MANAGEMENT OF SAVANNAS AND MAMMALIAN POPULATIONS IN AFRICAN PROTECTED AREAS

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Summary

In this review, general lines on African savannas are reported: their origin, conservation, and some management examples. In particular, we examined the herbivorous role and pasture impoverishment in sub-Saharan Africa. After that, some particular cases of savanna management are discussed: the Tsavo National Park in Kenya, the effect of creating additional water supplies, the burning strategy for a semiarid savanna in Namibia, baobabs and elephant management in Tanzania, the conservation status of Uganda's game and forest reserves, the food supply in a grazed savanna in Kenya, and some different forms of mammal conservation in Tanzania.

1. African Savannas: The Introduction

Savannas extend over a wide area of tropical Africa, extending from Senegal in the west to Ethiopia in the east. This megaregion is limited in the north by the subdesertic grasslands of the Sahel, and in the south by the tropical moist forest and rainforest occurring along the coastal regions of the Gulf of Guinea and forming the Guineo–Congolian rainforest block. This big forest block is extended over the equatorial strip, and embraces the whole central part of the African continent, from the coast of the Atlantic Ocean to the Mitumba Mountains. On the other side of these mountains, Uganda, Kenya, and Tanzania are mostly covered by savanna formations, which extend with very little interruptions (e.g., the Kakamega Forest in Kenya) till Mozambique, Zimbabwe, Zambia, Angola, and part of the Republic of South Africa. Although Africa is the continent in which savanna formations cover the most land, similar vegetation

zones are known to occur in other continents as well—South America, India, and Australia. Even the great prairie of North America and the Asiatic steppes somewhat resemble African savannas, but both their climate and the nature of the soil are clearly different.

2. Origin and Conservation of Savannas

In some volcanic areas of eastern Africa, savannas are characterized by enormous extensions of grasslands growing on a slight stratum of soil-covering volcanic materials. It does not permit the growth of trees and bushes with large roots, and so the geological structure has certainly been one of the factors limiting the historical growth of forests and promoting the massive development of savanna formations. Moreover, the rainfall regimes have been very important for the formation of savannas, as these grassy formations grow in areas with an annual precipitation regime of ~1250 mm, characterized by short rainy periods and long dry periods. Moreover, savannas are also prone to periodic burning, either by autocombustion of dry grass during the peaks of the dry seasons, or from lightning. Certainly, the influence of humans on the frequency of periodic fires in African savannas should not be forgotten. In general terms, fires may stop only in areas with thick woodlands where underbrush is very scarce, along riverbanks, or after prolonged rainfall.

As already mentioned, the typical plant type of the savannas is herbaceous. No doubt, we can stress that herbaceous grass and herbivores have coevolved, with much reciprocal influence on their main ecological and natural-history characteristics. All herbaceous grasses grow from their basal region, and not from their apical regions as do trees or bushes. Thus, this crucial property of their growth permits a fast regrowth after fire episodes, and also after removal ("predation") by herbivores. Some variation is present, as there are species that are able to immediately regrow after fires, whereas other species wait for the next arrival of the rains in order to regrow. Some Graminaceae (e.g., *Hyparrhemia*) are able to resist to the periodic fire episodes by the peculiar structure of their seeds, which are encased in a capsule of strong fibers arranged into a spiral shape. The reproduction of Graminaceae is independent of insect pollination, and depends only on the effect of wind. Graminaceae also spread by subterranean stems.

The exceptional adaptations of Graminaceae to survive in difficult conditions, together with their high nutritional power and the silicon accumulated in their structures, have caused, according to some authors, the evolution of a large to giant size in African savanna herbivores, and have permitted the extraordinary density that these animals may achieve in Africa (about 400 ungulates per hectare in Masaai Mara of Kenya and in the Serengeti prairies of Tanzania (cf. Sinclair and Norton-Griffiths, 1995).

3. The Herbivores

Herbivores are strongly dominant in African savannas. Among the savanna herbivores, there is an evident food-resource (i.e., niche) partitioning, with some species specializing in feeding upon grass, and others specializing in eating leaves. Generally, this ecological difference in feeding habits is accomplished with habitat resource partitioning, as the phyllophagous species (i.e., the leaf-eaters) tend to inhabit gallery

forests and thicker woodlands, whereas the grass-eaters tend to inhabit open grassy sites.

Thus, in every wide savanna extension, we may find some sectors of gallery forest and of bushy woodland. Each of these "habitats" are inhabited by specialized herbivore fauna—zebras (*Equus quagga*) in the prairies, water antelopes (*Kobus ellipsiprymnus*) in the shadow of the gallery forests along river courses, and dik-diks (*Madoqua* spp.) in the bushy spots.

Among phyllophagous herbivores, there is also a clear-cut partitioning of the available food resource, which is crucial to avoid the impoverishment of the pastures and to reduce the interspecific competition. To oversimplify the situation, it can be concluded that zebras select fibrous and relatively high grasses, whereas bovids (e.g., *Connochaetes taurinus*) prefer to eat on buds of grasses, gazelles (genus *Gazella*) eat on short grasses, and individuals of *Damaliscus* spp. prefer foraging upon high dry grasses.

4. The Impoverishment of Pastures

One of the salient features of African savannas is that they can sustain an enormous density of large herbivores without any rapid pasture impoverishment. This is due to the coevolution of herbs and herbivores over the last millions years. Each plant attracts specific herbivores, so that the enormous predatory pressure of the herbivores is spread over a number of different vegetation types. In addition, herbivores migrate from one side to the other side of the habitat, which produces a kind of large-scale rotation that is essential for the survival of this habitat.

Unfortunately, human activity has had terrible effects also on this "naturally rotated" habitat. In particular, the introduction of domestic livestock (e.g. by Masaai people) has impoverished and even destroyed the quality of pasture of large sectors of the African savanna, and has transformed former savannas in subdesertic lands. In this regard, an essential conservation role was also played by tse-tse flies (*Glossina* sp.), whose presence was an impediment to the proliferation of domestic livestock, whereas the strong battle against tse-tse flies, although it has produced clear benefits to human health, has opened savanna regions to herding activities, with devastating consequences for the natural environment.

5. Management of Conservation Areas as Ecological Baseline Controls

The scope of biological conservation is varied, and includes the preservation of rare species and habitats, maintenance of genetic diversity and above all, the protection of self-sustaining natural ecosystems from interference by modern humans in order to serve as ecological baselines. Conservation of African savannas should especially serve this last purpose. This is a management decision with several practical consequences:

- There is no intention of maintaining the ecological status quo. Ecological change is accepted and is especially interesting for conservation.
- Since the concern is with whole-ecosystem function (not just species survival), human interference that would confound natural processes must be kept to a

minimum.

- Large-scale nonintervention does not preclude active intervention for specific purposes (protecting rare species or habitats that have little impact on large-scale ecosystem processes).
- If subjective opinion perceives that human intervention is, nevertheless, altering the system, then management intervention should be done on part of the system only, leaving the rest as its own control.
- Monitoring of natural or human-induced changes is essential.

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Biographical Sketches

Francesco M. Angelici, PhD in Evolutionary Biology, is a mammalogist based at the Italian Foundation of Vertebrate Zoology and at the Institute Demetra, where he supervises projects concerning the ecology and management of lagomorphs, carnivores, ungulates, and rodents, in both Italy and Africa. He has published many papers on mammals, birds, and reptiles, is a member of various IUCN/SSC groups, and is coauthor of the Action Plan of *Lepus corsicanus*, published by the Italian Ministry of Environment. He is working currently on several conservation projects on threatened mammal species sponsored by National Parks and Reserves.

Dr. Luca Luiselli obtained the degree of Doctor in Natural Sciences at the University of Rome "La Sapienza" with a thesis on the comparative eco-ethology of some populations of Italian vipers. Since 1996 he has been a research associate with several industry organizations of the Ente Nazionale Idrocarburi group in Nigeria, as well as with conservation organizations in both Africa and Italy, including several national parks. He has been working for the environmental departments of several oil companies, conservation organizations (e.g., Cercopan), and in cooperation with scientists based at the Rivers State University in Nigeria. He is also a researcher associated with the National Park of Gran Sasso-Laga, the National Park of Majella, the Abruzzi National Park, and the Duchessa Mountains Natural Park. He is chairman for Nigeria of the International Union for Conservation of Nature–Species Survival Commission (IUCN/SSC) for DAPTF, a member of the IUCN/SSC TFTSG, and has won seven international scientific research prizes (four by Chelonian Research Foundation, two by Conservation International and one by IUCN/SSC Declining Amphibian Populations Task Force (DAPTF)). He is also coeditor of *Amphibia-Reptilia*, associate editor of *Endangered Species Research*, and serves on the advisory editorial board of *Herpetozoa*, *African Journal of Herpetology*, *Chelonian Conservation and Biology*, *Applied Herpetology*. In the last 15 years, he has published over 150 papers in peer-reviewed journals, including high impact periodicals (e.g., Nature, Oikos, Oecologia, etc). His main research interests are on the ecology of snakes in tropical and temperate regions, and on the modeling of forest reptile communities in areas under strong environmental stress.