occurring in these zones are considered to be of the savanna type, although their taxonomic status remains indeterminate in large parts of West Africa as discussed above. There were probably seasonal movements all along the southern biogeographical limit of the Sudanian Savanna Zone extending the range of the Savanna elephant populations well into the Guinean zone. This

is still evident in several localities. Until recently the elephants from Niokolo Koba National Park in Senegal were reported to migrate into Guinea, perhaps as far south as the Futa Djallon mountain range (see above). The elephant population in the Comoé National Park in Ivory Coast studied by Roth and coll. (1979, 1984), moves seasonally from moist semi-deciduous forest areas south of the Park far north into relatively dry savanna woodland. The herds of this population show many behavioural characteristics of the "transitional" elephants and include individuals which are morphologically not at all typical Savanna elephants (see above). Also in Nigeria such north-south elephant movement between savanna and forest zone along the Ogun river and across the Benué river seemed to have occurred until recent decades (Happold 1980, 1985). However, rapid increase of the human population has restricted elephant ranges and their movements.

Although not as evenly distributed as in the Guinean Forest Zone, elephants still occurred all over the Sudanian Zone around the turn of the century, from the Senegal and Gambia rivers to Lake Chad. To the north their range extended all through West Africa far into the Sahel, being limited only by the Sahara desert at 15-17°N. During the first two decades elephants in the Sahel Zone were almost extirpated ; only 3 isolated populations, in Mauritania, in Mali and in Nigeria, have survived to date (see below).

In **Senegal** elephants seem to have been extirpated along the coast line between the Gambia and Senegal rivers, and also in the lower Senegal valley, already during the last century. Only some scattered herds persisted on the Saloum river and near Thiès until the end of the 19th century (Joleaud 1932). The arid Desert of Ferlo, east of this coastal zone seems to have never been much frequented by elephants, so that their range was roughly limited at the beginning of this century by a line between the lower Gambia river and the middle valley of the Senegal north of Bakel.

It seems likely that at that time the elephant range extended continuously from the middle reaches of the Senegal river north onto the Assaba massif and the Affolé mountains in **Mauritania**, where elephants have survived in small numbers to-date (Lamarche 1980). These highly adapted desert elephants seem to roam around far in search for water allegedly passing the winter time south at Maghama and Nioro du Sahel across the Mali border (Trotignon 1977). Sporadic elephants were found to be still surviving in the Senegal valley north of Bakel, between Gourel Para and Harr in 1978 (Douglas-Hamilton 1979 b). At times they cross over into Senegal depending on remnant patches of dense woodland. Further south of Bakel, elephants were apparently exterminated already during the first decades of this century, the elephant range in **Eastern Senegal** becoming limited to the middle reaches of the Falémé river. Seasonal movements between there and the upper reaches of the Gambia river seem to have continued until the sixties, and in 1978 a small relic population was reported to still exist on the upper Famélé river on the border to Mali (Dupuy 1978). Since then the range of elephants in Senegal diminished further to comprise only the upper Gambia river system. Also the seasonal movements from the Gambia river into the Youkounkoun district of Guinea towards the Futa Djallon plateau seem to have ceased in recent years due to their severe persecution in this area.

The elephants in the upper Senegal (Bakoye) river system in western **Mali**, which was still abounding with elephants at the beginning of the century, were

extirpated early on, probably as a result of the construction of the railway line to Bamako (see below). A relic, fragmented population has survived until 1978 between the upper Falémé, Bafing and Bakoye rivers ranging at times across the Guinean border (Sayer 1977, Lamarche 1978, Lamotte 1980). Between the Senegal and Niger rivers elephants were still distributed as far north as Nara and Tombouctou at the beginning of this century, but were more or less restricted to the Baoulé river system well before the fifties. Later on this population became also isolated from the elephants of southern Mali where they were fragmented into two or three relic populations by the sixties (Lamarche 1978). Until the seventies these elephants appeared occasionally in the Tingrela district of Ivory Coast (Roth and coll. 1984), but are now feared to be extinct.

Until the twenties, elephants occurred widely on both sides of the Niger ranging east of Gao as far as the Niger border (Lamarche 1978). By 1930 there remained only one isolated population in the Gourma area (south of the Niger bend at about 16°N), well adapted to the arid conditions of this area. This important remnant population roams seasonally far south-east to the border of **Burkina Faso**, but no longer reaching the Niger (Olivier 1984).

In this country elephants remained to be widely distributed south of 13°N until the fifties. Although elephants had already disappeared from the White Volta valley at the beginning of the fifties they were still abundant all along the upper Black Volta, the Red Volta and in the southwest until the sixties (Blanchard 1981). Later they became reduced to 4 isolated remnant populations north of Bobo Dialassou, in the Grand Balé-Black Volta confluence area and in the Bourgouriba river system, and also in the upper reaches of the Comoé and Leraba rivers. Another viable elephant population survived until present in the southern part of the country in the Pô-Red Volta river system. Seasonal migrations of the southwestern as well as the southern elephants down the Black River valley into Ivory Coast and northeastern Ghana and to the White river valley into northwestern Ghana were reported until recent years (Merz 1976, Roth and coll. 1984, Asibey 1981). In the eastern part of the country, elephants were still found as far north as 13°30' the Sirba river area and Niger valley during the fifties. Now their range is limited to the southeastern part of the country but extends into the adjacent countries Benin and Niger. This distribution area totalling approximately 25.000 km², is the largest remaining elephant range in West Africa (see below). In **Benin** it extends beyond the Pendjari river plain and across the Mekrou as far east as the Alibori river, elephants ranging occasionally even further to the east into the Goungoun Forest Reserve and to the Sofa river. in **Niger** it included, until the sixties, the entire area between the Sirba, the Gouroubi, the Tapoa and Mekrou rivers, the Niger constituting the northwestern limit of the range (Poche 1974). More recently the north-south movement pattern has been more and more disrupted, elephants occurring still in the Sirba river area, but concentrating mainly on the Tapoa and Mekrou rivers. Until the sixties elephants were also recorded seasonally and sporadically in the Maradi and Diffa districts in southern Niger (Poche 1974). It is assumed that these have immigrated from Nigeria (see below).

In the northern savanna parts of **Guinea**, **Ivory Coast**, **Ghana** and **Togo** elephants were widely and abundantly distributed until the fifties. Since then only few isolated elephant populations have survived in this vast area, east of Kankan in the Kaurouna district of Guinea, south of Odienné and of Khorogo,

and on the upper Bandama and Comoé rivers in Ivory Coast, between Black and White Volta and on the Morago river in Ghana, and on the Koulougouno and Koumougou rivers of upper Togo. Whereas the remnant populations in Guinea and Ivory Coast are definitely totally isolated, Duncan (1985) believes that the elephants in northern Togo might still have interchange with the Arli-Pendjari population (see above) and might also migrate at times into northwestern Ghana. In the Savanna Zone of **Nigeria** elephants appear to have been decimated already early during the first half of the century, only one important elephant population surviving west of the Niger river and about 4 to 5 small isolated populations east of it (Priestley 1962, Sikes 1976). Of these, the elephants in the Bornu State probably maintained seasonal interchange with the elephants in Northern Cameroon until recently. Far north in the Sahel Zone at about 13°, elephants still occur on the eastern shore of Lake Chad. This elephant population was historically contiguous with the elephants of the Chari-Logone river system and ranged until the fifties across the Komadougou river into Niger where they have since become extinct (Hall 1977, Poche 1977).

CAUSES OF DECLINE

Generally there are two major causes operating in the past and present decline of elephant populations in Africa :

— loss of habitat due to climatic change or human influences, and ;

— hunting by man for meat, trophies or for population reduction or elimination as Government policy.

These causes are often interlinked, but one or the other usually predominates according to specific locally evolving conditions. Contrary to other game species no natural catastrophies or epizootic diseases resulting in major die-offs have been known to affect the overall pattern of elephant distribution. Each of these causes has been instrumental in exterminating local elephant populations either alone or in conjunction with the other (Douglas-Hamilton 1987).

Historically loss of habitat through desertification was certainly the most important cause for the decline of elephants in the *Sahara and Sahel Zone*. Increasing aridity and decline of the vegetation cover are probably still the predominating threat to the elephants in Mauritania, northern Mali and Nigeria, the three last populations in the Sahel zone. However, due to their isolation and dependence on water shared by man and livestock these relic populations have now also become particularly vulnerable to human predation which thus compounds the threat of their extinction.

In the *Sudanian Zone* the most important reason for the elephant decline has certainly not been habitat loss, but excessive hunting for ivory during the early colonial stages. During this time conflicts between agricultural development and elephants did not yet exist, and elephants were simply pursued and slaughtered in great numbers for commercial gain. The ivory export statistics of French West Africa (former AOF) since 1821 in the archives of Dakar, summarised into Fig. 3, elucidate when and where major killing of elephants occured. In Senegal this was already before the middle of the last century when no less than 392 t were exported between 1825 and 1845. Considering also the illegal export on land routes and the generally smaller size of tusks some 15,000 to 20,000 elephants were killed during this period resulting in a severe decline of

the elephant population in the eastern parts of Senegal between the Gambia and Senegal rivers. Only when colonial exploration and penetration eastwards from Senegal to the Niger and Upper Volta commenced at the turn of the century a new peak of ivory export occurred. The construction of roads and particularly the railway line to Bamako in 1904 facilitated and economized the export of ivory and has thus contributed significantly to the decline of Mali's elephants well before the First World War. Only the Gourma elephants secluded in their harsh and inaccessible environment, were not reached by this early wave of slaughter and still remain Mali's only larger elephant population. In Guinea elephants were also affected early on by ivory hunting, exports of ivory increasing gradually from 1898 until 1912. Similar to Senegal and Mali the elephants of Guinea were thus eradicated from most savanna areas before the twenties. Ivory Coast comprises only a small part of the Sudanian zone and was therefore less affected by early ivory hunting pressure. A peak of ivory export from there through Dakar occurred only in 1907-1914 and exporting continued on a relatively high level between the two world wars to reach another peak in 1945-1948 ; but this probably already reflects the increased exploitation of the elephants of the Guinean zone (see below). Dahomey, now Benin, has never been an important producer of ivory and exports from this country ceased already completely in the early twenties.

Fig. 3 shows that in each of the Sudanian West African countries ivory export increased until it suddenly collapsed before 1914. This happened despite further rise of the ivory price after this time. An explanation for this apparent discrepancy could be that the resource was overexploited in a classic "overfishing" scenario.

Agricultural development in the Sudanian zone intensified only in the thirties. It was then that elephants started to become deprived of large parts of their former range. However, by that time elephants had generally already been much depleted, commercial hunting of elephants being banned as late as 1936 (Bourgoin 1949). Loss of habitat in this zone was therefore not a primary cause for elephant decline, but may well have prevented the elephant populations from building to their former level.

Nowhere in West Africa was there ever a significant retreat of elephants into protected areas with consequent overpopulation and habitat destruction as was observed in many areas of Eastern and Southern Africa. In fact protection of elephants in the few existing conservation areas was never as effective as it was there. By the sixties the segregation of elephants into many small scattered relic populations rendered them more and more vulnerable to the once again mounting pressure for both meat and ivory, and this is definitely today's predominant threat to the survival of West Africa's remaining Savanna elephants, even in the so-called protected areas.

In the *Guinean Zone*, both the forest area and the transitional moist and partly forested savanna lands, elephants remained fairly protected against the early massacres and thus survived as a more or less contiguous population well into the forties. Contrary to the Savanna elephants they were never severely affected by habitat change and livestock competition, because the Forest elephant and its transitional form do not live in large herds and can well adapt to human induced modification of the forest habitat (Merz 1982, Roth et coll. 1984). Only large scale transformation of forest areas into industrial plantations drive the elephants out.

Such plantations, with the exception of Sierra Leone, were only developed after the Second World War. Timber exploitation if practised extensively and selectively, induces growth of secondary forest which actually constitutes preferred habitat for elephants (Merz 1982).

Even slash and burn agriculture which usually follows lumbering, does not directly threaten elephants. However, it does make the forest accessible and exposes the elephant population to commercially organized ivory poaching. This has become only during the last decade far more important for the rapid decline of elephants in the forest zone than previous habitat loss.

If one reviews the importance of the *ivory trade* in the eighties for the conservation of the remaining elephants in West Africa, one finds that West African countries have virtually ceased to be producers of raw ivory for export. Thus the international ivory trade does not seem to be incriminated. However, most West African countries, be they signatories to the Convention on International Traffic in Endangered Species of Fauna and Flora (CITES) or not, have become importers of mainly Central African raw ivory which is being carved locally into statuettes, jewellery, or souvenirs and then offered to tourists in great quantities in almost all West African capitals ; a large part of this worked ivory is exported clandestinely abroad (Roth and coll. 1984, Douglas-Hamilton 1987). Fig. 4 shows that imports of raw ivory into Ivory Coast, for example, have increased from 0.7 t in 1972 to 46 t in 1980 which amply demonstrates the increased demand despite ever increasing ivory prices.

An analysis in Tab. 2 of the individual tusk weights of the imports shows a marked shift to higher percentages of small and medium sized tusks. It may be concluded that fully grown elephants are becoming now also scarcer in the exporting countries. The existing ivory trade in West Africa therefore poses on the one hand a serious threat to the remaining elephants of the Central African countries ; on the other hand however, it is the single most important factor for the continued severe poaching of elephants mainly in the Guinean Forest Zone. As long as this local ivory trade exists, based on apparently legal imports, a poacher does not have to worry about export papers : he simply sells his ivory clandestinely to the carvers, often even being lent money by these or intermediate merchants. Thus there remains a strong incentive to kill even small elephants with less than a kilo ivory in the forests, rendering control of poaching in this zone almost impossible.

TABLE 2. — Fluctuation of weight (age) composition of traded raw ivory in Ivory Coast. Imports recorded by Direction de la Chasse, Ministère des Eaux et Forêts, with individual tusk weights.

Year	Total imports in kg	Total number of tusks	Mean tusk weight in kg	percentage of tusks weighing		
				<10kg	10-20kg	>20 kg
1975	3,352	287	11.68	18	29	53
1976	19,873	1,810	10.98	24	17	59
1977	25,067	3,174	7.90	20	43	37
1978	21,306	3,341	6.38	18	35	47
1979	34,926	6,488	5.38	26	63	11
1980	45,926	9,263	4.96	37	62	1

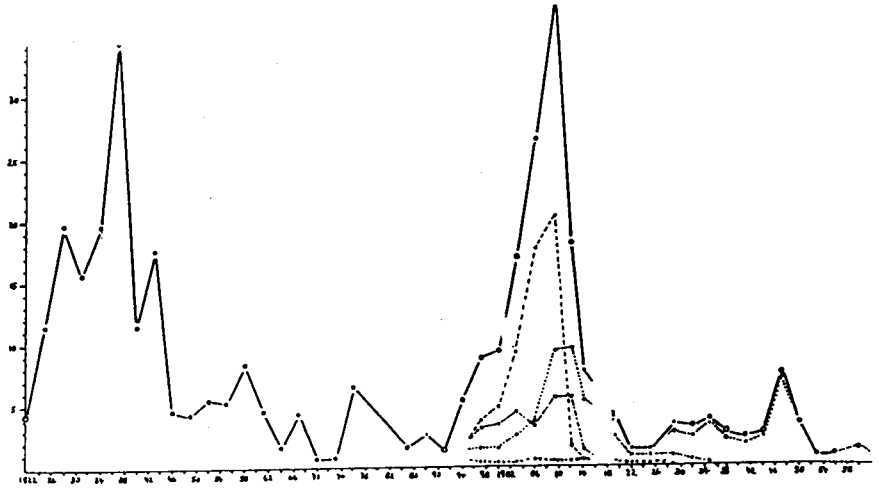


Fig. 3. — Fluctuation of raw ivory export from French West Africa from 1821 to 1960.

Export figures were compiled by Douglas-Hamilton (1979 b) from the Statistique Coloniale du Commerce and the Notices Statistiques sur les Colonies Françaises at the Archives at Dakar.

In 1902 the French Government consolidated all its possessions in West Africa into one federated administrative unit called « Afrique Occidentale Française (AOF) ». What is known to-day as Senegal, Mali, Burkina Faso and Niger formed « Senegambie et Niger » from 1899-1904 when they became « Haut-Senegal et Niger » ; in 1920 the area was renamed « French Soudan » from which they gained together with the other parts of AOF independance in 1960. Due to these administrative changes export statistics for Senegal, Mali, Burkina Faso and Niger are likely to include geographic confusions and are therefore combined.

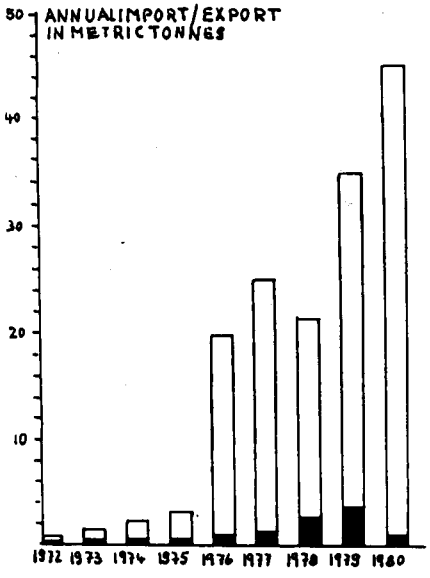


Fig. 4. — Increase of ivory trade in Ivory Coast from 1972 to 1980. Import figures are taken from the records of the Direction de Chasse, Ministère des Eaux et Forêts only ; statistics of the Direction de Douane showed lower figures for 1975-1979, but considerably higher ones for 1980 (56,6 to for the first nine months).
White : Recorded import of raw Ivory only (mainly from Zaire, Congo, CAR) = unrecorded (illegal) export.
Black : Recorded export (including worked Ivory).

TABLE 3 (a). — Protected areas and their importance to the conservation of elephants in the Guinean Zone of West Africa in 1976-1984.

FR = Forest Reserve, NP = National Park, GR = Game Reserve, CHA = Controlled Hunting Area, GRa = Game Ranch, BZ = Buffer Zone

0	no protection and heavy poaching	* 50-100	estimate based on actual census work
+	legal protection, but poaching uncontrolled	~ 240	estimate based on good local knowledge
+ +	efforts at protection made	? 200	estimate based on size and density comparison with other areas
+ + +	well protected and safe		

No (1)	Name	Country	Surface in km²	Legal - Prot. status		Elephant population(2) Tot. estimate	Density per km²	Lit. ref.
Guinean Forest Zone : rainfall 3,000 - 1,400 mm/annum								
1	Gola North, West & East	Sierra Leone	750	FRs	0	+ 150 (1982)	*0.20	1
2	Lofa Mano	Liberia	~2,000	prop. NP	0	? 400 (1978)	?0.20	2,3
3	Sappo	Liberia	~1,300	NP	0	? 200-300 (1980)	?0.15	3,4
4	Tai	Ivory Coast	3,400	NP	+			
	Tai buffer zone	Ivory Coast	660	GR	+	* 1,000-		
	N'Zo	Ivory Coast	727	GR	+	1,500 (1980)	*0.13	4
	Haut Dodo	Ivory Coast	~1,500	FR	+			
	Hana-Rapid Grah	Ivory Coast	~1,350	FR	+			
5	Okromodou-Diagoro	Ivory Coast	945	FR	+	~ 240 (1977)	~0.25	5
6	Azagny	Ivory Coast	200	NP	+ +	* 50-80 (1980)	*0.25	5
7	Mt. Peko	Ivory Coast	340	NP	+	~ 30 (1978)	~0.09	5
8	Tamin-Yaya Songan-Mabi	Ivory Coast	2,307	FRs	+	~ 200 (1978)	~0.09	5
9	Bia	Ghana	78	NP	+ +			
	Bia South	Ghana	224	GR	+ +	* 200-300	*0.25-	6,7
	Bia Tawya	Ghana	~350	FR	+ +	(1978)	0.37	
	Sukusu	Ghana	~150	FR	+ +			
10	Nini Suhien	Ghana	163	NP	+	~ 120 (1978)	~0.24	8
	Ankasa	Ghana	338	GR	+			
11	Oban	Nigeria	(7) ~2,500	FR	0	present (1976)		9
12	Boshi-Okwanogo	Nigeria	(7) ~750	FR	0	present (1976)		9
Total of protected areas: ~16,782 km² (7,430 km² NP & GR only) with 2,590-3,320 elephants								
Guinean Savanna Zone: rainfall 1,400-1,200 mm/annum								
13	Outamba	Sierra Leone	980	NP	+	~ 50-100 (1978)	~0.05	10
14	Sangbé	Ivory Coast	950	NP	+	~ 40 (1978)	~0.04	5
15	Marahoué	Ivory Coast	1,010	NP	+	~ 100-150 (1978)	*0.10- 0.15	5
16	Digya	Ghana	~3,120	NP	+	? 200-250 (1980)	?0.06- 0.08	
17	Fazao-Malfacassa	Togo	1,920	NP	0	? 50/60 (1981)	?0.03	11
18	Abdoulayé	Togo	300	prop. GR	0	? 20 (1979)	?0.07	12
19	Mt. Kouffé-Wari-Maro	Benin	~2,100	FR	0	? 40 (1976)	?0.02	13
20	Upper Ogun	Nigeria	1,100	GR	0	? 30 (1976)	?0.02	14
	Old Oyo	Nigeria	700	GR	0			
21	Pai	Nigeria	2,215	GR	0	? 50 (1976)	?0.02	14
Total of protected areas: ~12,595 km² (10,195 km² NP & GR only) with 580-740 elephants								
Total of protected areas in the Guinean Zone:			**29,377 km² (17,625 km² NP & GR only) with 3,170-4,060 elephants ~29,400 km² (~17,600 km² NP & GR only) with ~3,600 Forest elephants (including transitional populations)**					

(1) see Fig. 5 for location (2) densities are calculated all-year ranges, seasonally they may become much higher (3) never legally declared National Park, but managed as such (4) Sihvonen (1974) calculated a density of 0.21 km² using only 566 km² as range (5) Milligan (1979) calculated a density of 0.37 km² using only a Park surface of 3,924 km² (6) Heisterberg (1974) calculated a density of 0.56 km² for the Pô Park alone, with 460 km² (7) not belonging to Guinean Forest Zone, therefore excluded from surface total (8) now Burkina Faso.

TABLE 3 (b). — Protected areas and their importance to the conservation of elephants in the Sudanian Zone of West Africa in 1976-1984.

No (1)	Name	Country	Surface in km²	Legal - Prot. status		Elephant population(2) Tot. estimate	Density per km²	Lit. ref.
Sudanian Savanna Zone : rainfall 1,200 - 600 mm/year								
22	Niokolo Koba	Senegal	8,260	NP	++	- 50 (1983)	-0.01	15
23	Boucle du Baoulé	Mali	3,500	NP	+			
	Kongosanbougou	Mali	920	FR	0	- 150 (1979)	-0.02	16
	Badim-Ko	Mali	1,930	FR	0			
24	Haut Bandama	Ivory Coast	1,230	GR	0	- 60 (1979)	-0.05	5
25	Comoé	Ivory Coast	11,500	NP	++			
	Kinkéné	Ivory Coast	453	FR	+	* 1,000-	*0.08-	S ,17
	Suitoro	Ivory Coast	226	FR	+	1,500 (1979)	0.12	
	Bela Fima	Ivory Coast	228	FR	+			
26	Kollandé-Boulou	Upper Volta	-2,890	FRs	0	present (1981)		18
	Diéfoula-Logniégué	(8)						
27	Bontioli-Nabéré-	Upper Volta	-1,400	G & FRs	0	? 100 (1981)	?0 07	18
	Bougouriba							
28	Deux Bálé	Upper Volta	566	NP (3)	0	* 100 (1974)	*0 13	18,19
	Dibou	Upper Volta	224	FR	0		(4)	
29	Pô	Upper Volta	3,130	NP & CHA	++	* 600 (1981)	*0.11	18,20
	Nazinga	Upper Volta	2,400	GRa & BZ	++		(5)	
30	Mole	Ghana	? 4,920	NP	++	? 500	?0.10	
31	Keran	Togo	1,634	NP	++	? 40/60 (1981)	?0.03	11,12
32	Pama	Upper Volta	2,270	FR	+			
	Singou	Upper Volta	1,980	GR	+	* 1,440 (1981)	*0.27	18,21
	Arli	Upper Volta	1,100	NP (3)	++			
	Kourtiagou	Upper Volta	670	GR	+	* 260 (1981)	*0.09	18
	W(western part)	Upper Volta	2,290	NP	+			
	Pendjari	Benin	2,755	NP	++			
	Pendjari	Benin	1,800	CHA	++	* 1,010 (1981)	*0.22	22
	Atacora	Benin	1,220	CHA	++			
	W(eastern part)	Benin	5,680	NP	+	* 1,030 (1981)	*0.13	22
	Djona	Benin	1,180	CHA	++			
	W(northern part)	Niger	2,200	NP	0	* 700 (1977)	*0.29	23,24
	Tamou	Niger	220	GR	0			
33	Lake Kainji	Nigeria	5,170	NP	++	* 1,450 (1976)	*0.28	25
							(6)	
34	Lame-Burra	Nigeria	-2,320	GR	0	few only (1976)		26
35	Yankari	Nigeria	2,243	GR	+++	* 270-350 (1977)	*0.12-	27
							0.16	
36	Kambari	Nigeria	11,449	GR	++	* 40-50 (1976)	*0.03	28
36	Sambisa	Nigeria	512	desig.GR	0	* 150-200 (1976)		29
			(9,500)	*unprot.*	0			
38	Falgore (formerly	Nigeria	920	GR	0	- 50 (1976)	-0.05	26
	Kogin Kano)							
Total of protected areas In the Sudanian Zone:			**81,370**	**(62,267 km² NP & GR only) with 8,903-9,560 elephants**				
			-81,400 km² (-62,300 km² NP & GR only) -9,200 Savanna elephants					

References :

(1) Merz et Roth (1984), (2) Verschuren (1979), (3) Roth (1980), (4) Merz (1982), (5) Roth et al. (1984), (6) Martin (1982), (7) Short (1983), (8) Martin (1980), (9) Agbor (1977), (10) Teleki (1980), (11) Duncan (1985), (12) Dogbe-Tomé (1980), (13) Oude (1981), (14) Happold (1980, 1985), (15) Hall-Martin (1984), (16)Harenga (1981), (17) Muehlenberg et al. (1984), (18) Bousquet (1982), (19) Sihvonen (1974), (20) Heistenberg (1974), (21) Green (1979), (22) Bousquet et Szaniawski (1981), (23) Poche (1974), (24) Koster (1977), (25) Milligan (1979), (26) Sikes (1976), (27) Marshall (1977), (28) Colquhoun (1977), (29) Hall (1977).

TABLE 4. — Summary of the distribution and status of elephants in West Africa in 1976-1984. (1) see Fig. 1 for biogeographical zoning (2) see Fig. 2 for geographical location (3) estimated by mapping and measuring on maps in sq.km and percent of country area (4) only National Parks, Game Reserves and Controlled Hunting Areas from Table 3 in sq.km and percent of total elephant range of the country (5) numbers referring to Table 3 and Fig. 5 (6) Gourma area (Réserve des éléphants) not considered to be a protected area (7) without Sahara zone.

Country surface in km²	Veg. zones (1)	Elephant range (2) total in km² (3)		protected in km² (4)		refer. (5)	Elephant populations number	total size estimate
Mauritania	Sa	~8,000		-			1 (-3?)	?40
388,600 (7)	total	**~8,000**	**(2.0%)**	**-**	**(0%)**		**1+**	**~40**
Senegal	Sa	negligible		-			1?	?10
	Ss	~9,000		8,260		(22)	1 (-2?)	~50
	Gs	-		-			-	
196,192	total	**~9,000**	**(4.6%)**	**8,260**	**(96%)**		**1+**	**~60**
Mali	Sa	~28,000		- (6)			1	~550
	Ss	~10,500		3,500		(23)	2(-4?)	~350
745,100 (7)	total	**~38,500**	**(5.1%)**	**3,500**	**(9%)**		**3+**	**~900**
Gambia	Gs	-		-			extinct	-
11,300	total	-		-			-	-
Guinea - B.	Gs	~200		-			1 (-2?)	?20
36,100	total	**~200**	**(0.6%)**	**-**	**(0%)**		**1+**	**~20**
Guinea - C.	Ss	~4,000		-			2	?100
	Gs	~4,000		-			5 (-6?)	?400
	Gf	~2,000		-			3 (+)	?300
245,857	total	**~10,000**	**(4.1%)**	**-**	**(0%)**		**10+**	**~800**
Sierra Leone	Gs	~1,500		740		(13)	2	~250
	Gf	~1,000		-			4 (+)	~200
72,325	total	**~2,500**	**(3.5%)**	**740**	**(30%)**		**6+**	**~450**
Liberia	Gf	~27,800		1,300		(3)	4 (+)	~1,300
111,369	total	**~27,800**	**(25%)**	**1,300**	**(5%)**		**4+**	**~1,300**
Ivory Coast	Ss	~23,000		12,730		(24,25)	5 (-7?)	~1,750
	Gs	~3,000		1,960		(14,15)	3 (-4?)	~250
	Gf	~27,000		5,327		(4,6,7)	23 (+)	~2,800
322,462	total	**~53,300**	**(17%)**	**20,017**	**(38%)**		**31+**	**~4,800**
Ghana	Ss	~5,500		4,920		(30)	2 (-3?)	?500
	Gs	~3,000		3,120		(16)	1	?400
	Gf	~2,200		803		(9,10)	4 (+)	?600
238,537	total	**~10,700**	**(4,5%)**	**8,843**	**(83%)**		**7+**	**~1,500**
Togo	Ss	~2,000		1,634		(31)	2	?70
	Gs	~2,500		1,920		(17)	1 (-2?)	?70
	Gf	-		-			-	
56,000	total	**~4,500**	**(8.0%)**	**3,554**	**(78%)**		**3+**	**~140**
Benin	Ss	~13,500		12,635		(32)	1	~2,000
	Gs	~2,000		-			1 (+)	?40
	Gf	-		-			-	-
116,762	total	**~15,500**	**(13%)**	**12,635**	**(81%)**		**2+**	**~2,040**
Burkina Faso	Sa	unknown		-			seasonal	
(Upper	Ss	~27,500		~16,000		(27,29,	4 (- 8?)	~2,500
Volta)						32)		
274,200	total	**~27,500**	**(10%)**	**~16,000**	**(58%)**		**4+**	**~2,500**
Niger	Sa	-		-			extinct	
	Ss	~3,000		~2,400		(32)	1 (-4?)	~700
556,000	total	**~3,000**	**(0.5%)**	**~2,400**	**(80%)**		**1+**	**~700**
Nigeria	Sa	~2,400		362			1	?170
	Ss	~14,000		8,467		(33-35)	4 (-6?)	2,100
	Gs	~1,800		2,599		(20,21)	2	?80
	Gf	~3,300		-			unknown	? ?
923,768	total	**~21,500**	**(2.3%)**	**11,448**	**(53%)**		**7+**	**~2,350**
West Africa	Sa	~38,400	(2.8%)	362	(1%)		3 (-6?)	770
South of Sa-	Ss	~112,000	(6.7%)	70,106	(63%)		24 (-39?)	10,120
hara	Gs	~18,300	(2.3%)	9,879	(54%)		16 (-19?)	1,510
	Gf	~63,300	(16%)	7,430	(12%)		38 (+)	5,200
	total	**~232,000**	**(5.4%)**	**88,697**	**(38%)**		**81+**	**~17,600**

PRESENT POPULATION STATUS AND PROSPECTS FOR CONSERVATION

In all West African countries elephants enjoy full legal protection and may not be hunted any more for sport. However, in most countries there is legal provision for control of elephants, which cause damage to agriculture or forestry. Roth and coll. (1984) have shown in Ivory Coast that such provision is easily abused and that despite the species' endangered status, relatively large numbers of elephants may still be killed legally.

The numbers are, of course, insignificant compared to the constant illegal drain by poaching. Despite their legal status elephant survival in West Africa depends entirely on existing protected areas, shown in Fig. 5. These areas do not necessarily have National Park/Game Reserve status, but are often only "protected forests" (Forêts classées). In fact, most of these areas afford little, if any, active protection against poaching, but they have remained relatively uninhabited and poorly accessible. Though ecologically modified they constitue forest or woodland habitat to which the elephants can withdraw at least seasonally and where they survive during the dry periods.

In order to determine the conservation status of elephants in West Africa it is thus necessary to investigate the dependence of each population on a particular

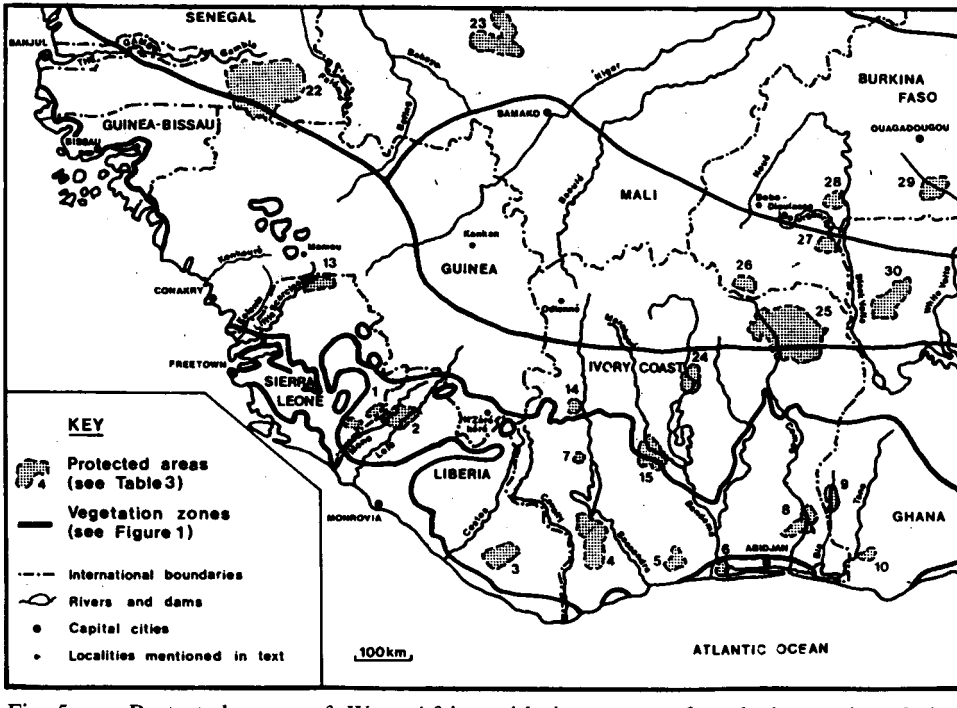


Fig. 5. — Protected areas of West Africa with importance for elephants, in relation to biogeographical zones.

protected area and to evaluate the conservation conditions in and around these areas. This was done for each of the more important populations by investigating :

— degree of isolation, possible interchange with neighbouring elephant populations ;

— seasonal movements out of the protected area and the determination of the total population range in relation to the size of the relevant protected areas ;

— size, nature and protective status of areas constituting elephant range ;

— availability of trend information.

The investigations were carried out by field studies in some of the countries, visits to most of the others and by correspondence with officials and research workers in all of the countries concerned, between 1979 and 1984. Ranges were plotted from best available data and measured by planimetry. The level and accuracy of information on each elephant population varied and was therefore subject to careful interpretation, including the application of population density figures from other ecologically similar areas. Unless otherwise stated these are indicative only and are at times the result of informed guesswork.

The results of the investigations represent the status of elephants in 1984 and need to be further updated. Data of the most important populations of Forest elephants, including 9 of the transition category (see above), are shown in Table 3 (a) and those of the most important 17 populations of Savanna elephants in Table 3 (b). They are discussed country by country and the overall results of the investigations are summarised in Table 4.

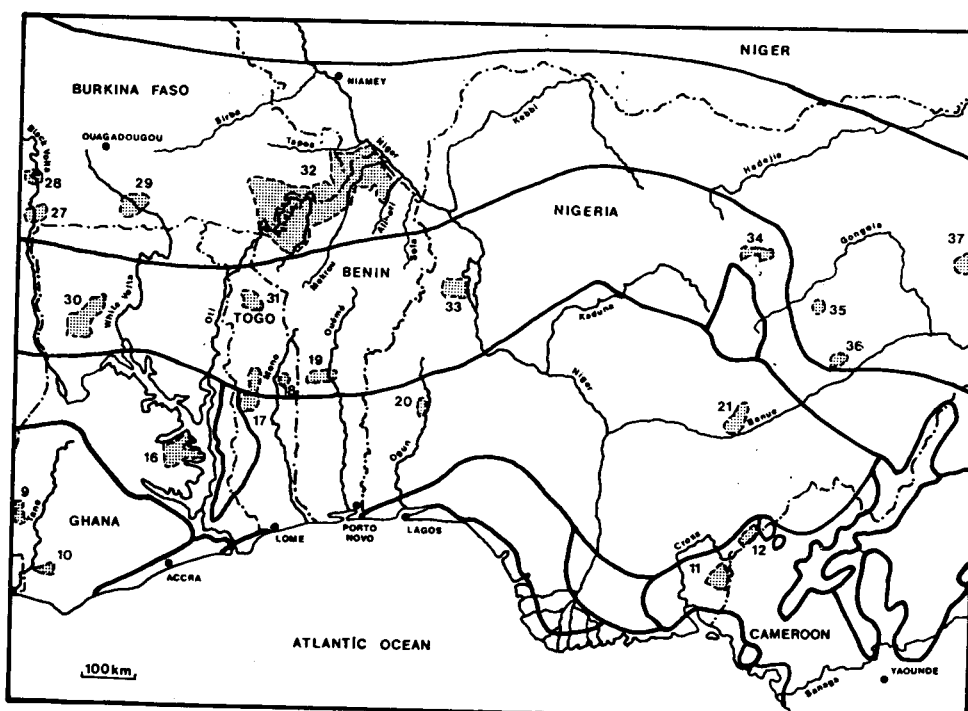


Fig. 5, continuation.

Mauritania : Very little is known about the status of the remnant elephant population in this country. Whereas Trotignon (1977) has still estimated these at about 160 heads, Lamarche (1980) who has verified the continued survival of elephants north of Sélibaby in the Assaba region in 1980, has put the estimate as low as 40. No part of their extensive range enjoys a protective status and there is steady deterioration of their habitat. The Senegal valley, possibly an important part of this elephant range, is being intensively developed for irrigation which denies any survival of elephants. Considering the existing conflicts with agriculture in an area where people themselves struggle to survive, the prospects for long term conservation of elephants in Mauritania seem rather remote.

Senegal : Elephant conservation in this country is entirely linked to their protection in the Niokolo Koba National park, the last remaining elephant range, against increasing poaching pressure. Elephant numbers seem to have increased from about 100 in 1967 to about 400 in 1975 during which time seasonal migration out of the Park's territory southwards across the Guinean border and eastwards to the Mali border, was still observed (Dupuy 1978, 1982 a, Sane 1980). Since 1976, however, poaching pressure has strongly increased, elephants now being pursued and killed in the Park. Despite greatest efforts by the well organized Park's administration (Dupuy 1982 b), up to 40 elephants were lost annually, reducing the population to less than 50 in 1983 (Verschuren 1981, Hall-Martin 1984). Although still a viable population in a sufficiently large and well protected range, prospects for survival of elephants in Senegal are doubtful.

Mali : The total of elephants surviving in this country in 1976-1978 have been estimated by Lamarche (1978) at about 900. Only two of the remnant populations have been studied and are subjected to conservation efforts : the Boucle de Baoulé and the Gourma elephants. The dry season range of the first one enjoys a protective status either as National Park or as adjacent Forest and Game Reserves, but nevertheless elephants in this area are extremely endangered by unimpeded heavy poaching. During the dry season they depend largely on the permanent water pans along the Baoulé river, but migrate far outside the protected area during the rainy season, allegedly as far north as Yelimané near the Mauritanian border. Lamarche (1978) has estimated the population at only 70 elephants in 1975, but Harenga (1981) regarded this figure as too conservative considering the heavy annual losses of more than 24 elephants only in 1979-1980, and put the population size at 150. However, during an aerial census in 1980 and 1981 of the protected area no elephants were seen, only tracks and 8 skeletons (De Bie and Kessler 1983). Unless more effective protection at least within the dry season habitat can be achieved, these elephants seem to be doomed.

None of the range of the Gourma elephants has a protective status although referred to as "Réserve des éléphants". Nevertheless they have a much better chance of survival than the Boucle de Baoulé population. Their range which extends during the rainy season as far south as the border area of Burkina Faso is less accessible and they are tolerated by the indigenous pastoralist tribes. According to Lamarche (1978) they still numbered about 550 in 1978. Olivier (1983) has made detailed recommendations for the management of the Gourma range.

Guinea : Very little is known about the status of the surviving elephant populations in this country numbering probably less than 800 animals. None of the existing elephant ranges enjoys a particular protective status, neither in

the Sudanian nor in the Guinean zone. In the north, along the Senegal and Mali borders, elephants have been reported to be mercilessly pursued for their ivory. The elephants which used to live in the Kankan Game Reserve seem to have been extirpated (Lamotte 1980). In the south surviving elephants were relatively safer as long as their dense forest habitat was largely maintained. The recent political change implies an increased exploitation of this habitat, and therefore elephant survival in Guinea depends entirely on the immediate creation of a system of wildlife reserves and/or National Parks. These must comprise the known relic elephant ranges, including particularly also the range extending from the Outamba-Kilimi National Park in Sierra Leone along the Kaba and Mongo rivers into Guinea (see below).

Sierra Leone : Surviving elephants in this country were estimated by Teleki (1980) at 450 in 1979. Their conservation depends on the future consolidation of the Outamba-Kilimi National Park in the northwest and acknowledgement of the Gola Forest Reserves in the eastern region as Game Reserves or National Park. In the Outamba-Kilimi National Park no elephants seem to have survived in the Kilimi section (Kolente river system) which is separated from the Outamba section (Little Scarcie river system) by the international road to Medina Oula in Guinea. The Outamba section contains according to Teleki (1980) about 50-100 elephants of the transitional category which migrate probably at times into adjacent Guinea (see above). The Gola forest reserve complex was surveyed by Merz and Roth (1984) who estimated the residual forest elephant population there at about 150 animals which will be entirely cut from Liberia if the planned Mano river dam will be built. Other elephants in the small Kangari Hill Reserve, the heavily exploited Tama Forest Reserve and north of the Loma mountains have no chance for survival (Merz and Roth 1984).

Liberia : This country is fortunate in still having a relatively viable though increasingly pursued Forest elephant population totalling in 1981 perhaps some 1300 animals (Roth 1980). If proposals made by Verschuren (1979) for the creation of a system of Reserves and National Parks including a large portion of the still unexploited Lofa-Mano high forest would be implemented there would be a good chance for the conservation of several viable Forest elephant populations. At present however, the only area enjoying a National Park status is the Sapo area (Sinoe river system) which according to the research of Merz (1982) in the neighbouring Tai National Park in Ivory Coast, is unlikely to contain more than 200-300 elephants.

Ivory Coast : The conservation status of elephants in this country was studied in detail by Roth and coll. (1984). The total number of Forest elephants, including transitional forms, was estimated in 1980 to be about 3,000. However, only 5 of the more than 26 ranges to which these elephants are restricted, have National Park or Game Reserve status. The longterm conservation of Forest elephants in Ivory Coast (and probably in all of West Africa) depends thus on the consolidation of the existing Forest reserves, but particularly on the better protection of the Tai National Park and its adjacent Game and Forest reserves. These comprise an area of no less than 7,627 km^2 of unexploited or only extensively timbered rain forest containing 1,000-1,500 elephants in 1980. However, Merz (1982) has shown how sensitive this population is to the ongoing regional development and that its size had diminished by about 30 % during the short period of 1978 to 1980, due to increasing commercial ivory poaching. The two next

important elephant ranges, north of Fresco and on the lower Comoé River, containing in 1978 some 200 Forest elephants each, are only Forest reserves which enjoy little if any factual protection. Though well protected, the recently created Azagny National Park near Abidjan, has only a small elephant population of about 50-80 animals (Foehrenbach 1980, Roth and coll. 1979). Elephants in the Marahoué National park were estimated in 1978 at 100-150 (Sutherfield 1979), but are certainly declining due to lack of protection. The total number of Savanna elephants in 1980 has been estimated at about 1,750 of which 1,000-1,500, i.e. 86 % are living in the Comoé National Park and adjacent Forest reserves (Steinhauer 1984). This area totalling no less than 12.407 km², constitues one of the most important elephant ranges in West Africa and its improved protection and management will be vital for long term conservation of elephants in West Africa. In particular, the Forest reserves to the south and the west of the Park, but also to the north across the border of Burkina Faso (see below), forming the rainy season range for the elephants, must receive full legal and factual protection if elephants are to the maintained. An aerial census of the area in 1983 showed that probably due to poaching the population appeared to have decreased since 1977/80 (Muehlenberg and coll. 1984).

Ghana : In this country only the status of the Forest elephants has been studied in greater detail (Martin 1979, Short 1983). Their conservation depends mainly on the consolidation and management of the Bia National Park and its adjacent Game and Forest reserves, the Nini Suhien National Park with the adjacent Ankasa Reserve and the planned Kakum National Park. The Bia population was estimated in 1978 at 200-300 elephants, whereas numbers in the Nini Suhien/Ankasa area were believed to be lower. Elephants in the Kakum area were estimated at 100-150 (Dudley and coll. 1990). The Goaso elephants north of the Bia National Park depending solely on a mosaic of small Forest reserves which are being rapidly transformed into agricultural land, have no long term survival chances.

Considering the size and the inaccessibility of the Digya National Park this could be another important area for the conservation of transitional type Forest elephants. Little is known about the number and status of elephants in this area which might contain up to 300 animals. In the Bui National Park bordering Ivory Coast, elephants seem to have been extirpated a long time ago.

Conservation of the Savanna elephants depends on their protection in the Mole National Park (Pegg 1969). With an area of approximately 4,920 km² this protected area is estimated to contain some 500 elephants which seem to migrate seasonally northwards out of its boundaries (Asibey 1981). Considering all rather scanty information the total of surviving elephants in Ghana is probably less than 1,500.

Togo : Comparing the size of the relic elephant ranges with known elephant densities elsewhere there are probably no more than 100-140 elephants left in this country (Dogbe-Tomi 1980, Duncan 1985). Considering the increase of human population pressure, the elephants in central Togo (see above), possibly migrating seasonally into Benin, appear to have a limited chance of survival despite Government plans for the development of a Fazao-Malfacassa National Park of 1,920 km². Savanna elephants in the north may be conserved in small numbers within the Keran National Park, the area of which has been recently extended to comprise 1,634 km², and the small Fosse aux Lions Reserve south of Dapango in the north.

Benin : As in Togo very little is known about the elephants which had survived until 1982 in small numbers in the centrally located Monts Kouffé and Wari-Maro Forest Reserves. A survey of this area was carried out by Rahm in 1974 and another one by Oude in 1979 confirming the seasonal presence of elephants on the Wari river and the potential of this area as National park. Apart from this central area, the most important Savanna elephant range in West Africa extends across the Pendjari and Mekrou rivers into Benin and constitutes here the Pendjari and W National Parks with adjacent Controlled Hunting Zones totalling 12,635 km². The improved protection and management of this area, is vital for the conservation of the largest remaining West African Savanna elephant population, estimated at more than 3.000 animals and ranging between Niger, Benin and Burkina Faso (see below).

Burkina Faso (former **Upper Volta**) : According to the survey of Bousquet (1982) about 2,500 Savanna elephants are still roaming this country. Of these, only about 30 % occur in the Volta and Comoé river systems in the south and southwest, disintegrated into at least 4 or 5 isolated relic populations (see above). The dry season range of the population in the Volta river system is protected by the Deux Balé proposed National Park and the adjacent Dibou Forest Reserve (Grand Balé river and its confluence with the Black Volta), by the Bontioli and Nabéré Game Reserves and the Bougouriba Forest Reserve (Bougouriba river system) and by the Pô National Park with adjacent Controlled Hunting Zones and the Nazinga Game Ranch (Red Volta and Sissili river system). Most of the southwestern elephant range on the upper reaches of the Comoé river bordering the Ivory Coast, has Forest Reserve status, but has been proposed for National Park development (Bousquet 1982).

The elephant population of the Deux Balé so-called National Park was estimated in 1973 at about 100 animals (Sihvonen 1974), and that of the Pô National Park and adjacent areas, based on an aerial total count by Heistenberg (1973), at about 250-300 (Green 1977). The survey work of Bousquet (1982) has indicated an apparent diminution of elephants in the Pô National Park, whereas numbers in the adjacent Nazinga Game Ranch seem to have increased to about 300. The Pô elephants are concentrated in the southern part of the Park and it is possible that better protection has attracted these to the Nazinga Ranch area. The elephants of these two areas are one of the locally densest and best visible elephant populations in West Africa.

Very little is known about the status of the elephants in the Bontioli/Bougouriba area and of those occuring in the upper Comoé and Laraba drainage system in the Koflande-Boulou-Diefoula-Logniegué Forest Reserves. Whereas the former are resident in at least a third of the Bougouriba valley the latter might well be only wet season migrants from Ivory Coast (see above).

The larger part of the country's elephants, about 1,700, occurs in the southeastern range which comprises the Forest and Game Reserves of the Pama and Singou rivers, the Arli Game Reserve, Hunting Zone and so-called National Park (Pendjari drainage system), the Kourtiagou Game Reserve and part of the W National Park (Mekrou/Niger river system), totalling more than 8,300 km². It extends however to the north and northeast into Niger's and Benin's portions of the W National Park and to the east into the Pendjari National Park and adjacent Controlled Hunting Zones of Benin. Including these large areas this elephant range comprises almost 25,000 km² of still very sparsely inhabited, partly

very dry and inhospitable savanna land and constitutes the most important elephant conservation area in West Africa.

The elephants of this large area have been studied and censused in Burkina Faso by Boy (1963), Green (1977, 1979) and Bousquet (1982), in Niger by Poche (1974) and Erickson (1977), and in Benin by Sayer (1976), Sayer and Green (1984), and Bousquet and Szaniawski (1981). They seem to still constitute one contiguous population which, however, splits up into several herds concentrating during the dry season in the western part of the range on the Pama and Singou rivers, in the northwestern part on the Mekrou river and in the southeastern part on the upper reaches of the Pendjari. During the rainy season the western herds seem to migrate eastwards to the Arli, Pendjari and Kourtiagou rivers, some of them possibly leaving the area northwards accounting for rainy season elephant reports as far north as the Tapoa and even Sirba rivers, tributaries of the Niger. The Mekrou herds move westwards to the Tapoa and Gouroubi rivers, but also eastwards as far as the Alibori and Sofa rivers. Considering the size of this range and the unequal distribution of elephants in it the number of the population is difficult to estimate. An aerial census of the Niger part of the W National Park in 1977 indicated some 700 elephants between Tapoa and Mekrou rivers (Koster 1977). A successive aerial coverage of the larger part of the range in Burkina Faso and Benin in March/April 1981, i.e. during the peak of the dry season, yielded estimates of 850 for the Pama Reserve and adjacent area, 590 for the Singou Reserve, 260 for the W National Park of Benin with Controlled Hunting Areas (Bousquet and Szaniawski 1981). Even if one allows for errors of extrapolation it would thus appear that the total elephant population in this range still exceeds 3,000-3,500 animals.

The population is everywhere in its range subject to poaching pressure and certainly not increasing. Bousquet's (1982) survey work has shown that most elephant herds withdraw during the daytime very far from human settlements, 50-60 km into the centre of the protected areas, feeding only during night in the riverine forests. From a conservation point of view the W and Pendjari National Parks as well as the Pama and Singou Forest and Game Reserves constitute the most important elements in this range ; the so-called Arli National Park does not hold any elephants during the dry season. This Park as well as the adjacent Pendjari Park and the Niger portion of the W National Park are fairly well developed for tourism which ensures relative protection, whereas the Pama and Singou Reserves still afford protection only because of their remoteness and inaccessibility.

Niger : The only elephants in this dry country which have hope for longterm survival are those ranging between the Gouroubi, Tapoa and Mekrou rivers on the southern side of the Niger, i.e. in the Tamou Reserve and the Niger portion of the W National Park (see above). Based on aerial census these were still estimated at 700 in 1977 (Koster 1977). Since then this number has certainly considerably diminished, probably to less than 400 (Green 1977). According to Newby (1983) some elephants seem to have become resident on the Sirba river, a former migration area northwest of the Tapoa-Mekrou elephant range.

Nigeria : Forest elephants west of the Niger river must be regarded as very rare, if not extinct, and their survival east of it, in the Oban and Bashi Forest reserves of the Cross River State needs confirmation. Similarly, the survival of the elephant populations in the Upper Ogun and Pai Reserves needs to be verified.

Conservation of the Savanna elephants depends entirely on the Lake Kainji National Park, the Yankari Game Reserve and the proposed Sambisa Game Reserve which contain the bulk of the countries remaining Savanna elephants, totalling only about 2,000 animals. In the Lake Kainji National Park repeated census work between 1962 and 1977 has shown an increase from several hundreds to about 1,450 elephants (Howell 1968, Child 1974, Milligan 1978). Also in the Yankari Reserve the well contained population has definitely grown from only 100 in 1970-1971 to about 300 in 1980 (Henshaw 1975, Marshall 1980), and is now starting to degrade the Reserve (Green 1985). The remaining viable elephant population in the Bornu State, numbering some 100-200 animals in 1976 (Hall 1977), ranges over some 10,000 km² of which only a small portion of 512 km² is designated as Game Reserve. Therefore, conflict between these elephants and agriculture is certain to develop during their rainy season dispersal, menacing seriously the continued survival of this population. Elephants in the Kambari Game Reserve, still numbering 40-50 in 1976 (Colquhoun 1977), have diminished to a relic herd of some 7-14 animals only (Happold 1985).

The remainder of the once large elephant population of Lake Chad, already extinct in Nigeria and Chad, numbered in 1976 only 150-200 animals (Hall 1977). Since their range on the Nigerian eastern shore was declared a Game Sanctuary in 1973 and hunting stopped, the population was reported to expand but has come into conflict with irrigation projects (Happold 1985).

In a comparative biomass study, Milligan and Ajayi (1978) have included also elephant density figures from some protected areas in West Africa, including the Kainji National Park and Yankari Reserve. They showed that densities and biomass levels are generally low compared with East African Parks and suggest that West African wildlife populations are everywhere well below the carrying capacity of their habitats.

CONCLUSIONS

Due to the lack of museum material it is presently not possible to determine the taxonomic status of elephants in all parts of West Africa. The West African Forest elephants are considered to be *L. a. cyclotis* although no comparative craniometric studies have as yet proven their subspecific identity with the Central African *cyclotis*-type. Only the occurence in West Africa of the so-called Pigmy elephant, *L. pumilio*, as described from Central Africa, was investigated and may be ruled out. The Savanna elephants in the eastern part of the West African Sudanian zone are considered to be *L. a. oxyotis*, but sub-specific status of elephants in the western part of this zone and in the Sahel remain indeterminate.

The distribution of Forest and Savanna elephants in West Africa is related to the pattern of biogeographical zones, but cannot be distinctly delimited. The Forest elephant has historically occurred from western Sierra Leone all through the Guinean forest zone as far north as 9°, but today typical representatives of *L. a. cyclotis* may only be found in the remaining evergreen forest areas from eastern Sierra Leone to western Ghana. From there its distribution eastwards is interrupted due to the advanced regression of humid closed forest and the tremendous increase in human population between Accra in Ghana and Porto

Novo in Benin, where the Biafro-Congolese rain forest block commences. There are some indications however, that this separation occurred only in recent historic times although the "Dahomey gap" between the rain forest blocks evolved early.

Although elephants occured historically all through the West African Sudanian Savanna Zone from the Senegal coast to Lake Chad, typical Sudan elephants may only be found in northern Nigeria, Benin, Niger, Burkina Faso and Mali. Between the Sudanian Savanna Zone and the Guinean and Biafran forest block a wide zone of derived Guinean savanna has developed during the last 60 years, comprising a mosaic of moist forest patches, wide riverine forests, moist bush and grasslands with cultivation. This zone which extends in Senegal, Guinea, Togo and Benin right to the Atlantic Ocean is inhabited by morphologically transitional elephants which can neither be referred to the Forest nor Savanna type.

The intermediate elephants may simply result from continuous local interchange of genetic material between intergrading Forest and Savanna elephant populations which appears possible according to their caryotypical identity. They may, however, also represent either a secondary evolutionary stage from Forest to savanna adaptation, or the primary most original type from which both small forest and large savanna elephant types have evolved. The latter hypothesis is supported by the fact that the Northwest African antique elephants were rather small and *Cyclotis*-like and may have extended through Mauritania, Senegal and Guinea to West Africa.

In 1984 when the present survey was terminated, elephants were still inhabiting roughly about 232,000 km² of West Africa south of the Sahara which represents only about 6-7 % of the area they had inhabited at the end of the previous century. The diminution of elephant range since that time was greatest in the Sahel and Guinean Savanna Zone of which only 2.8 % and 2.3 % respectively are still inhabited by elephants, as compared to 6.7 % in the Sudanian Savanna Zone. If one considers however only their dry season concentration ranges, the area in this zone, too, becomes much smaller.

Compared with the large dry savanna areas, distribution in the much more limited Guinean Forest Zone has probably always been more even and relatively denser. The elephant range in this zone thus still comprises about 16 % of it. All over West Africa elephant distribution is fragmented. In the Sahel only 3 distinct populations survive, whereas in the Sudanian Zone there are at least 24 isolated elephant ranges. In the Guinean Zone elephants are split up intc almost certainly more than 54 sometimes very small relic populations with very residential habits.

This situation highlights the extreme menace to the further survival of elephants in West Africa.

The reasons for the decline of elephants have varied in the different biogeographical zones. In the Sahara and Sahel, desertification with consequent loss of habitat was historically the most important cause, only later compounded by exposure to ivory hunting. In the Sudanian Zone however, the decline of elephants has been clearly associated with excessive killing during the early colonial time from which the population has never been able to recover. In the Guinean Zone elephants remained sheltered until intensive agricultural development after the Second World War deprived them of large parts of their habitat and has made the humid forest accesible to ivory poaching. This and not habitat loss anymore, is presently the more important threat to their survival. A major conclusion

therefore is that the fate of elephants in West Africa depends primarily on the suppression of any ivory trade as the only means to remove the incentive for elephant poaching and thus to curb it. The setting aside and better protection of sufficiently large tracts of elephant habitat assumes also great importance, but should have secondary rating.

At present only about 38 % of the above mentioned total area of elephant distribution has National Park or Game Reserve status and is thus at least theoretically protected. If one adds Forest Reserves the percentage increases to almost 50 %. About half of the total elephant range is thus subjected to agricultural development in one form or another. The situation varies however greatly according to the different ecological conditions, only about 12 % of the Forest elephant's range being legally set aside for conservation as opposed to 63 % the Sudanian elephant range.

Accepting all the problems and inaccuracies of elephant censusing the total of elephants which had survived in 1978/84 in the above discussed area is very roughly estimated at 17,600 at the very most. Of these about 5,200 are considered to be true Forest elephants, 1,500 transitional and about 10,900 Savanna elephants. Of these elephants only about 11,500 (3,500 Forest and 8,000 Savanna elephants) live in or around National Parks and Game Reserves. Due to the difference of applicable census methods the estimates for Forest elephants tend to be too low whereas those for Savanna elephants too high. Since compilation of these population data, reports have been obtained that indicate further dramatic decrease of elephant numbers in many areas. There is only one conservation area in West Africa, the Yankari Reserve in Nigeria, in which definite increases of elephants have been recorded since 1980.

The elephant population in West Africa has therefore probably by now diminished considerably below the above figures.

From a point of view of overall elephant conservation strategy it is important to note the differences of the conservation status of elephants in the different countries. In 4 countries (Mauritania, Senegal, Gambia, Guinea-Bissau) elephants are either already extinct or on the verge of extirpation. In 4 others (Mali, Guinea, Sierra Leone, Togo) only greatest and immediate efforts can possibly ensure further survival of the very small relic populations. In another country (Niger) elephant survival depends entirely on conservation action in the neighbouring countries. Only in the remaining 6 countries (Liberia, Ivory Coast, Ghana, Burkina Faso, Benin and Nigeria) which hold together more than 80 % of West Africa's elephants, have a true chance of survival. Here again one must distinguish between Forest and Savanna elephants. Survival of the former depends primarily on conservation efforts in Ivory Coast and Liberia in which about 79 % of the remaining *L. a. cyclotis*-population lives and relatively large conservation areas have been set aside. In the other countries (Sierra Leone, Guinea, Ghana, Nigeria) this subspecies is already so diminished that longterm survival under present conditions seems doubtful. Survival of the Sudan Savanna elephants, *L. a. oxyotis*, depends mainly on efforts to protect and to manage the largest remaining elephant range of West Africa between Burkina Faso, Benin and Niger, the W, Arli and Pendjari National Parks containing about 44 % of the total Savanna elephant population. Other essential conservation areas for them are the Comoé National Park in Ivory Coast, the Pô National Park with adjacent areas in Burkina Faso, and the Lake Kainji National Park and Yankari Reserve

in Nigeria comprising another 38 % of the total population. The survival of the especially adapted Sahel elephants could well be achieved in the Gourma area of Mali and also on the Lake Chad shore of Nigeria, if determined last minute international and national initiatives were taken.

Many of the countries of West Africa show elephants in coats of arms, badges and the like, symbolizing power and wisdom. Numerous ministers are proud to display elephant tusks in their offices, the possession of which having been formerly the privilege of important tribal chiefs only. Nevetherless, the protection and conservation of this unique species in West Africa has been such that it has become too rare for the great majority of people of the West African states to ever see an elephant, unless they go to a zoo. Even for foreign tourists it has become extremely difficult to find and observe elephants in any of the existing National Parks. The best chance to see a Savanna elephant is probably in the Pô National Park in Burkina Faso and to see a Forest elephant in the Azagny National Park of Ivory Coast. If the appaling lack of conservation awareness and action continues elephants in West Africa are likely to disappear entirely within the next decades.

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ERRATUM :

H.H. Roth and I. Douglas-Hamilton
Distribution and status of elephants in West Africa
Mammalia, 1991,55 (4) :

Pl. IV (Ph. II) and Pl. V (Ph. IV) :
Savanna-forest intermediate type elephants in the Comoé National Park, Ivory Coast Photos : J. Gilbert).

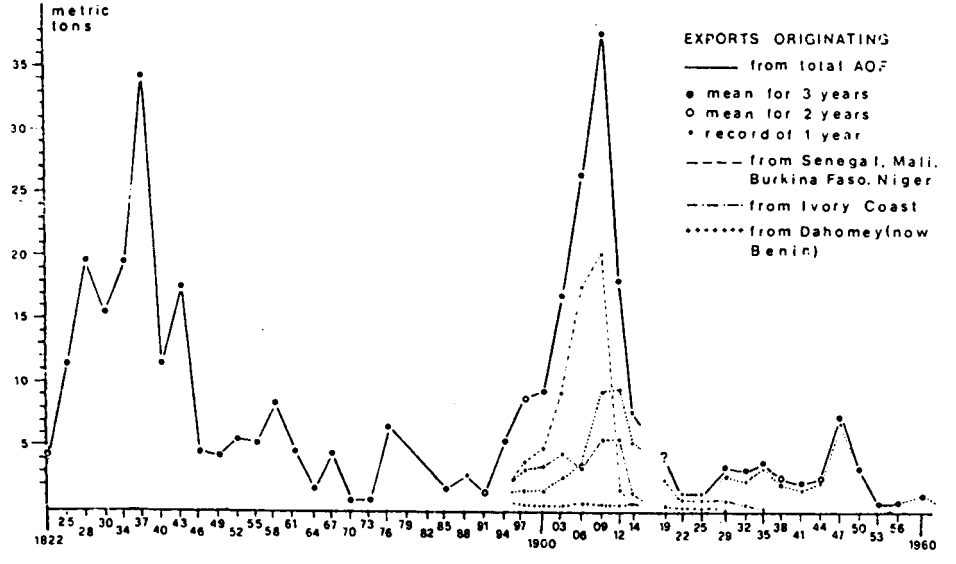

fig. 3. — Fluctuation of raw ivory export from French West Africa from 1921 to 1960.