The Kenyan hippo

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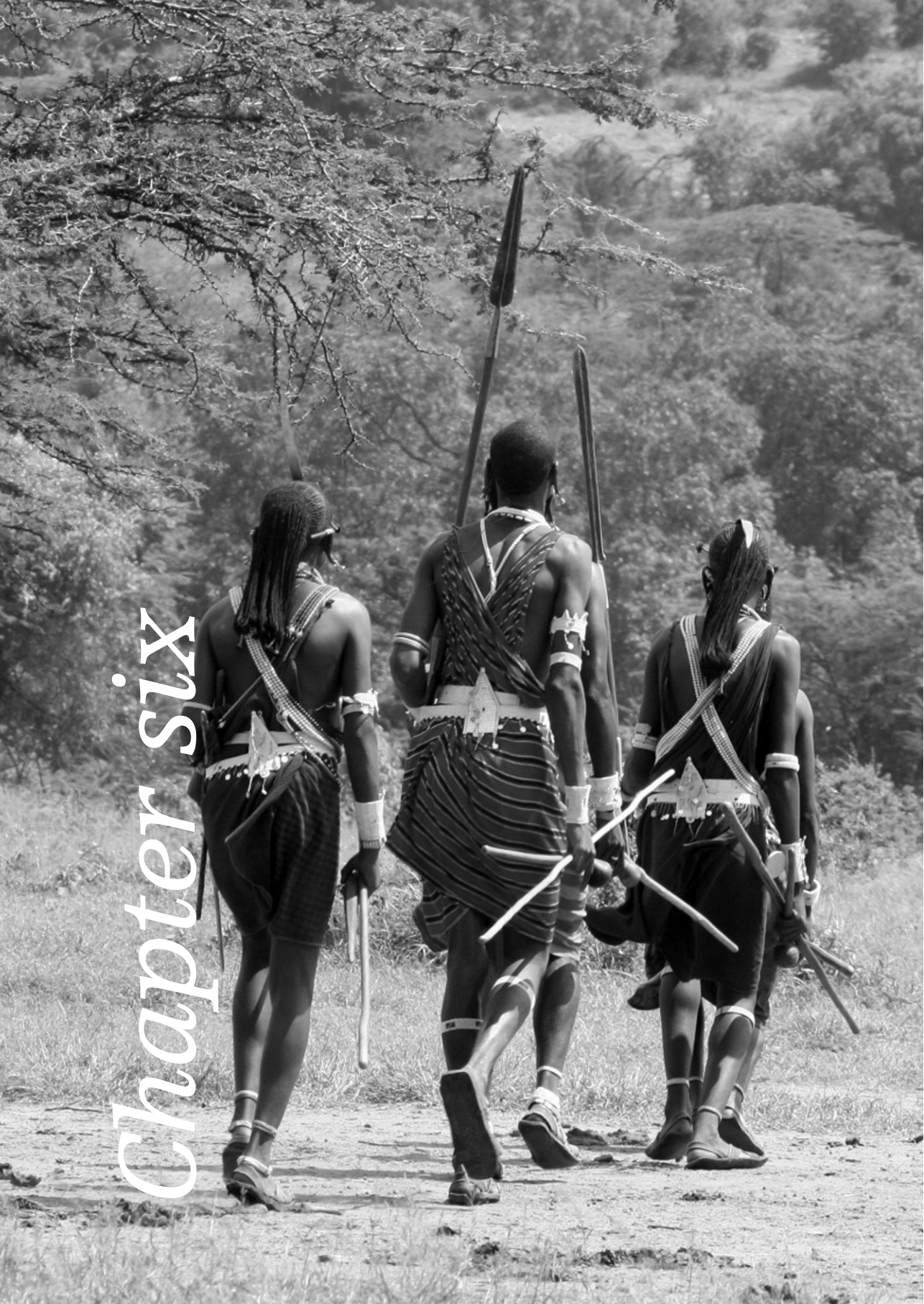

chapter six

6

Hippopotamus as agents of change on riparian-edge communities: A synthesis

Introduction

Hippopotamus are semi-aquatic herbivores, and water, in which mating, playing, fighting and defecation all takes place, is at the centre of their social life. That is probably why hippopotamus means "river horse" in the ancient Greek language. Hippos also require an open terrestrial grazing land, where their grazing range is limited to grassland mosaics within immediate reach of water. This is a unique lifestyle compared to other grazing herbivores. Due to their large size, habitat and food requirements, hippos tend to have substantial impacts on riparian communities. Their grazing strategies and physical alterations to the environment affect plant and wildlife community compositions in areas they frequently graze (Thornton 1971; Lock 1972; Eltringham 1999). Due to their high dependence on water, their fortunes fluctuate along with those of the water and the wetlands they depend on (Klingel 1995). Despite our knowledge that hippos require water and wetlands for survival, and that wetlands are severely threatened, research on hippopotamus is rare in Kenya. Therefore, this thesis sought to address an important knowledge gap, by studying the nature and dynamics of human-hippo conflicts throughout Kenyan wetlands to understand the challenges facing the conservation of this unique herbivore, under changing land-use and increasing anthropogenic impacts on wetlands; long-term hippo population dynamics in a premier conservation estate in Kenya and East Africa, the Masai Mara. Furthermore, we analyzed the impact and consequences of hippo grazing on vegetation and other herbivores in riparian-edge habitats of the Mara and how these are modified by land use and seasonality in rainfall.

Insights into the ecology of hippopotamus

Wildlife population size estimates are central to conservation and management of biological diversity. Counting animals, however, can be difficult as some animals are on the move and many others actively avoid human counters, complicating detection and accurate counting. Consequently, we are rarely in a position to obtain absolute total counts in the wild. In studying the hippopotamus population in the Mara Region of Kenya, we established that our 2006 census is the first detailed and complete count for hippopotamus along the Kenyan section of the Mara River system (Chapter 3), although other counts provide good general references. Results from our count showed that there are over 4,000 hippos in Mara and this may be one of the largest single hippo population in Kenya. Thus the Mara is an important hippo conservation stronghold in Kenya and currently holds about 3% of the African hippopotamus population. Our experience from the census is that hippos are usually submerged and do not synchronise their surfacing, thus there are high

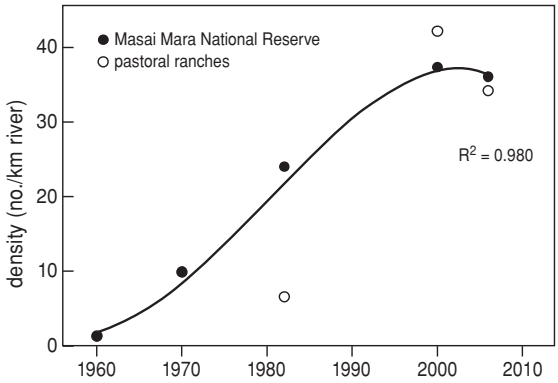

Figure 6.1 Dramatic increases of hippopotamus densities in the Mara Region of Kenya during 1958 to 2006. Diamond and pyramid marks denote MMNR and pastoral ranches respectively.

chances of undercounting during ground censuses as hippos actively avoid counters. However, more accurate numbers can be obtained if individuals and groups are in shallow water and pools. Our results demonstrate that the Mara hippo population density dramatically increased during 1958 to 2006 (Fig. 6.1) and that hippos spatially expanded their range into the pastoral ranches, suggesting that the community pastoral ranches provide important habitats for hippos in the Mara.

Smuts and Whyte (1981) describe the reproductive strategy of the hippo as one well adapted to the semi-arid environments, such that when resources are limiting, populations are able to maintain stable populations by delayed sexual maturity and fecundity and so adjust to the carrying capacity of the environment; equally, populations are capable of rapid increase when resources become abundant. Surprisingly, our results reveal considerable increases in hippopotamus numbers and range expansions, while hydrological investigations showed that between 1973 and 2000, the Mara River flow regimes changed drastically, with sharp increases in peaks, attenuated hydrographs and reduced base flows (Mutie et al. 2005), that unfavorably affected shelter and day living space for hippos (Mati et al. 2008). In addition, Oliver and Laurie (1974) and Tembo (1987) suggest that shelter and day-living space generally regulate hippopotamus populations. Therefore, our census results have important implications for hippopotamus ecology, because, contrary to these suggestions, the Mara hippo population dramatically increased during 1970 to 2006 when their shelter and day-living spaces were reasonably unstable. The only plausible explanation that we can put forward for this situation is that the Mara has relatively abundant and sufficient forage (O'Connor and Campbell 1986; Boutton et al. 1988; Onyeanusi 1988), which may outweigh the limitation imposed by deteriorating shelter and day-living space. However, it is evident that the massive destruction of the Mau Forests which forms the catchment of the Mara River and the spiralling extraction of water for irrigations and expansion of settlements, all of which combine to reduce the quantity and quality of water in the Mara River will,

unless regulated, certainly reduce hippo range in the Mara and probably also their abundance.

The spatial range expansion for hippos recorded in Chapter-3 further reveals that the occupation of Keekorok pool and the Mara River outside MMNR are new colonisation events which occurred after 1982. The nearest hippo groups to Keekorok pool are at Mara Bridge, a distance of over 25 km, while the colonised range along Mara River is over 60 km upstream into the pastoral ranches. This demonstrates a remarkable capacity of the common hippopotamus to disperse to new localities. The length of the Mara River that was covered during the count is 99 km (53.3 km in MMNR and 45.7 km in the pastoral ranches). Using the identified hippo grazing range lengths (Chapter 4 and 5), we estimate the hippo grazing area at 426.4 km^2 and 274.2 km^2, for the MMNR and pastoral ranches, respectively, resulting in a nocturnal terrestrial feeding density of 4.51 hippos/km^2 in the MMNR and 5.73 hippos/km^2 in the pastoral ranches during dry seasons. However, during the wet seasons, hippos ranged shorter distances, shifting their nocturnal terrestrial feeding density upwards to 7.22 hippos/km^2 in the MMNR and 6.87 hippos/km^2 in the pastoral ranches. An interesting question then is whether the Mara is overpopulated with hippos? Interestingly, the present hippo densities have not changed much from the 5 hippos/km^2 recorded in the MMNR in 1970 (Olivier and Laurie 1974), and are similar to 4.5 hippos/km^2 recorded in Liwonde National Park, Malawi in 2002/2003 (Harisson et al. 2007), 4 hippos/km^2 reported for Luangwa River, Zambia in 1982/1983 (Tembo 1987) but are lower than the 28 hippos/km^2 reported for Queen Elizabeth National Park, Uganda between 1963 to 1967 (Field and Laws 1970). It is therefore well possible that Mara can hold more hippos than it supports at present.

Ecological influences of hippopotamus within Mara riparian-edge community

Hippopotamus grazing pressure transforms tall grasslands into a shifting mosaic of short, medium and tall grass patches, and they maintain the short grass swards through repeated and continuous grazing. This is demonstrated by our results in Chapter 4 and 5, in which areas within the MMNR where hippos are the main resident grazers, the spatial distribution of their grazing lawns contributes significantly to structural diversity of vegetation within the strip of 0-3 km from rivers (Fig. 6.2, O'Connor and Campbell 1984). Although McNaughton (1984, 1985) notes that large herds of migratory mesoherbivores create and maintain grazing lawns, our results suggest that hippos have superior effects on lawn formation and maintenance within the riparian-edge habitats. Our suggestion is supported by the fact that even with over one million immigrant mixed herds of wildebeest, zebra and

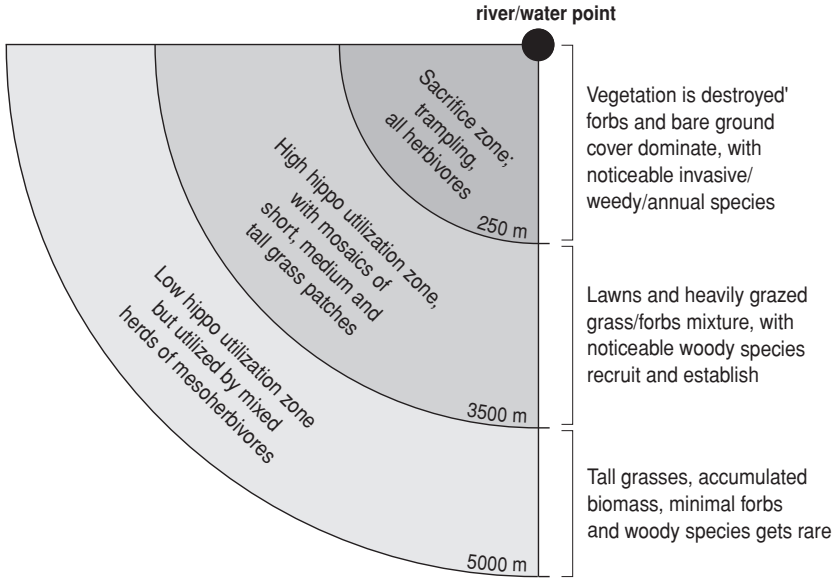

Figure 6.2 Hippopotamus grazing in the MMNR, diversify vegetation structure and enhance spatial heterogeneity by creating and maintaining mosaics of short and medium grass patches.

Thomson gazelle in the Mara during the dry season, evidence of grazing lawns was only clear within the 3 km strip zone from rivers, a zone that correspond with hippo grazing range (Chapter 4 and 5), notwithstanding the fact that the mixed herds of mesoherbivores freely grazed beyond the 3 km hippo range from rivers. There are many other factors influencing vegetation structures in the Mara, but our results show that hippopotamus grazing has distinct impacts at the riparian-edge habitat patch level. This finding guides us to conclude that hippopotamus is a keystone ecosystem engineer able to profoundly modify ecosystems and facilitate other herbivores in the Mara (Owen-Smith 1987) in ways that even large herds of mesoherbivores cannot.

Hippos establish a well-developed pathway network for exit and entry into water and for accessing their grazing range. Their trampling effects at riverbank exits cause considerable increase in bare ground, which, in addition to the denuded trails, accelerate soil erosion (Thornton 1971; Lock 1972). Furthermore, the short-grass grazed areas decrease available combustible biomass, promoting their invasion by woody species (Fig. 6.2, Fig. 6.3, and Chapter 4 and 5). The effects of hippopotamus grazing on soils, plants and other herbivores was most pronounced immediately at the riverbanks due to their trampling effects (the 'piosphere' effect, Lange 1969) and at intermediate distances from rivers (Fig. 6.3). Hippo-grazing effects enhanced vegetation structural diversity and improved spatial heterogeneity associated with the riparian zone, and thus enhanced species diversity and caused

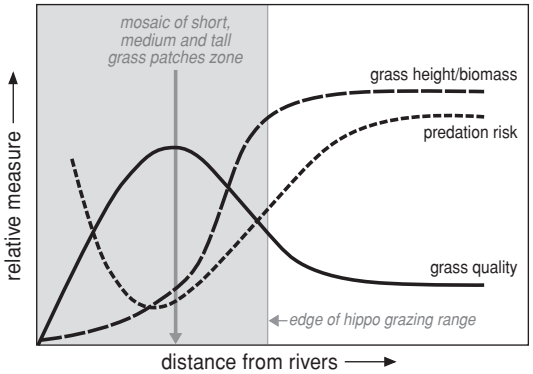

Figure 6.3 Effects of hippopotamus grazing on the quality and quantity of grass with distance from rivers in Mara and its associated influence predations risk to mesoherbivores.

compositional shifts in both plants and herbivores at intermediate distances from rivers within the MMNR (Chapter 4 and 5). However, grazing effects of mesoherbivores and livestock did not achieve similar outcomes. Heavy grazing by livestock in the pastoral ranches reduced the quality and quantity of forage and vegetation cover, and further adversely affected plants and herbivore species richness, abundance and composition. Sedentarization of the pastoral Maasai in the Mara has resulted in year-round congregation of livestock around water sources, which clearly reduces standing biomass and herbaceous species diversity, thus reducing the ability of the pastoral ranches to support diverse wildlife assemblages.

Threats to hippopotamus

The common hippopotamus' population in Africa declined due to habitat loss, exploitation and conflicts with people by 7-20% during 1996 to 2004, and the current population is likely between 125,000 and 148,000 hippos in the wild (Lewison and Oliver 2008). Unfortunately, detailed information on hippopotamus population trends and associated threats are lacking in Kenya. However, results in Chapter 2 and 3 show numerous threats to hippopotamus conservation across Kenya and the major threats include declining habitats and range, incompatible land uses, land-use changes and conflicts with people. In the Mara region, deforestation, agricultural expansion and intensification (including irrigation) and expansion of human settlements, have negatively affected the hydrologic, physical and social aspects of the Mara River Basin (IUCN 2000; Gereta et. al. 2002; Mati et al. 2008), with potentially adverse consequences for the Mara River hippopotamus population. Although this thesis did not directly quantify threats to hippos in the Mara, it is probable that changes in the hydrological cycles of the Mara River could reduce the hippo range and hence also their abundance. This bleak scenario is repli-

cated in many other Kenyan wetlands (Crafter et al. 1992), which are important for hippopotamus conservation.

Human-hippo conflicts pose an important threats and challenges to hippo conservation endeavors in Kenya, especially with increasing pressures on wetlands and a realization that a substantial number of hippos inhabit wetlands that often extend outside of protected areas, into the agricultural landscapes, thus increasing interactions between people and hippos. Consistent with these increased interactions, human-hippo conflicts have increased in space and time in Kenya (Chapter 2). These conflicts are not likely to decline and may in fact be intensifying as increasing human population and land-use changes impact more adversely on wetlands. However, historical records show that hippos have long been a problem to rural farmers in various parts of Kenya and were accorded official protection in the 1920s to reduce their persecution (Kenya Game Department 1953).

We analyzed the nature, intensity, seasonality, spatial and temporal patterns in human-hippo conflict incidences reported from wildlife stations Kenya-wide, over a 12-year period spanning 1997-2008, and established that human-hippo conflicts indeed increased 26-fold. Hippos killed 67 and injured 88 people, in addition to being involved in 47 incidences of livestock attacks. In retaliation, 522 hippopotamus were killed as a problem animal control strategy by wildlife mangers. Based on the Kenya Wildlife Service 8-Conservation Regions across Kenya then, our results show that 50% of these regions experienced considerable increases in conflicts over time. This dramatic rise in human-hippo conflicts in Kenya is a consequence of both natural and human-mediated disturbances on hippo habitats including wetlands (Crafter et al. 1992). Hippopotamus habitat losses have accelerated through conversion of hippo grazing ranges into agricultural use, while aquatic refugia are diminished by irrigation and other human activities along riverine systems (Eltringham 1999; Smuts and Whyte 1981). The high frequency of crop raiding behavior shown by hippos is construed to indicate increasing agricultural expansion on wetland habitats in Kenya. However, the high lose of hippos through unregulated problem animal control measures, is of conservation concerns.

Illegal hunting (poaching) of hippopotamus is rare in Kenya, but in the rest of Africa, poaching of hippos is mostly done for meat though there is increasing demand for hippo canine teeth (Weiler et al. 1994), the ivory of which is considered better quality than that of the elephant. If trade in hippo teeth develop and thrive, then hippopotamus will be at serious risks (Eltringham 1993).

Concluding Remarks

In this thesis, I show that hippos increased dramatically in numbers and extended their range in the Mara against a background of deteriorating habitat conditions

related to recurrent droughts, rising temperatures and progressive habitat desiccation and fundamental land use changes, implying that hippos can increase rapidly even in a context of considerable climatic variability. However, it is certain that anthropogenic land-use changes affecting the Mara River and its hydrological cycles may constrict the Mara hippo population range and possibly reduce their abundance. The hippo census was very challenging and further investigations should focus on how to improve census techniques for hippopotamus.

Our results indicate that ecological processes or habitat characteristics associated with hippo grazing structure plant species richness and composition and the distribution of other herbivore along riparian-edge habitats. Plant species richness and composition varied along the hippo-grazing gradient from rivers, partially in response to spatial heterogeneity of vegetation structure resulting from hippo grazing activities. Consequently, hippos facilitated grazing by mesoherbivores and enhanced co-existence of plant species, thereby promoting species diversity. Therefore, along the riparian-edge habitats the hippopotamus is an important ecosystem engineer and a keystone herbivore, creating and maintaining shifting mosaics of grazing lawns, an ecosystem function that was not effectively performed by large herds of grazing mesoherbivores. Furthermore, large herds of livestock in the pastoral ranches homogenized vegetation and shifted plant species composition towards invasive and unpalatable annuals; in addition, presence of livestock repelled other herbivores away from water sources and disrupted their distribution patterns.