

ENGLISH SUMMARY.

The present study of the ecology of the 22 species of Ungulates living in the Albert National Park, eastern Belgian Congo, has been carried out from July 1957 to December 1959.

Chapter I is devoted to the description of the various habitats which can be found in the 8.090 square kilometers of the Park, with emphasis on their geographical, climatic (tables 1 and 2), edaphic and botanical characteristics. Three broad categories can be distinguished : « open » environments, « closed » environments and montane communities.

The first ones are met with in the low plains south and north of Lake Edward (altitude ca. 1.000 m). The climate is characterised by a low or moderate rainfall with two dry seasons, an average annual temperature of 23,6° C, with slight seasonal variations and a strong diurnal evaporation. Saline soils are widely distributed. As for vegetation, the following physiognomic types are recognized : steppes (grass steppe without and with thicket clumps), savannas (three types) and swamps.

A number of rather diverse vegetation types are included in « closed » environments; thicket, dry deciduous forest, vegetation of the recent lava fields, lowland rain forest (moist semi-deciduous forest), gallery forest and montane evergreen forest.

Above about 2.500 meters on the high mountains (Ruwenzori and Virunga volcanoes) are found various montane communities : bamboo forest, *Hagenia* forest, tree heaths zone, alpine zone. Snow and hail often fall on the summits of Mikeno (4.437 m) and Karisimbi (4.507 m); glaciers cap the summits of the Ruwenzori range (4.802-5.119 m).

These various habitats intergrade widely, thus multiplying the ecotones. Moreover active volcanoes are numerous in the southern part of the Park (map 1) and lava fields at various stages of recolonization may be found in many places. Emission of toxic gases is frequent and kills many animals. In the open plains of the central and northern section of the Park fires have been prohibited since 30 years, but a number of natural bush fires (and fires coming from surrounding districts) take place every year (map 2-3). The evolution of vegetation during the last 25 years is illustrated by plates X to XII^{bis}; on the whole steppes and savannas do not appear to have changed very much during that time, reforestation occurred mainly on the mountain sides and deforestation in the periphery of the open plains. The vegetation of the Rutshuru river valley apparently did not change very much.

Chapter II is concerned with the detailed geographic distribution of the 22 recorded species, with special emphasis on their autoecology, mainly limiting factors and food habits.

The Elephant is found everywhere, up to the alpine zone; it is more frequent in « closed » habitats than in the open. The species continuously wander through the Park without showing any regular pattern of migrations. A marked female was followed during 2 years (p. 30) and has showed a remarkable fidelity to a rather limited district, but the size of the herds to which she belonged was very variable. Elephants feed mainly on grass and leaves, but are also very fond of the bark of certain trees (*Albizzia*) and of some roots.

The diurnal Warthog is restricted to « open » environments and feeds mainly on grasses, bulbs and tubers. The nocturnal Bush-pig appears to be found only in some districts, always in more or less « closed » habitats. On the contrary the forest Hog is very widely distributed.

The Hippopotamus is one of the dominant species of the Park. It lives in waters whose temperature ranges from 18 to 40° C and has been found up to an altitude of 2.000 meters, and as well in small lakes as in mountain streams or in rapids. Depth of the water and structure of the shore are not important limiting factors either. Swampy shores are avoided. The presence of adequate grazing grounds not too far from their aquatic refuge appears to be essential for them. A census of the total population of Hippopotami in the Park has been made (table 3) and the grand total approximates to 19.000 individuals. The Hippo population is always less dense in forest areas than in the open plains. On the Rutshuru river the population density averages 115 animals per kilometer of river. Very few hippos live on the steep western shore of Lake Edward, when the population is much more important on the low southern and northern shores. Anyway the number of individuals per kilometer of lake shore is always inferior to that of the animals living in the most densely populated rivers. Hippos wander very much by night in the open plains, some animals even settling temporarily in wallows.

The Water chevrotain is restricted to the lowland rain forest of the middle Semliki.

The Okapi is met with only on the left bank of the Semliki river, always in lowland rain forests (map 4).

The Situtunga is not common in the Park and confined to a few marshy areas.

The Busbuck on the contrary is found almost everywhere even in the lowland rain forest and in the montane evergreen forest.

The Bongo has been found on the right bank of the middle Semliki.

The Buffalo is one of the most abundant Ungulates in the Albert Park. This species is polymorphic in this area. Most of the open plains specimens

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belong to the black savanna type with large horns, but a certain number of them have a reddish coat and smaller horns (see coloured frontispice). In the Upper Semliki open plains, up to 20 % of the adults have a reddish coat. On the contrary, the forest type is met with in the Semliki forest and on the Virunga volcanoes where it has been found up to 4.500 meters. The Buffalo feeds mainly on grasses during the rainy season, but appears to turn to many other plants and even foliage at the end of the dry season.

Among the Duikers, *Cephalophus nigrifrons* is very common in montane forest both in the north and the south of the Park and has even been found at an altitude of 4.400 meters in the alpine zone on the Ruwenzori. In the *Hagenia* forest of the Virunga volcanoes, its density reaches 10 to 28 individuals per square kilometer. *Cephalophus sylvicultor*, *C. dorsalis*, *C. callipygus* and *Philantomba monticola* are restricted to the lowland rain forest. The common duiker *Sylvicapra grimmia* is very scarce in the open plains.

The Waterbuck is generally met with in more or less wooded savannas, but is also abundant in the open plains of the upper Semliki river. It feeds mainly on grasses, but occasionally eats some leaves.

The Uganda Kob is typical of grass-steppes of the Rwindi-Rutshuru plains. It never enters *Cymbopogon* and tree savannas, except after the bush fires. This animal is not abundant north of the lake Edward, and is neither found on the western shore of this lake, nor south of the Kwenda river. The Uganda Kob feeds mainly on short, green and tender grass.

Reedbuck are not very numerous in the open plains of our area.

The Topi is as characteristic as the Uganda Kob of the grass-steppes of the Rwindi-Rutshuru plains. It feeds on the same kind of grasses and is particularly fond of *Bothriochloa glabra*. It is not found north of Lake Edward.

The *Hylarnus harrisoni* is met with in the lowland rain forest of the middle Semliki river but is also found in more open habitats south of the forest itself.

The diggings of J. DE HEINZELIN DE BRAUCOURT have made possible the study of the evolution of the Ungulate fauna of our area during the last 7.000 years at Ishango. In the lower levels the Lelwel hartebeest was present, together with the Topi, the Reedbuck, the Buffalo, the Yellow backed Duiker, the Bushbuck, the Hippopotamus, the Warthog and the Bush-pig. The Waterbuck appeared later, after the Katwe volcanic explosions. The Uganda Kob was not found in any of these fossil deposits.

The last Klipspringer was killed in 1943, north of Kasindi.

The density of Ungulate populations is studied in Chapter III. Regular censuses were made by C. CORNET D'ELZIUS every two months in 600 square kilometers of the open plains south of the Lake Edward, in 1958 and 1959. Patrols of observers « combed » up this area on foot, walking parallel to each other at intervals of 1 kilometer. Any animal present within 500 meters on each side of the observers were counted. Results are given

in table 4. Similar censuses were made in 1959 on 226 square kilometers north of the Lake Edward (table 5). In the same time counts were made regularly on 4 line-transects in various types of habitats. Results are given in tables 6 to 11. Every habitat appears to harbor its own characteristic species and to sustain different densities of population. Uganda Kob, Topi and Buffalo rank first in steppes and low savannas. Next comes the Warthog. Elephants and Waterbucks are scarce. In tree or grassy savannas Buffalo, Waterbuck and Elephant come first, Uganda Kob is scarce and the Topi even scarcer. The more open is an habitat the more important are the seasonal variations of Ungulate population density.

Standing-crop biomass is calculated for these various habitats (table 11).

During the last 30 years the populations of the various Ungulate species varied in different ways in the same environments. Elephant increase has been spectacular and is obviously due as much to immigration as to natural increase. 3.293 have been counted in June 1959 in the open plains south of Lake Edward when their numbers did not exceed a few hundreds in 1931. The population of Hippopotami appears to be far more stable; in the bay of Kamande their numbers increased by about 43,7 % between 1931 and 1959. Despite the epidemics of rinder pest the increase of Buffalo populations has been as spectacular as that of Elephants. In the open plains south of Lake Edward 24.054 were counted in June 1959. On the contrary the number of Topis decreased regularly from 1931 to 1939 and then started to increase to reach a total now of 4.798 south of the Lake Edward. Uganda Kob did the same, with a « low » in 1940 and a subsequent regular increase to the present day total of 9.571 heads south of Lake Edward. The possible causes of these fluctuations are discussed.

Population structure is dealt with in chapter IV. Adult sex-ratio appears to be more or less equal in the Elephant and in the Hippopotamus. A clear preponderance of females was found in adults Warthogs, Buffaloes (45,7 % of males), Waterbucks (30,5 % of males), Uganda Kob (37,1 % of males), Bushbuck, Reedbuck and Topi (35,7 % of males). Age criteria are discussed for various species of open plains Ungulates and some results of age-ratios in the various specific populations are given. The following percentages of adults were observed : Elephant, 62,1 %; Warthog, 65,3 %; Hippopotamus > 44,3 %; Buffalo, 72,7 %; Waterbuck (males only), 54,6 % and Uganda Kob (males only), 60,3 %. Some data on the age of sexual maturity are given. The social structure of the various specific populations of open plains Ungulates is studied, together with its seasonal variation. 11,3 % of the Elephants observed were solitary and small herds of 3 to 7 animals were most frequent. The social grouping of Warthogs is highly variable. Hippopotami are highly sociable animals, but the interpretations of their social structure so far given are unsatisfactory; we have found no proof of any territorial behaviour in this species. Females as well as young males may be solitary. The Bushbuck is most often found singly. Among

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buffaloes solitary individuals are always males; a marked bull has been observed for more than two years occupying the same area, living alone or in company with 2 to 15 other males. Females (with or without young) live always in troops. All duikers live singly or in pairs. Waterbucks, Uganda Kobs and Topis are met with either singly or in bi-sexual groups of variable composition; tables 14, 15 and 16 do not show any sharp seasonal variation in the frequency of these social groupings. The Reedbuck is most often observed singly.

Chapter V is devoted to the study of population dynamics of the same species. Without exception any Ungulate in our area is able to reproduce at any month of the year. Topis nevertheless drop their young mainly from January to May. Comparisons are made with other areas in east and south Africa. Natality rate averages 9,2 % for the Elephant, 20,4 % for the Warthog, 10,5 to 18,2 % for the Hippopotamus, 10 % for the Buffalo and from 19,2 to 31,9 % for the Topi. Fecundity rate was found to range from 13,4 to 21,3 % for the Waterbuck and from 9,1 to 11,3 % for the Uganda Kob. The various causes of mortality are discussed for some abundant species. Predation plays a negligible role; lions and leopards are scarce and wild dogs have virtually disappeared since 1957. Epidemics are important only for buffaloes (rinder pest) and Hippopotami (anthrax). Table 17 gives the complete list of « mass dyings » observed from 1930 to 1959 in our area. Among the various causes of accidental deaths, intoxications by toxic gases of volcanic origin (mainly CO²) are frequent and kill a number of animals (figures 91 to 94). The behaviour of Ungulates during volcanic eruptions is studied in some detail. Competition for food in the various environments does not appear to play an important role among herbivores in the Park. Table 18 gives an idea of the biomass of rodents found in the main types of habitats. One estimation of the mortality rate is given for the Elephant. It appears to be very low (about 3 %) and is probably twice as high for young animals as for adults. Criteria of dental age are given for the Elephant, the Warthog, the Hippopotamus (figures 96 and 97) and the Buffalo. The systematic collecting of mandibles of Hippos (n = 148) shows that quite a number of these animals die at an advanced age.

On the whole the open plains of the Albert National Park harbor the highest Ungulate biomass ever found in Africa. With the exception of the Elephant the species do not seem, nevertheless, to exceed the carrying capacity of the environment.