Rolf D. Baldus and Ludwig Siege (Eds.)

The Selous-Niassa Wildlife Corridor

By
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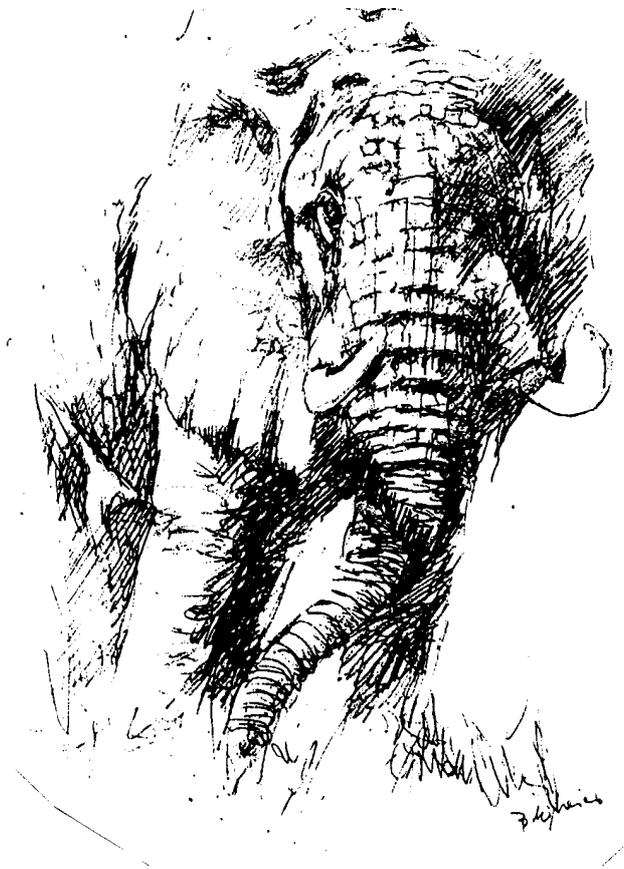
FORWORD

In the debate on biodiversity conservation two topics have gained prominence in recent years. One is connecting important protected areas by „corridors" in order to safeguard the vital genetic flow and exchange with the aim to avoid „conservation islands". The other topic is transboundary partnerships in conservation.

This paper describes how a number of governmental and nongovernmental actors under the leadership of the Tanzanian Wildlife Division have worked towards the creation of „Wildlife Management Areas" on village land in Southern Tanzania, which would serve as a string of protected areas to form a corridor connecting two elephant ranges of high importance, the Selous Game Reserve and ecosystem and the Niassa Game Reserve in Mozambique.

The Editors

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The elephant on the title page was drawn for us kindly by Bodo Meier

Connecting the world's largest elephant ranges

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Location

The Selous – Niassa ecosystem in Southern Tanzania, Ruvuma Region, extending into Northern Mozambique, Niassa Province, is one of the largest natural trans-boundary ecosystems in Africa, covering approximately 154.000 km^2 .

In this ecosystem, currently various categories of protected areas contribute to an official protection status of 103.000km^2, the size of Malawi.

These are in Tanzania:

Selous Game Reserve	48.000 km^2
Wildlife Management Areas as buffer zone of Selous Game Reserve	7.500 km^2
Mikumi National Park	3.000 km^2
Kilombero Game Controlled Area	6.500 km^2
Muhuwesi Game Controlled Area	1.500 km^2
Mwambesi Game Conrolled Area	1.000 km^2
Lukwika - Lumesule/Msanjesi Game Reserve	400 km^2
Sasawara Forest Reserve	385 km^2
Total	68.285 km^2

and in Mozambique

Niassa Game Reserve	23.400 km^2
Hunting Blocks as buffer zone of Niassa Game Reserve	19.000 km^2
Total	42.400 km^2

In Tanzania an additional 7.500 skm around the Selous are Wildlife Management Areas of the villages. They serve as a buffer zone, although they do not yet bear an official protection status.

It is now sought to safeguard a passage way, so-called „corridor", which allows for animal movement between the above listed protected areas systems. This future Selous - Niassa Wildlife Corridor connects the Selous Game Reserve with the Niassa Game Reserve, covering approximately 8000 km^2 of currently sparsely settled area over a distance of 160 km.

Ecology

The corridor would link the world's largest miombo woodland ecosystem and covers traditional migratory routes for elephants between two major elephant (*Loxodonta africana*) populations in Africa. During the dry season aerial census of 1998, which was carried out in both countries at almost the same time, the total elephant population of the entire ecosystem was estimated at 64.400 elephants, with the majority of 84,4% on Tanzanian side.

This was the first scientific wild animal survey ever done in the remote, unknown area of the corridor's southern part, using the methodology of systematic reconnaissance flight. It revealed also that, with close to 4000 animals, the corridor harbors a substantial population of Roosevelt's sable antelope (*Hippotragus niger roosevelti*): DNA analyses have confirmed the subspecies status of the population as roosevelti.

Also other globally significant populations of Lichtenstein's hartebeest (*Alcelaphalus buselaphus lichtensteinii*)*,* African buffalo (*Syncerus caffer*), Nyassa wildebeest (*Connochaetes taurinus cooksoni*), Eland (*Taurotragus oryx*), Greater kudu (*Tragelaphus strepsiceros*), Common waterbuck (Kobus ellipsiprymnus), Bushbuck (*Tragelaphus scriptus*), Common Reedbuck (*Redunca arundinum*) and different Duiker species are linked by the corridor. Beside these species the corridor is the home of a variety of large carnivores

including African wild dog (*Lyacon pictus*), Lion (Panthera leo) and Leopard (*Panthera pardus*), Spotted hyaena (*Crocuta crocuta*), Crocodile (*Crocodilus niloticus*), Common hippopotamus (*Hippopotamus amphibious*), smaller mammals and other rare Tanzanian fauna, especially bird life. The information about its ecology is still insufficient.

Threats to the Ecosystem

Whereas the northern part of the corridor bordering Selous Game Reserve is well protected by a buffer zone composed of village wildlife management areas, the southern part (3000-4000 km^2) towards Ruvuma River has not received any attention in the past. Illegal over-utilization of the natural resources, in particular poaching of wild animals and poisoning of fish, destructive wildfires and unplanned farming has lead to habitat degradation and loss in biodiversity. The obstruction of the movements of large herbivores such as the African elephant will ultimately result in increased human – wildlife conflicts.

An Opportunity

The Selous – Niassa Wildlife Corridor Project is planned by the Tanzanian Government as a development cooperation project financed by Global Environment Facility (GEF) in cooperation between Selous Conservation Programme/GTZ, the Wildlife Department and the Districts of Songea and Tunduru. It seeks to protect the southern part of the wildlife corridor through a network of Village Wildlife Management Areas, a move initiated by the villagers of the area concerned. Thus, not only the conservation status of the corridor will be improved, but also the local communities will be offered the opportunity for economic development using the area for eco-tourism and sport hunting.

The Wildlife Division of Tanzania is the executing agency of the Corridor Project and Selous Conservation Programme (SCP) the executing partner, in association with the District Authorities.

The Selous Conservation Programme (SCP)

SCP is jointly administered by the Tanzanian Wildlife Division and GTZ (German Agency for Technical Cooperation) and started 1988 as a bilateral cooperation agreement between the German and Tanzanian Government. The SCP focuses on the assistance in the rehabilitation and management of the Selous Game Reserve in Tanzania and establishment of a programme of community based conservation in the bufferzone adjacent to the Selous GR in cooperation with the local population.
The activities of the SCP extend from strengthening the Reserve administration to the implementation of a Community Conservation Programme in at present 50 villages around the Reserve.

The objectives of the Selous Conservation Programme are:
- To safeguard the existence and ecological integrity of the Selous Game Reserve as a conservation area.
- To significantly reduce conflicts between the Reserve and the local population by implementing a programme of sustainable wildlife utilisation by local villages.

To achieve these objectives, it was agreed that the SCP is focussing on the following activities:
1. Assisting in the rehabilitation and management of the Selous GR.
2. Establishing, in cooperation with local villagers, a programme of sustainable wildlife utilisation in buffer zones adjacent to the Selous GR (Community Based Conservation).

So far there has been no formal consultation on the corridor between the two countries.

Wildlife Management in Tanzania and Vision

The wildlife of Tanzania is a unique natural heritage and resource that is of great importance, both nationally and globally. Its importance lies in the biological diversity of the species and habitats found in the country. Tanzania established a network of protected areas, which is a basis for conserving its biological diversity.

According to the National Environment Action Plan (1994) one of the objectives is to conserve and enhance natural and man-made heritage, including the biological diversity of the unique ecosystems of Tanzania. A further objective is to raise public awareness and understanding of the essential linkages between environment and development and to promote individual and community participation in environmental action.

In this context the following are aimed at:
- Development of a unified institutional set up for more effective management of wildlife resources.
- Development of comprehensive management plans for areas where there are competing interests.
- Initiation of programs whereby wildlife conservation contributes to local development, using community based approaches.
- Development of wildlife accounting frameworks to calculate the benefits of alternative uses to local communities and the nation.

With the Wildlife Policy of Tanzania (1998) the Government focuses inter alia on the following objectives:
- Maintaining and developing the protected areas network by involving all stakeholders in the conservation and management, especially local communities.
- Facilitating the establishment of a new category of protected area, known as Wildlife Management Area (WMA), where people will have full mandate of managing and benefiting from their conservation efforts thus taking care of corridors, migration routes, bufferzones and other wildlands.
- Further the government will cooperate with neighboring countries in the conservation of migratory species and transboundary ecosystems.

The Selous Niassa Wildlife Corridor Project

The Selous Game Reserve in Tanzania (48.000 km^2 protected area and World Heritage Site with a total ecosystem of 90.000 km^2) is connected in its south-western part by a sparsely settled area with Niassa Game Reserve in Mozambique (42.000 km^2 protected area). This „biological corridor" with a width of 30 – 40 km (west – east) has a length of about 200 km in north-south direction beginning at Selous Game Reserve and ending at the Ruvuma River. The Ruvuma River forms the northern border of Niassa Game Reserve and the international border between Tanzania and Mozambique.

The northern part of the corridor is already protected through the "North East Undendeule Forest Reserve" and the Wildlife Management Areas of several villages, which are part of the Selous Game Reserve's bufferzone project. The Wildlife Department and Selous Conservation Program/GTZ are implementing this project based on a community conservation concept. Villages, involved in this programme, developed together with the local authorities a land-use plan and set aside a potential area of the village land for the purpose of natural resource conservation. The Village Government manages with the assistance of the Village Natural Resources Committee this WMA on village land. It is responsible for the protection of the natural resources and in return benefits from a sustainable hunting quota, which is provided by the Wildlife Division. Village Game Scouts are responsible for the protection, fire management, law enforcement and hunting of the village quota. With the sale of game meat in the village the local population has legal access to meat. In furure they will also be able to lease out hunting and other rights, subject to CBC-Regulations, which are not yet released by the Ministry. The money derived is used for the payment of the scouts and village development projects. The villages of the buffer-zones in Songea and Tunduru District are represented in the District Natural Resources Committees. The WMA's of the northern part of the corridor are regularly patrolled and monitored by scouts of the Selous Game Reserve and village game scouts.

The southern part of the corridor, which is currently not protected, is the actual project area. With approximately 3000 km^2 it falls within the Ruvuma Region, respectively Songea and Tunduru Districts. The type of forest ecosystem is mainly "Miombo Woodland" interrupted by wetlands and riverine forests from several rivers draining towards the Ruvuma River.

It is thought that the corridor covers a traditional migratory route for elephants between Tanzania and Mozambique and will provide a permanent link between two of the biggest intact elephant ranges in all Africa.

In addition the corridor allows gene-flow between globally significant populations of sable, Liechtenstein's hartebeest, Nyasa wildebeest, eland and Greater Kudu. It has populations of wild dog, lion and leopard and small populations of Peter's oribi, Southern elephant shrew, new species of galago and other rare Tanzanian fauna.

It is hoped the corridor will give added protection to waterfowl and other birdlife of the Ruvuma River.

Threats

Immediate threats are meat poaching for the local market and poaching for ivory, which is a transboundary problem. An agreement on cross border law enforcement between the Tanzanian and Mozambique Governments does not exist. A further threat is habitat degradation due to uncontrolled and destructive wildfires caused by the local population. In the long run the high population growth and associated agricultural expansion (e.g. tobacco farming) will increasingly convert this still biologically intact corridor to cultivation.

The loss and fragmentation of natural habitat will form a genetic blockade between the world's largest protected miombo forest ecosystems and elephant habitats.

The obstruction of the movements of large herbivores such as the African elephant will ultimately result in increased human – wildlife conflicts.

According to experience people will intensify farming and settlement along roads. There are still gaps between villages along the major roads; through which the animals move, but it can be expected that in the future, in particular along the Songea – Tunduru highway, these gaps will be blocked by intensified human activity. This road will be upgraded with the economic development of the so called "Mtwara Corridor" and will become attractive for development. Quick action is required by the corridor project to secure and protect these areas, which still serve as migratory routes for animals.

Dense human population and agricultural activities to the east of the corridor along Ruvuma River in Tunduru District, prevent any migration from Niassa Game Reserve into Tanzania. Within the corridor mammals could easily cross, but concentrated fishing activities and snare-lines from poachers along the river and some of its tributaries disturb the animals when crossing, drinking and feeding in the riverine forests. Especially in the dry season, when fishing activities are at its peak and the animals are most dependent on the river for water and food, the migration is blocked.

Furthermore uncontrolled fishing and destructive fishing methods (use of fish poison) deplete the fish stocks of the river and disturb the aquatic fauna.

Uncontrolled commercial logging for valuable and marketable species was also observed and will increase simultaneously with the growth of the major towns and the improvement of the road system. If not controlled or prevented it will ultimately lead to a genetic depletion of some valuable species. (The same phenomenon was observed in other areas round Selous Game Reserve; Kilwa and Rufiji District).

The Sasawara Forest Reserve, located almost in the center of the area acting as a corridor, is with 385 km^2 a core area for the protection of biodiversity amid increasing human activity. However satellite images and reports show that heavy encroachment and destruction from activities such as farming and settlement take place in the eastern part of the Forest Reserve

Objectives

The project aims at the protection of the wildlife corridor through the creation of a network of Village Wildlife Management Areas. This requires that local communities concerned will be included in the active planning, protection and management of these areas and will have substantial benefits from wildlife management for their own development as stipulated in the Wildlife Policy of Tanzania. Benefits are legal supply of game meat, obtained through an annual hunting quota for each village, and income in terms of cash (for community projects)

from sustainable utilisation of wildlife (photographic or hunting tourism). The potential for a permanent income for local communities supports the concept of sustainability. Utilization of fire as a management tool and the prevention of destructive wildfires, too, can improve wildlife management.

In order to combat the transboundary elephant poaching an agreement of cooperation and law enforcement between the Governments of Tanzania and Mozambique would be useful.

The overall goal is the long-term conservation of biological diversity and in particular of the Miombo woodland ecosystem within protected areas of northern Mozambique and southern Tanzania by developing an effective wildlife corridor.

The following activities are planned:

1. Carry out aerial game counts and surveys of the project area in order to obtain baseline data about the number of animals per species (elephant as key species), to get information about the actual land-use and finally to identify the boundaries of the corridor.
2. Monitor the seasonal migration of animals, their number, the poaching status and the occurrence and origin of wildfires.
3. Raise awareness about natural resources conservation and their sustainable utilisation among the local population.
4. Support self-help projects linked to biodiversity matters and according to priorities set by villagers to enhance confidence and trust between wildlife personnel and local population. Self-help projects will mobilise the forces of the villagers and will establish and exercise the skills, which are required for wildlife management (management, accountability etc.).
5. Carry out a participatory rural appraisal and facilitate an official landuse planning process whereby WMAs are established and demarcated for later gazettement.
6. Assist the villages to write up and implement management plans for their WMAs and facilitate community hunting.
7. Support the institutionalization of village natural resources committees to assure efficient management of the WMAs and the election of village game scouts.
8. Assist with a specific training of elected committee members and village game scouts at the national Community Based Conservation Training Institute in Songea District.
9. Supply the villages with the initial equipment for their game scouts.
10. Support the national antipoaching unit to assist the communities in the case of severe poaching situations.
11. Facilitate meetings of District/Provincial authorities and wildlife staff of Tanzania and Mozambique in order to exchange experiences in community based conservation and transboundary antipoaching methods.
12. Facilitate meetings of the Tanzanian and Mozambican wildlife authorities, in order to achieve cross border antipoaching cooperation.

Niassa Game Reserve/Mozambique

The Niassa Game Reserve (2,400 sqkm) and buffer zone (19,000 sqkm) is the largest conservation area of Mozambique and has the greatest concentration of wildlife in the country. Niassa Game Reserve is located in the northern Mozambique covering parts of Cabo Delgado Province and nearly one third of Niassa Province. It is bordered by Rovuma River in the north (Tanzania border), Lugenda river in southeast, Luatize River, southwest and Lussanhando River in the west.

Niassa Game Reserve was established in 1964. During the war, people fled the area and poaching in the reserve and surrounding areas increased. With the peace agreement of 1992, people have begun returning to the area. Currently, the reserve has a population of about 21,000 people. The largest settlement is Mecula, which is the district capital and has about 4000 inhabitants. The local communities living in and around Niassa reserve are among the poorest in Mozambique. Their main occupation is subsistence agriculture, fishing, hunting and collecting forest products. Most of the area is unsuitable for agriculture.

Niassa Reserve is one of the largest protected miombo forest ecosystems in the world. The vegetation is mostly Brachystegia (miombo) woodland (50%), followed by open savannah (40%), wetlands (5%), mountains and inselbergs (3%) and riverine and montane forests (2%). There are 21 vegetation types and the preliminary surveys indicated 191 species of trees and shrubs.

A remarkably rich and diverse wildlife has survived the years of conflict. There are three endemic subspecies, which exist in Niassa but are rare elsewhere, namely: Niassa wildebeest (*Connochaetes taurinus johnstoni*), Boehms zebra (*Equus burchelli boehmi*), and Johnstons impala (*Aepyceros melampus johnstoni*). The endangered African wild dog occurs in the Reserve, with an estimated population exceeding 200 animals, which makes this area an important refuge for this species for the world. The results of the aerial census carried out in October 2000, estimated an elephant population in the region of 12,000, with evidence of rapid increase in numbers.

The Reserve also has over 9000 of the sable antelope and several thousands each of Cape buffalo, Lichtensteins hartebeest, eland, and zebra. There are smaller populations of kudu, bushbuck, impala, wildebeest, waterbuck, reedbuck, and hippo. Lion, leopard and spotted hyena are common. The Reserve has a rich birdlife including the rare Angola pitta (*Pitta angolensis*), Pel's fishing owl (*Scotopelia peli*), and abundant raptor population. Rovuma River is an Important Bird Area and over 370 bird species have been identified already.

Niassa Game Reserve represents one of the most important components of the Mozambique Government national strategy for the rehabilitation of the war-torn parks and reserves. In 2000, the Government of Mozambique established SRN (Sociedade para Gestão e Desenvolvimento da Reserva do Niassa) as the administrative structure for the management of Niassa reserve. This management agency, SRN is based on an innovative partnership between the public and private sector, where the Government of Mozambique retains ownership of the land and wildlife resources and plays a very important role in the management of the reserve. SRN is a legal entity, with a management team composed of Mozambican nationals, assisted by a team of wildlife conservation specialists. The Chairman of the SRN is the National Director of Wildlife and Forests. The Board members include representatives of both government and private sector, including the Governors of the Niassa and Cabo Delgado provinces. SRN hired an Executive Director, in May 2000, who is operating from Maputo and has overall responsibilities for the SRN activities, including providing support for the reserve, fundraising, liaison with the governmental agencies, local authorities and investors in the buffer area.

The Niassa Reserve Management Unit (NRMU) is responsible for the conservation and management activities in the field and is headed by the Reserve Warden, who reports directly to the Executive Director of SRN. The NRMU operates from the Main Camp in Mbatamila (40 km from Mecula), and from the 10 outposts across Niassa Reserve. The NRMU has four main departments: (i) Conservation and Management; (ii) Maintenance and Infrastructure; (iii) Administration; and (iv) Community Development.

The buffer area is divided in five blocks, which surround the Reserve on its eastern, southern and western boundaries. The management of these blocks is contracted out by SRN to operator/investors through long-term leases, under which they develop commercial tourism operations, in addition to having some clearly defined development obligations. The operators pay a percentage of their income to the SRN, as a contribution to the revenue needed to operate the reserve. A further percentage is paid to the local communities to support their development. Grants from various donor agencies (WWF, Tusk Trust, US Fish and Wildlife Service, The Humane Society etc) are also received.

Sources of information: B. Chande, A Rodriguez

Selous - Niassa Wildlife Corridor

Tanzania

Selous

Wildlife
Corridor

Niassa

Mozambique

Map by A. Cauldwell
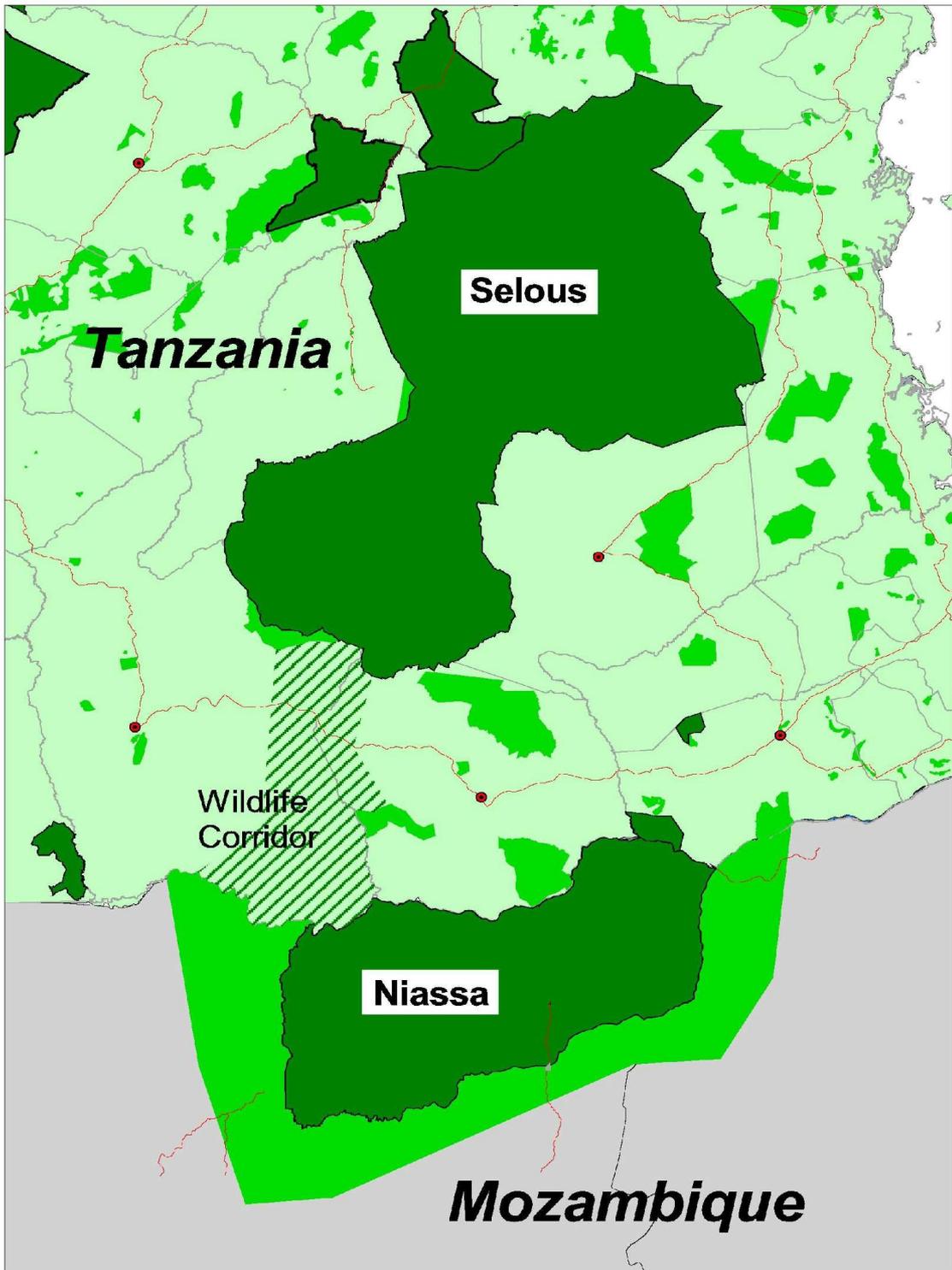
The Selous-Niassa Corridor Research Project

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In order to provide key information for the planning and implementation of the Selous-Niassa Wildlife Corridor Project a complementary research project was launched in April 2000. Financed by the German Government under its Tropical Ecology Support Programme (TOEB), the Selous-Niassa Corridor Research Project is carried out in cooperation with various institutions. These are the Wildlife Department, Tanzanian Wildlife Research Institute (TAWIRI), Sokoine University of Agriculture (SUA), Institute for Zoo Biology & Wildlife Research Berlin (IZW) and Selous Conservation Programme/GTZ.

In 2000 the status and migration routes of the populations of key mammal species in the Selous-Niassa Wildlife Corridor were to a certain extent unknown, even though good educated guesses as to the populations and movements of the key species existed. Thus, for the setting up of the Corridor and the planning of its precise location, it was regarded as vital to identify the distribution patterns and the traditional migration routes of elephants and those of other large mammals. It was also regarded to be useful to determine the distribution, population size, age structure, fertility and other aspects of the reproductive biology of those species for which hunting quotas and other forms of utilisation are likely to be set, and assess the health status of the populations of key wildlife species and their contacts with livestock.

The current debate in the literature on the conservation value of wildlife corridors suffers from an absence of empirical data on the value of corridors in terms of population persistence and genetic diversity and the occurrence and spreading of pathogens. The research project is generating information that (1) will for the first time permit an assessment of the health and reproductive status of an East African elephant population; and (2) contribute to a wider debate on the importance and conservation value of wildlife corridors for key species such as elephants.

The research project contributes to the conservation of wildlife movements and the genetic viability and persistence of wildlife populations in the Selous and Niassa Game Reserves by providing the key information for (1) the establishment of legal protection of a wildlife corridor in the appropriate locality, (2) the establishment of sustainable quotas for consumptive wildlife utilisation, and (3) activities that minimize the potential of conflicts between wildlife and local communities.

Objectives of the Research Project

The main objectives of the research project are:

1. Definition of the area that requires protection as a wildlife corridor in particular with respect to elephant movements, in order to assist the preservation of the genetic viability and persistence of two of the largest elephant populations in Africa and the implementation of attempts to minimize conflicts between wildlife and local communities, particularly farmers.

2. Assessment of the population size, health status and reproductive potential of key wildlife species.

3. To assess the health status of the populations of key wildlife species and their contacts with livestock. Elephants and other wildlife species moving through wildlife corridors might be at greater risk from pathogen borne by domestic stock than those within protected areas and thus might assist in the spread of pathogens from infected areas.

The project makes use of two complementary methods to obtain the required information:

State of the art techniques are involved, including the use of GPS/ARGOS satellite transmitters for remote tracking of elephants, and the most advanced methods to assess the health status and fertility of elephants. The project cooperates with Institut für Zoo- und Wildtierforschung Berlin (IZW), whose scientists are the world's leading experts in this field.

Further seasonal population surveys on the spatial distribution of large mammalian herbivores were conducted, using SRF (systematic reconnaissance flight) methodology.

The second method uses the indigenous knowledge of the people living in the area. Village game scouts collect data during their patrols. Information about movements of elephants and other mammals, their sex, age and cow-calf relationship, preferred forage plants of elephants and their distribution, information about crop damage and other relevant information are being collected during interviews and bush walks with traditional hunters (warumba) and bee-keepers, fishermen and farmers of all villages involved.

A wet and a dry season systematic reconnaissance flight was carried out in the year 2000. In the northern part of the corridor, in August 2000, four elephants were immobilized and equipped with GPS/ARGOS satellite transmitters. Their movements are permanently monitored with the help of satellites. Also samples of tissue, blood and semen were collected for screening and fertility tests. In November 2001 six more elephants of the corridor's southern part were equipped and monitored for one year. In November 2002 the transmitters have been removed.

Preliminary Results

The fieldwork has come to an end at the end of 2002. Analysing the data and publishing the final report will take time. Whereas a more detailed summary of the research is provided in the contribution of D. G. Mpanduji at. al. in this paper (page 13ff), some preliminary results are as follows:

1. Elephants occur throughout the Corridor. Roosevelt Sable antelope, eland and duiker are widespread. Liechtenstein's hartebeest, Greater kudu, waterbuck, hippopotami and Southern Reedbuck have a locally restricted distribution. There is currently no evidence that Niassa wildebeest still exist in the southern part of the corridor. African wild dogs are strictly seasonal, but when present are widespread throughout. Great numbers of buffalo are present all year round in the northern part of the corridor, however buffalo are only found seasonally in the southern part due to poaching. The Selous-Niassa Wildlife Corridor should be viewed as an internationally important wildlife area.
2. The Corridor contains a number of well established, traditional movement routes for wildlife, and numerous areas that are important as seasonal or year-round habitats for elephants and other wildlife species.
3. Human derived changes, particularly in terms of cultivation for cash crops, have begun to affect wildlife. Intense and scattered cultivation is spreading along the roads thus threatening to block the corridor. Extensive cultivation along the Songea-Tunduru road and along the road from Ligusenguse to Lusewa in the southern section now leaves few places safe to cross for wildlife. Several traditional key movement routes for elephants and other wildlife already have to cross roads or the periphery of cultivated areas.
4. Illegal exploitation of wildlife resources is particularly prominent in the southern section of the Corridor. Illegal fishing along the Ruvuma and its tributaries is widespread, and trans-boundary poaching for wildlife meat and trophies (ivory) continues. Snare lines prevent wildlife from reaching water sources and the presence of people and fishing camps stop wildlife from crossing the border River Ruvuma. Several elephant carcasses which had been shot for ivory were found close to the Ruvuma. Niassa Game Reserve reports at least 44 poached elephants within the Reserve and bufferzone in 2001.
5. Several wildlife species damage crops, attack livestock and/or people. The frequency of such attacks and the total acreage damaged are modest. In response, the appropriate authorities undertake measures to protect crop and people against elephants, hippos, buffaloes, lions and leopards. Conflicts with wildlife are currently not considered a key factor preventing people developing their livelihoods within the Corridor.

The Selous Game Reserve

With an area of around 48,000 sq.km, representing 5% of Tanzania's land surface, the Selous Game Reserve is the largest protected area in Africa. Founded already in 1896 it is also the oldest.

Three-quarters of the reserve consists of miombo woodland where the dominant trees are Brachystegia, Julbernardia globiflora, Isoberlinia, Pterocarpus angolensis and Combretum. The eastern part of the reserve is mainly grassy woodland with Terminalia species. The tourist sector of the reserve north of the Rufiji River contains all the various forms of vegetation to be found in the ecosystem. Miombo woodland covers the ridges of the mountains around Beho Beho and Stiegler's Gorge; also there are open woodlands with Terminalia spinosa trees, hardpan and short grassy plains with seasonally flooded "mbuga The savannahs provide grazing and browse and support a wide range of wildlife, in particular wildebeest and other species of antelope in great numbers.

In addition to miombo, open woodlands and savannah, another type of vegetation occurs here in the form of riverine forests with dense thickets. The wide meandering Rufiji River with its lakes and swamplands interlaced with a myriad of channels is ecologically one of the most important habitats in the whole of eastern Africa.

The reserve contains some of the largest and most important populations of elephants, buffalos and wild dogs in Africa. It is home of almost 60,000 elephants. There are high populations of other animals there, like 120,000 buffalo, 40,000 hippo, 5,000 lions and countless antelopes.

There are around 440 species of birds in the Selous.. With its extensive area of miombo woodlands, the Selous is one of the largest forest areas under protection. Due to its unique ecological importance it has been designated a 'World Heritage Site' by the United Nations in 1982.

The Selous is managed by the Tanzanian Wildlife Division. A retention scheme enables the Selous GR to meet its most urgent management costs from its own resources. The Selous GR generates its revenue from tourism. Some 80-90% is derived from 'safari hunting', the other from game viewing. 50% of this revenue is retained by the reserve.

The Selous GR is presently effectively safeguarded, even though occasional trophy poaching takes place in some areas bordering the reserve. The Game Scout force is well equipped and therefore more effective in the field. In all eight sector stations infrastructure has been set up with the aim of improving general living conditions of the Game Scouts. A large road programme has been implemented, which facilitates the management tasks greatly.

With the involvement of the Selous administration biodiversity has been preserved even in areas outside the reserve which had been threatened by destructive forms of landuse. Poaching in the buffer zones decreased significantly and wildlife is now coming back to areas where it has been absent for many years. This has been achieved in partnership with the surrounding villages and District administrations.

gene flow, it has great value as habitat for plant and animal communities. It supports large numbers of globally significant large animal species like the African elephant, the Roosevelt sable antelope, the wild dog, the Nyassa wildebeest and the Nile crocodile. It is one of the main migration routes for elephants between Tanzania and Mozambique. The entire corridor is currently threatened by poaching for meat and ivory as a trans-boundary problem, habitat degradation because of uncontrolled and destructive bush fires and a high population growth rate with associated agricultural expansion (such as raising tobacco and cashew nuts), which may result in the conversion of this biologically intact corridor into cultivated land. This process will ultimately prevent movement of the wildlife populations between Selous Game Reserve and Niassa Game Reserve, increasing human–wildlife conflict. Long-term effects include genetic isolation of wildlife populations, which increases the potential for inbreeding and chances of population extinctions in both reserves. This study reports on major elephant migration routes and movement patterns in SNWC.

The study area

The SNWC is located in southern Tanzania, north of Niassa Game Reserve in Mozambique. The corridor is separated from Niassa Game Reserve by the Ruvuma River, which forms the international boundary between Tanzania and Mozambique. The corridor lies within the Ruvuma region in the two districts of Songea (major western section of SNWC) and Tunduru (smaller eastern section). In total, SNWC covers approximately 6000 to 8000 km^2 . The area is mostly covered by miombo woodland and wooded grassland, with substantial areas of open savannah, seasonal and permanent wetland, and riverine forests along numerous rivers and streams. Major wildlife species include but are not limited to African elephant, sable antelope, duiker species, eland, Liechtenstein's hartebeest, greater kudu, leopard, lion, spotted hyena, Cape buffalo, warthog, waterbuck, wild dog, Nyassa wildebeest and zebra. Minor species include aardvark, yellow baboon, bushbuck, bush pig, crocodile, hippo, jackal,

porcupine, klipsplinger, reedbuck, pangolin, and African hare. Cattle are rare, and in most villages goat, sheep and poultry are present but in modest numbers. Twenty-one villages surround SNWC. The 1988 national census showed a total population of 37,298 people with an estimated density of 3 persons per square kilometre and a projected annual growth rate of 4.1%. Currently, the figure is likely to be higher as new villages emerge. Subsistence farming is the main activity for the local people supplemented by fishing in areas near major rivers and streams and by hunting—usually illegal (for protein suppliment). The farming system is extensive; it is based on shifting cultivation with crop acreage expanded by clearing bush, using the hand hoe. Cashew nuts and tobacco are major cash crops; maize, rice, cassava, sorghum and millet are the main food crops. Coconut trees are becoming increasingly common in some areas since public campaigns conducted by the Songea District Rural Development Programme (formerly Songea Development Action, SODA). Other commonly grown crops include pigeon pea, simsim, sweet potato, various legumes, onion, groundnut, banana, sugar cane and orange.

Research objective
The principal objective of this study was to trace and locate the traditional migratory routes of elephants by analysing the knowledge of the local villagers combined with own field observations. The study was part of wider assessment of the SNWC including satellite tracking of 10 elephants collared with GPS system. These information will provide baseline data to be used in planning for the long-term requirements for wildlife conservation in SNWC and implementing them. These data will be used to assist in preserving the genetic viability and persistence of two of the largest elephant populations in Africa and implementing methods that would minimize conflict between wildlife and local communities.

Method
Data were collected by conducting public village meetings, using questionnaires for standardized personal interviews, and making field observations. Individual questionnaires were filled in to obtain more detailed information, particularly on the presence or absence of elephants on village lands and seasonality of their presence, plant species that elephants might prefer as feed plants, and the timing of their fruiting or peak maturity in relation to elephant migrations. Direct field observations were made in remote areas of village land to confirm information previously recorded in the public meetings and questionnaires. Elephant signs such as tracks, faeces and feeding sites were observed and entered in a field observation book. Plant species that had been reported during interviews as being preferred foods were identified, collected and stored for future botanical identification. The locations of tracks and migratory routes for elephants were recorded using the Global Position System (GPS) and later downloaded to computer (Fugawi® software, Northport system, Canada) and the routes marked out. For each village, field observation took a minimum of two days and was carried out by the first author, accompanied by one or two traditional hunters, porters and an armed game ranger.

Results

Distribution and migration routes of elephants in SNWC
Elephant were reported to occur frequently and everywhere. According to 74% (n = 65) of the informants, elephant were reported to be common and widely distributed everywhere except near Lusewa in the southern section of the corridor, an area conspicuous for its impoverishment in wildlife species. It was further pointed out that both resident and migratory herds of elephants occur in the corridor, with the migratory herds moving all along from Selous to Niassa in Mozambique. In most cases, mixed herds of adults and young elephants were reported to be common occurring all year round with peak occurrence during March and April.

Three major migratory routes were identified through which elephants move from the Ruvuma River to the centre of SNWC.

The first migratory route starts at Lukawanga, about 27 km east of Magazini village, at a junction between the Lukawanga River in Mozambique and the Ruvuma River. This route

continues northwards along the Msanjesi, Majimahuu and Matepwende Rivers to the Changalanga and Mtungwe mountain area in the centre of the corridor.

The second route starts as four separate crossing points some 14 km west of Magazini village; the area includes the Mkasha Mountains, and Lusanyando, Ajemsi and Rutukila along the Ruvuma River. All these routes join at the Binti Uredi seasonal stream and proceed north-east via the Namisegu River to join the Lukawanga route.

The third route also starts with four separate starting points, which include a point near the Ndalala River in Mozambique, Binti Hasani, Msawisi and Kipembele Rivers south-west of Magazini village in Tanzania; it runs north-west to the southern face of London Mountain near Msisima village and also northwards along the Msawisi River to Luyati and Tingilafu Mountains and their associated rivers and forests near Amani village.

From here, some elephants cross the Amani–Magazini road to join the Lukawanga route. However, those from the London Mountain and the associated forest are reported to proceed westwards via Nambwela Forest and the Lisugu and Kimbande Mountains and their associated forests to Lukimwa River and Ngoma Litako swamp. They are then reported to change their course northwards by the way of Lukimwa river to Mtelamwahi areas at the centre of SNWC.

From the centre of the corridor, elephants appear to have four separate migration routes— Malimbani, Nampungu ya Chakame, Ritungula and Sasawala-Lukumbule—that ultimately connect Ruvuma River in the south with Selous Game Reserve in the north and Mwambesi Game Reserve in the southern east.

The Malimbani elephant route links Mbarangandu in the north and Kitwanjati in the south near Mtungwe. The elephants use nine small tributaries that drain into the Lukimwa River, but they do not follow the main river course. The route crosses the Songea–Tunduru main road between Mchomoro and Kilimasera, about 16 km from Kilimasera.

The Nampungu ya Chakame elephant route, which has its origins on Mbarangandu River catchments, crosses the Songea–Tunduru main road at Mt Kilimasera. It continues south via three important tributaries: Nampungu ya Chakame, Nampungu ya Kalwembe and Nampungu ya Wazee, to the Mbawa River, which drains into the Nampungu River. From here, the route continues via the Luchilikulu River and Nkalela Forest to the upper banks of the Msanjesi River.

The Ritungula elephant route broadens as it emerges from Selous Game Reserve. The elephants are reported to follow the Ritungula River or the Muhuwesi River via a series of small tributaries: Manoni, which drains into Mbarangandu, or Miwawa, which drains into Muhuwesi, to Kumbuja (which itself drains into Miwawa). The elephants then enter the Kapesula River and thereafter to Muhuwesi before proceeding to the Ritungula River.

The route crosses the Songea–Tunduru main road at Mlima Simba and the former Mwembenyani village near Hulia. The elephants then proceed southwards via a series of three small tributaries draining into the Nakapeye before it enters the Nampungu River. From Nampungu the elephants raid crops in the nearby villages of Changalawe, Hulia, Nampungu, Namwinyu, Mbatamila and Mnenje. The route continues farther south through Nkalela Forest and Mtumbitumbi and Malisafi Rivers to the upper banks of the Msanjesi River. Nkalela Forest links the Ritungula elephant route with the Malimbani and Nampungu ya Chakame routes via the Luchilikulu River and its associated forest. Another link is reported to exist between Ritungula and Malimbani routes via Kitwanjati River). The elephants are also reported to traverse between Msanjesi and Sasawala Rivers via Nakawale and Namakong streams. Namakong is a small permanent stream draining into Msanjesi. It is known to provide good shelter and grazing ground for elephants and other herbivores year round.

The Sasawala-Lukumbule elephant route uses a series of eight small tributaries draining into Sasawala before it enters Kiumbe Forest, Lukumbule River and the Mwambesi Game Reserve. Mwambesi Game Reserve is separated from Niassa Game Reserve by the Ruvuma River. This route suggests a link between the eastern and the western wildlife corridors. Elephants from Mwambesi Game Reserve were reported to have killed one person during

April 2001. These animals (a cow and two calves of different age groups) were followed and reported to have gone as far as Nampungu village in the central portion of the corridor.

Seasonal elephant movements

In all villages, the peak occurrences of elephants were reported between March and April, which corresponds to the peak rainy season. This is the same period during which the elephants are reported to proceed from south to north. The north-to-south movements are reported to occur between June and December. The key factors responsible for these movements are thought to be the availability of water, food, and in some places, increased disturbances by humans. During early March to April, elephants are likely to move northwards upstream to avoid swollen rivers and flooded wetlands after heavy rain. The north-to-south movements are probably triggered by a decline in availability of forage and water. At this time of the year, most of the trees shed their leaves and the seasonal streams run dry. The major sources of tree foliage and water are then permanent water sources such as the Ruvuma River, permanent swamps, and some smaller permanent streams. Thus, elephants are likely to concentrate in riverine forests during the dry season. Interviews also revealed that on the Mozambiquan side, elephants move towards the Tanzanian border during the dry season between June and December. This movement had been linked to lack of water and food plants on the Mozambiquan side as most rivers and streams are seasonal and dry up completely, and bush fires occur then.

During this time the elephants cross the Ruvuma and its associated islands to Tanzania in search of riverine food plants. Both personal field observations and interviews suggest that all major elephant movement routes are likely to depend on large, permanent river systems. The Msawisi River system forms another important elephant migratory route in the southern section of the corridor.

Common feed plants for elephants

During this study, 31 plants were named as feed plants preferred by elephants that were subsequently identified during field observation. Elephants were reported to forage on leaves, bark, tubers, or whole plants in 20 tree species, fruit in 10 tree species and in one species on both leaves and fruit. The peak fruiting period of marula fruit (*Sclerocarya birrea*) was associated with peak occurences of elephants along the major rivers where these fruit are found. Other fruits and plants were not associated with seasonal congregation of elephants.

Discussion

African elephants, the largest of all land animals, were originally found throughout the African continent (Halternorth and Diller 1986). However, in many areas, populations have been greatly reduced by poaching (Dublin and Douglas-Hamilton 1987; Siege 1999) and increase in human population with associated increase of demand for land for agriculture and habitat loss (Lamprey et al. 1967; Laws, 1970; Western and Lindsay 1984; Barnes et al. 1998). As a result, most of Africa's elephants are now forced to seek refuge in isolated pockets of protected areas (Cumming et al. 1990; Shauri and Hitchcock 1999).

Having no conservation status, SNWC is faced with many threats attributed to an increase in human activities including; human population growth, agricultural expansion, deforestation, uncontrolled bush fires, and illegal fishing and poaching. Uncontrolled human activities will ultimately result into considerable loss of biodiversity, obstruct movements of large herbivores such as elephants and consequently intensify human–wildlife conflicts. The SNWC supports large numbers of wildlife (CIMU 2001; Hofer et al. 2001; D. Mpanduji pers. obs. 2000) including the IUCN Red List of threatened and endangered species. The 1990 IUCN Red List included two species that are present in SNWC. These species (with their status in parentheses) include the African elephant Loxodonta africana (Vulnerable) and the African hunting dog Lycaon pictus (Endangered). The corridor links the gene pools between the two largest protected areas in Africa, the Selous in Tanzania and the Niassa in Mozambique.

Experience in wildlife conservation gained over a century in Africa has shown that the critical areas for survival of wildlife species outside protected areas such as breeding sites, migratory corridors, dispersal areas and foraging grounds have been neglected by conservationist resulting in intensified land-use conflicts and considerable loss of biodiversity (Kideghesho 2000). The degradation occurring within and surrounding individual protected areas may affect the rate of extinction of some species, particularly the large mammals and other

migrant animals that require habitat beyond protected areas (Wilfred and Ruzika 2000). In Tanzania for example, land around protected areas and migratory corridors between them are particularly hard hit in the crowded '"northern circuit'. The areas of Serengeti, Ngorongoro, Lake Manyara, Tarangire, Arusha and Kilimanjaro are reported to have lost most of their wildlife migratory corridors and dispersal areas (Shauri and Hitchcock 1999; Kideghesho 2001a,b, c and 2002), as a result a number of large mammal species have been reported locally extinct in some of these areas (Gamasa 1998; Shombe-Hassan 1998 as quoted by Kideghesho 2002; Silkiluwasha 1998). The situation is quite different south of Selous. In its current status, SNWC passes through sparsely populated villages. The northern section of this corridor, which passes through 17 villages, is currently protected by a series of wildlife management areas managed by local people as part of Selous Game Reserve buffer zone project guided by the Wildlife Division and the Selous Conservation Programme. However, the southern section of the corridor, which is about 3000–4000 km2 and contains 18 sparsely located villages, is currently not protected and is vulnerable to unsustainable exploitation of land resources incompatible with wildlife conservation.

Many human development activities are reported to be detrimental to elephant habitats. Construction of roads, railways and human settlements are activities that have been reported to impede the movement of elephants (Johnsingh and Christy-Williams 1999). Already the Songea–Tunduru main road crosses SNWC. Its impact is, however, minimal as elephants traverse the road at different sites. Human habitation and expanded agricultural activities between Mchomoro and Kilimasera and between Kilimasera and Hulia had already increased the number of incidents of conflict between human and elephant (Hahn 2001; Nalimi Madatta pers. comm. (2000). Similar phenomena are very likely to occur between Magazini and Amani, Magazini and Likusanguse and at Ligunga-Amani in the southern end of the corridor.

During this study, all critical elephant migratory routes along the Songea–Tunduru main road were identified. Through the efforts made by the Selous Conservation Programme, a workshop including all stakeholders was conducted in Ruvuma region to include the two districts falling within the SNWC. The district commissioners of Songea and Tunduru; district game, forest, bee, fishery, agriculture and livestock officials; councillors; village chairpersons; and other district and village officials under SNWC attended the workshop. Other invited delegates came from the United Nations Development Programme (UNDP) and the Global Environment Facility (GEF) and Niassa Game Reserve in Mozambique. It was agreed during this meeting that the areas already identified as important elephant migration routes be protected and kept free of human development activities. It was further agreed to incorporate this decision in village bylaws. Through this decision, the Litungula elephant route was saved from total obstruction, as encroachment was already severe, and the former Mwembenyani village was slowly growing. Inhabitants from this village shifted voluntarily to the nearby villages of Hulia, Kilimasera and Pachani near Milonde and Matemanga. Efforts are being made using satellite telemetry to identify other routes and important elephant ranges.

In this study, elephants are reported to proceed from south to north between March and April and from north to south between June and December; these times conform to the dry and rainy seasons. Halternorth and Diller (1986) reported movements of large herds over great distances, amounting to approximately 500 km during the late dry season, in search of new growth and fruiting food plants. The peak fruiting period of marula in March was associated with peak occurrences of elephant congregations along the Ruvuma River; other fruits had no known influence on elephant movements. Several well-established elephant migration routes have been found in the corridor through which elephants and other wildlife move during long-distance migrations. These routes were found to be contiguous with large, permanent water systems, which in most cases are considered to be the dry-season refuge for elephants (Kingdon 1997).

The wet- and dry-season aerial census (CIMU 2001) in SNWC reported high concentrations of elephants in the centre of the corridor towards the Nampungu River and Sasawala Forest Reserve while few or no elephants were found on the south-central parts of the corridor. High levels of human activity in the southern half likely interfered with the movements of elephants between the southern and northern halves. This may equally be true between Niassa Game Reserve and SNWC (Hofer et al. 2001). Detailed information on home ranges, seasonal or periodic long-distance movements, foraging behaviour and spatial use of resources by

elephants in SNWC will be undestood after detailed analysis of movement data in 10 radio-collared elephants in different areas of the corridor. The information obtained during the present study and in future from the radio-collared elephants is vital for the long-term conservation and management of elephants and other wildlife in SNWC.

An early report by Said et al. (1995) and Barnes et al. (1998) mentioned the possible cross-border movements of elephants between the now-named SNWC north of Ruvuma and Niassa Game Reserve south of the Ruvuma River. Our study identified nine such crossing points through which elephants from either side are reported to cross the Ruvuma River. Uncontrolled wildfires, poaching, and increased human activities, mainly fishing and encroachments along the Ruvuma River, will ultimately prevent the movement of elephants and other wildlife in SNWC. Human habitation and expanded agricultural activities between Mchomoro and Kilimasera and between Kilimasera and Hulia already had impact on elephant movements with the associated human–elephant conflicts likely to increase (Hahn 2001). Similar phenomena are likely to take place between Magazini–Amani, Magazini–Likusanguse and Ligunga–Amani in the southern end of the corridor.

The wildlife potential of SNWC has been noted in reports by Hofer et al. (2001) and CIMU (2001). Although SNWC seems to be a critical area for the survival of a diverse number of wildlife, large portions of the southern section completely lack official protection, and hence they are vulnerable to all kinds of unsustainable wildlife use (Hofer et al. 2001). Participation of local communities in wildlife management decisions, the sustainable use of natural resources, and the distribution of income generated by natural resources on a local level can help to limit over-exploitation and habitat degradation by local communities (Lewis and Alpert 1997).

This aspect has been recognized by the government of Tanzania in its wildlife policy published in March 1998, in which it commits itself to 1) involving all stakeholders, particularly local communities, in the conservation and management of wildlife areas, 2) establishing wildlife management areas as a new category of protected area, with local people having a full mandate of managing and benefiting from conservation efforts, and 3) cooperating with neighbouring countries in conserving migratory species and transboundary ecosystems.

This study was therefore initiated by the Selous Conservation Programme in collaboration with the Germany Agency for Technical Cooperation (GTZ), Tanzania to provide baseline data for planning and implementing the SNWC development cooperation project whose aim is to protect and manage the southern part of the corridor through a network of village wildlife management areas.

The goal of this project is to protect the wildlife corridor by having the local communities participate and benefit from sustainable utilization, and to combat transboundary elephant poaching through an agreement of cooperation and law enforcement between Tanzania and Mozambique. Benefits could include 1) legally supplying game meat, obtained through annual hunting quotas for each participating village, 2) empowering participating villages to protect themselves and their property against problem and crop-raiding wild animals, 3) generating cash income for community projects from sustainable use of wildlife through photographic or hunting tourism, and 4) providing employment for youths as village game scouts. The results of the present study are therefore important prerequisites for establishing management procedures for SNWC, particularly in reducing competition between people and wildlife—in this case, elephants.

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