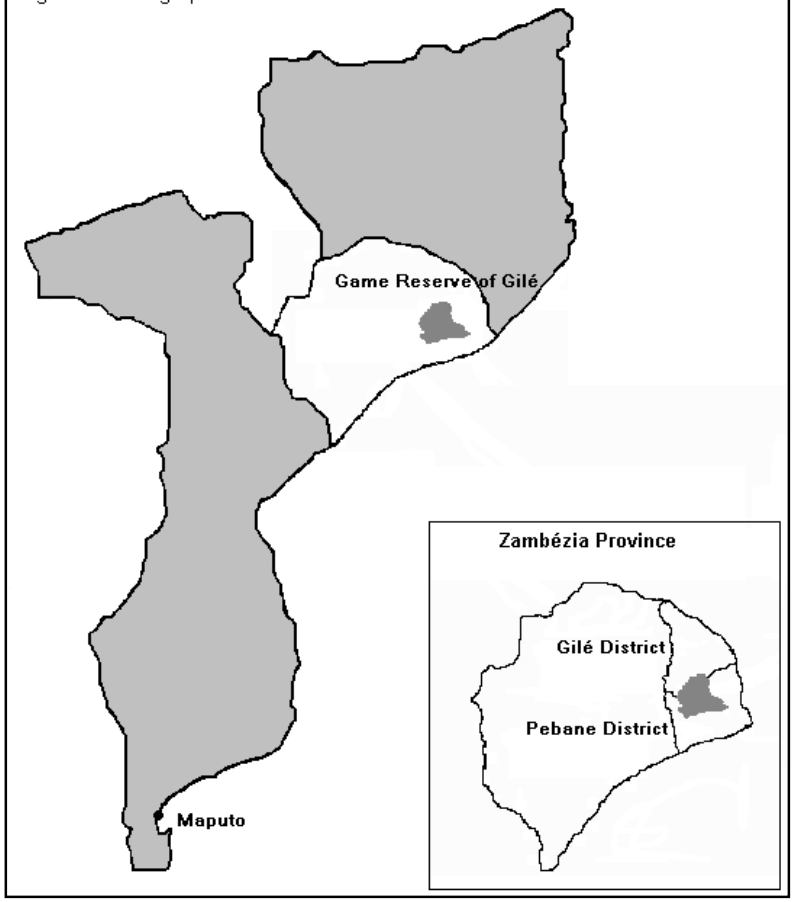
# 2 RESOURCES DESCRIPTION

## 2.1 Geographical Location

The Game Reserve of Gilé is located in the northeaster part of Zambézia Province and is comprised between 16° 14' 45" and 16° 50' 30'' South and between 38° 05' 38'' and 38° 48° 45'' East, covering an area of 2,100 km$^2$ between Pebane, the second larger district in the Province (10,087 km$^2$) and Gilé, the fourth larger district (9,526 km$^2$) (Fig. 2.1 and 2.2). The following watercourses bound the northern, western and eastern sectors of the GRG: Nanhope (northern sector), Naivocone, Lice and Mulela (western sector), Molocué (eastern sector). No geographic delimitations are present in the southern sector where the border is administratively established by a line parallel to the road that connects the Mualama and Nova Nabur administrative localities in Pebane District. The GRG is reachable from Quelimane (administrative capital of Zambézia Province) by means of 410 km road (200 asphalted and 210 unpaved) and from Nampula (administrative capital of Nampula Province) by means of 210 km road (100 asphalted and 110 unpaved). No asphalted roads exist both inside and in the neighbourhood of the GRG.

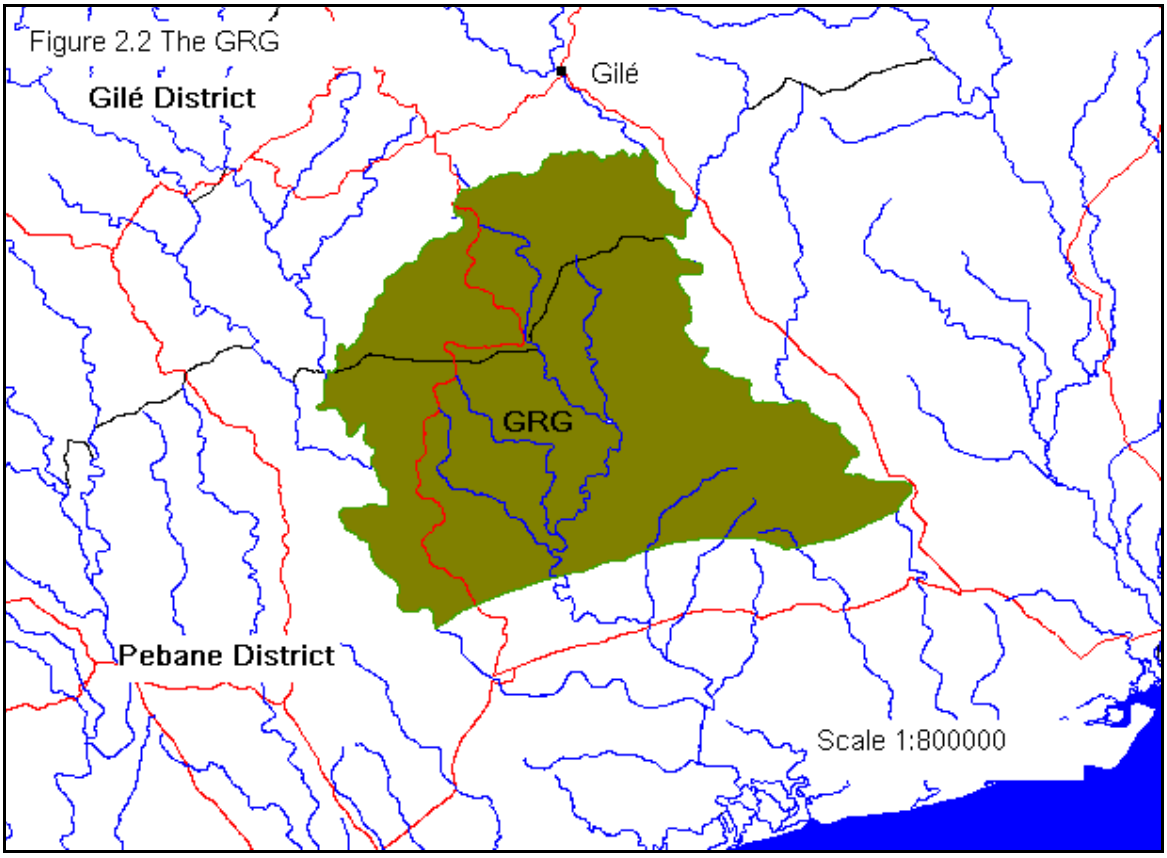
Figure 2.1 Geographical location of the Game Reserve of Gilé




The GRG is the only protected area of Zambézia Province[1], and together with the Reserve of Niassa (Niassa Province) are the only protected areas of northern Mozambique (i.e. north of Zambezi River)[2].

[1] The protection status of the Derre Forest Reserve (*Reserva Florestal de Derre*), located in the southern part of Zambézia Province, is not well defined and only concerns the exploitation of timber products.

[2] Between September and October 2002, it is planned the establishment of the Quirimbas National Park in the Province of Cabo Delgado, which will represent the first National Park in Northern Mozambique.




## 2.2 Local People

Zambézia Province, with an estimated population of 3,476,484 in 2002 is the first Province for number of residents and the second one for population density (33.4/km$^2$). Within Zambézia Province, Pebane District is the eleventh for number of inhabitants, with an estimated population in 2002 of 161,484, and the sixteenth for population density with 15.4 inhabitants/km$^2$, while Gilé District is the twelfth for number of people with an estimated population in 2002 of 159,839 and the fifteenth for population density with 15.8 inhabitants/km$^2$. Both districts experience high rates of population growth (over 3%), which lead to estimate populations of 202,668 and 189,883 for Gilé and Pebane respectively in 2010 (INE, 1997). Given the scarcity of demographic data at district level (data those consider all single locality and village), is complicated to assess the whole population living in the area. Nevertheless, considering a radius of 20 km[3] around the GRG borders, we can estimate that the inhabitants living around the protected area are approximately 12,000 in the Gilé and 20,000 in the Pebane. Instead, no human settlements are present within the GRG limits.

Most of local people in the area, as in the whole north sector of Zambézia Province, belong to the Lomwé tribe, one of the twenty ethnic groups recognized in Mozambique. Unfortunately, not a lot is known about the geographical origin and movement of this Bantu population. Within the whole area, the Elomwé is the mother tongue, even if the Portuguese language is widespread. The

[3] This radius has been considered taken into account the one-day-distance usually covered by the locals during several activities as: hunting, fishing, and non-timber products gathering (honey, wild fruits and mushrooms).

larger part of the population living in the Gilé district is Catholic, whereas along the seacoast of Pebane District most of people are Muslims due to the influence of the Swahili culture.

Almost the totality of households in the target area is involved in agricultural activities (Gallego & Rasul, 2001). Agriculture is considered as the main economic and subsistence activity in Gilé and in the interior areas of Pebane. Along all the costal area of Pebane the exploitation of sea fisheries represents a significant economic resource and food intake for local residents.

Agricultural production is done in individual plots and most households produce a diversity of crops mainly for subsistence purposes: cassava, maize, rice, sweet potato, groundnuts, pigeon pea, cow pea and some vegetables. All agricultural tasks, from land preparation to harvesting, are accomplished manually with the help of simple agricultural instruments (i.e. hoes).

Presently, the main cash crop in the area is cashew. However, cashew production has suffered from several constraints during the last decades that have severely reduced its importance on rural livelihood. First, most plants were planted during the colonial period and their old age has substantially reduced yields. Second, cashew trees were rigorously affected by Powdery Mildew, which has cumulatively reduced production by almost 75% in the whole country. Finally, the civil conflict led to the abandonment of most of the cashew orchards and since then no care has been provided to cashew production.

Both Gilé and Pebane used to be important producers of cotton, but production levels have plummeted in recent years owning to lack of investment by agro-industrial companies and to low international prices.

## 2.3 Geology and soil

The geology of the area comprises two Precambrian series, highly metamorphosed and deformed, locally invaded by granite intrusions and small bodies and dikes of basic rocks. The first series, called “Regional Greises” represent the oldest one and is associated with white, yellowish or green magnetite bearing quartzite. The second series, called “Meta-sedimentary series” are composed of schists comprising paragreises, sandstones and quartzite (Dutton et al., 1973). Two different soil types are observable in the GRG: (1) a light sandy soil and (2) a red clayey soil, whose distribution is quite irregular within the GRG (INIA, 1994). Both soils have a low degree of fertility and are quite susceptible to hydrological erosion.

## 2.4 Climate

The GRG climate lies within the Walter’s tropical summer-rainfall climatic zone (White, 1983), with a well-defined wet period between November and April and a dry period for the others six months (May-October) (Fig. 2.3). The annual average rainfall is around 800-1,000 mm. The annual rainfall recorded for the period 1995-1999 was 1,122.62 mm (data from the DDADR-Gilé) (Fig. 2.4). Temperature varies substantially during the dry season, from 13°C (mean minimum in June) to 35.7°C (mean maximum in October), which permits to recognize an “early-cold dry season” between May and August and a “late-hot dry season” in September and October. Instead, the variation of the temperature during the rainy season is less marked.

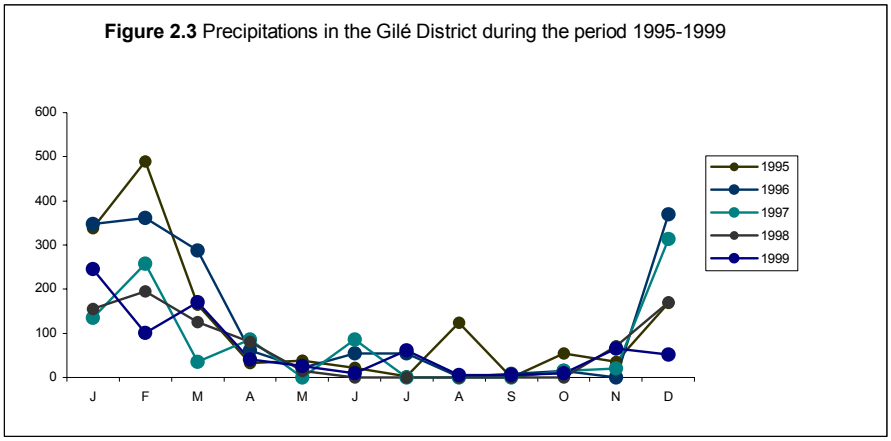



**Figure 2.3** Precipitations in the Gilé District during the period 1995-1999

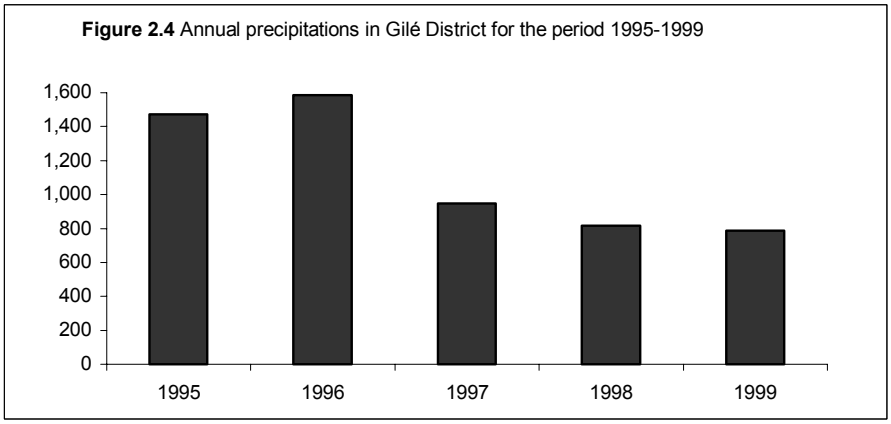



**Figure 2.4** Annual precipitations in Gilé District for the period 1995-1999

## 2.5 Landscape

The topographic side view of the GRG is characterized by a gently sloping plain declining southward with an altitude comprised between 100 and 200 m a. s. l., and by several granite outcrops (inselberg) that emerge from the woodland.

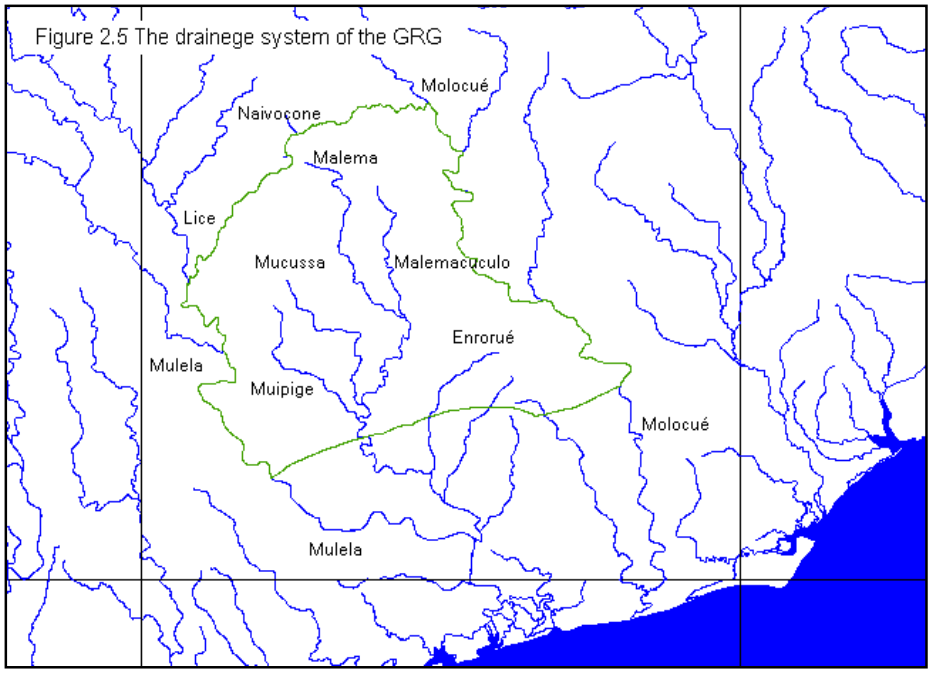
The upper five inselberg within the GRG are: Namirrue (434 m a. s. l.), Nachipe (340 m), Mucocha (332 m), Mussirima (332 m) and Pope (265 m). The impressive Gilé inselberg, unfortunately outside the GRG limits, reaches 822 m.

The area presents a complicate drainage system constituted by three major watercourses and by numerous small streams some with permanent water others simply seasonal. The three major watercourses are the Mulela, which flows along the western border of the Reserve, the Molocué, which flow along the eastern border and the Malema, which flows in the middle of the GRG and then flows into the Mulela (outside the southern border). Other permanent watercourses, whose rate of flow is very reduced during the dry season, are: Nanhope and Naivocone in the northern sector; the Nakololo, Malema, Malemacuculo and Mucussa in the core sector; the Muipige, and Enrorué in the southeaster sector (Fig. 2.5). No permanent water-polls are present within the GRG.

The physiognomic diversity of landscape consists of a woodland/grassland dambos mosaic where deciduous miombo woodland is dominant in cover percentage. However, the miombo woodland within the GRG is not homogeneous, but shows a strong variation of some biotic features such as:

- Height of trees
- Shape of the tree canopy (vertical or horizontal)
- Density of undergrowth (shrubs and herbs)
- Proportion between deciduous and evergreen tree species

The density of undergrowth is a direct consequence of the first two biotic features (height of trees and shape of the tree canopy) because the larger the canopy coverage the higher the light reaching the ground and hence the undergrowth development. The different proportion between deciduous and evergreen species is due to the different soil conditions. Evergreen trees were more abundant along permanent river basins, but also in some areas far from surface water. This difference likely depends on the depth of the waterbed in the underground. A further index of spatial heterogeneity is given by the different phaenology shown by trees and herbs of the same species, but situated in distinct areas (i.e. some trees belonging to the same species may be leafless, germinating or fruiting in different stands). Such variation probably depends on both edaphic conditions, as soil moisture and soil depth, and frequency and intensity of seasonal wild fires.




The dambos spots are small to medium size edaphic grasslands, flat-bottomed valleys that are often seasonally waterlogged (rainy season). Dambos occur where the underground water comes near to surface and hampers the tree growth. Few or a part of them may remain boggy throughout the year but most of the surface becomes dry and very compact during the dry season. These soils are normally acid.

# 2.6 Vegetation

## 2.6.1 Phytogeographical aspects

Of the 18 major phytogeographic units delimited by White (1983) for the Afrotropical Region, only three occur within the political borders of Mozambique: (1) the Zambezian Regional Centre of Endemism, (2) the Tongoland-Pondoland Regional Mosaic (TPRM) and (3) the Zanzibar-Inhambane Regional Mosaic (ZIRM).

The GRG territory falls within the Zambezian Regional Centre of Endemism (ZRCE), but nearby with its easternmost border to the Zanzibar-Inhambane Regional Mosaic (ZIRM). The first one occupies the whole internal part of the Mozambican territory, whereas the second one extends along the coast southwards to Limpopo mouth (Gaza Province), forming a narrow belt-zone more or less penetrating inwards from the seacoast.

According to the classification of vegetation types of Mozambique suggested by Wild and Barbosa (1967), the miombo woodland of the GRG corresponds to the Mapping Unit 24, named as "Deciduous miombo woodland-lowland type". This type occurs in lower Zambézia at a height of approximately 100-200 m and an average annual rainfall of 800-1,000 mm. It deals with a miombo dominated by *Brachystegia spiciformis, B. boehmii* and *Julbernardia globiflora*, with the participation of species from the '*Acacia-Combretum*' communities.

A more recent classification of African vegetation (White, 1983), places the territory of the GRG into the Vegetation Type n. 26 "Dry Zambezian Miombo Woodland". Here, miombo trees are usually 12 to 18 m tall, with a canopy cover higher than 40% and broadleaf shrub and grass beneath.

Generally, miombo soils are of eluvial origin on basement quartzites, schists and granite rocks. The soil texture is sandy loam, sand clay loam and sand clay. Soil colour varies from shades of brown in the topsoil (0-30 cm), to reddish and orange in the bottom soil on well and poor sites, respectively. These soils have low concentrations of organic matter, macronutrients and exchangeable bases, which decreases with depth (Chidumayo, 1997).

Fire is one of the most important ecological factors affecting miombo woodland. The strong seasonality in precipitation leaves the vegetation dry for several months of the year, and thunderstorms at the onset of the rainy season can easily set the vegetation alight. However, in addition to being naturally fire-prone, miombo is frequently burned by people to clear land for cultivation, to maintain pastures for livestock, or to drive game animals to positions where they can be easily hunted.

The GRG vegetation supports greater floral richness and includes almost all the miombo dominants, such as *Brachystegia spiciformis*, *B. utilis*, *B. boehmii* and *Julbernardia globiflora*. Deciduous riparian forest lines the numerous rivers in the area, while dry forest and thicket associations are also found in the ecoregion, especially in rocky places.

## 2.6.2 Plant communities

The species composition of the deciduous miombo woodland in the GRG changes in relation to soil and vegetation dynamics. Because of *Brachystegia spiciformis* is the most demanding as to soil conditions it is the dominant species in the climactic phase of the vegetation catena. In areas where soil conditions are more severe (e.g. bordering dambos or subjected to erosion), this species is largely replaced by *Brachystegia boehmii*. Lower still in the catena sequence also *B. boehmii* disappears leaving *Julbernardia globiflora* dominant. The latter is capable of rapid regeneration and is dominant in secondary woodlands, in drier localities and those with poorer drainage. For this reason, in areas where *J. globiflora* is dominant, the forest is less high with a reduced canopy overlapping over a dense layer of shrubs.

Presently, the checklist of plants of the GRG contains 285 species (including grasses), as reported in Annex (1). A further checklist is in preparation in the contest of the Finnish Government financed "Project of Sustainable Use of Natural Resources" (*Projecto de Maneio Sustentado dos Recursos Naturais* - PMSRN), which is operating in Zambézia and Inhambane Provinces. This checklist will be available during 2003 (Fernando Sedano, pers. comm.).

During the last decade, two different descriptions of the vegetation types occurring within the GRG have been provided (see Box 2.1). According to the results of the last survey conducted during 2002, five different vegetation types have been recognized within the GRG: 1) Open forest, 2) Woodland, 3) Closed forest, 4) Riverine Vegetation, and 5) Dambos (Figure 5.6).

**Box 2.1 DNFFB and MICOA Forestry Surveys in the GRG**

During 1995, the National Directorate of Forestry and Wildlife (*Direção National de Florestas e Fauna Bravia* - DNFFB) provided vegetation maps for the whole country. Present, six different vegetation types have been described for the GRG using as criterion the percentage of canopy cover and trees height: **Open forest** with trees of lower height; **Middle thick forest** with trees of lower height; **Thicket** with trees of higher height; **Thicket** with trees of lower height **Thicket** with trees of medium height; **Woody grassland** with small trees and lower canopy cover and large grass layer.

During 1999, a team of the Ministry of Environment (*Ministério para a Coordenação da Acção Ambiental* - MICOA) carried out a forestry survey in the GRG. The study results show that the habitat degradation in the GRG produces a mosaic of different vegetation communities, which are distinct phases of the same vegetation catena. Four vegetation types have been recognized using as a criterion the degree of canopy coverage: (1) **LF1 type** (covered) characterized by a high species diversity with canopy cover > 70% and trees height > 7 m; (2) **LF2 type** (medium covered) characterized by low altitude vegetation (< 1,500 m) with canopy cover ≥ 10% and ≤ 40% and trees height ≥ 7 m; (3) **LF3 type** (scarcely covered) characterized by low altitude vegetation with canopy cover < 10%; (4) **T type** (bush land) characterized by small trees (height ≥ 3 m and ≤ 7 m) and several grasses species (Fig. 6). The LF1 and LF2 type were dominated by *Brachystegia spiciformis*, the LF3 by *B. boehmii*, the T type by *Julbernardia globiflora*.

*Sources*: DNFFB, 1995; MICOA, 1999.

### Open Forest

This vegetation type covers the greatest area of the GRG from the northern limit to more than half surface in southern direction and from the eastern to the western limit and is only interrupted by the vegetation type designed as Closed Forest that covers a small area in north-eastern part of the GRG (Figure 2.7).

There is no evident species dominance within this vegetation type; common trees include: the wild custard apple (*Annona senegalensis*), a species of bride's bush (*Pavetta* sp.), the monkey pod (*Senna petersiana*) and the snake bean (*Swartzia madagascariensis*). A species of resin tree (*Ozoroa reticulata*), endemic for Mozambique, has been recorded in this vegetation type. Open forest presents the second richness index of GRG (same as closed forest), and presents a higher level of plant diversity, which is expressed by the higher values of both diversity and evenness indexes.

Canopy cover is usually between 40 and 70%, with tree density of ~ 1,159 per hectare (trees > 2 m). The tree phytomass calculated as tree equivalent per ha (TE/ha)[4], is 16,199 kg/ha. The

[4] This parameter, used as index of the phytomass of a woody vegetation, is defined as a tree or shrub that is 1.5 m height and is calculated by dividing the total height of trees and shrubs recorded within a plot by 1.5 (Trollope, 1990; Trollope *et al.*, 1990).

distribution of phytomass is mainly located within the following height classes: C5 (≥ 5.5 m), C4 (≥ 3.5 m and ≤ 5.4 m) and C1 (≥ 1 m and ≤ 1.4 m).

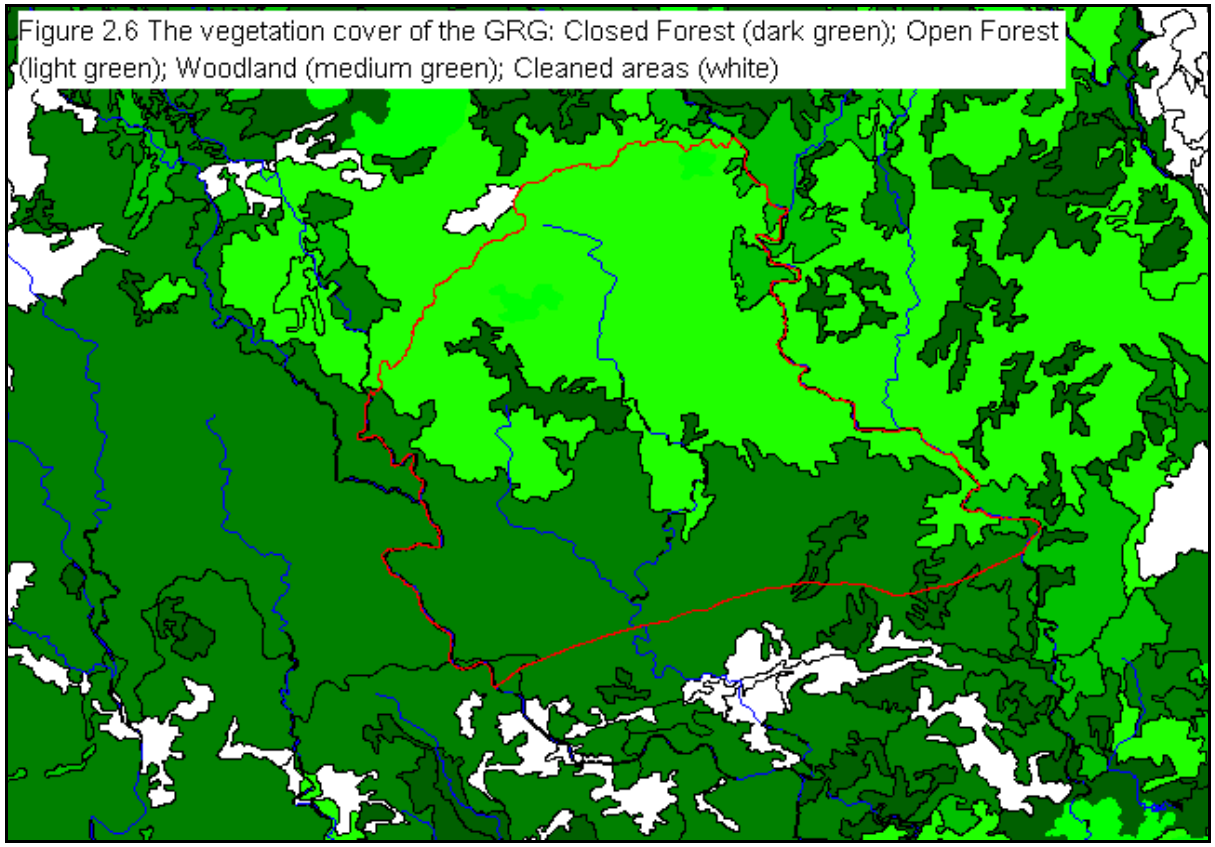


Figure 2.6 The vegetation cover of the GRG: Closed Forest (dark green); Open Forest (light green); Woodland (medium green); Cleaned areas (white)

The grass phytomass is some 2,172 kg/ha and the grass layer is mainly composed by: *Setaria* sp., *Themeda triandra*, *Eragostris rigidor* and *Digitaria* sp.. The grass layer in the open forest presents a high forage score[5], indicating its capacity to host grazers and high fuel score[6], indicating its potential for producing fuel for supporting fires.

**Figure 2.7** The Open Forest of the GRG

**Woodland**

Woodland corresponds to the second larger vegetation type within the GRG in terms of extension, covering less than half of its southern sector (Figure 2.8).

[5] The forage core indicates the potentiality of a given grass layer for producing forage for grazers and is given by the quantity and quality of grass species.
[6] The fuel score indicates the potentiality of a given grass layer to produce grass fuel for supporting fires.

The dominant tree species include: munondo (*Julbernardia globiflora*), mobola plum (*Parinari curatellifolia*), the parsley tree (*Heteromorpha trifoliata*) and the heart tree (*Hymenocardia acida*).

Co-dominant and associated species are: msasa (*Brachystegia spicifomis*), mfuti (*Brachystegia boehmii*), zebrawood (*Dalbergia melanoxylon*), the natal plane tree (*Ochna natalitia*), wild teak (*Pterocarpus angolensis*), wild custard apple (*Annona senegalensis*), stink bushwillow (*Pteleopsis myrtifolia*) and the ordeal tree (*Erythrophleum africanum*).

**Figure 2.8** The woodland of the GRG

The tree richness, as well as the diversity and evenness are lower comparatively to the other vegetation types (Open Forest, Closed Forest and Riverine Vegetation).

The canopy cover is usually less than 40%, with tree density of ~ 1,241 per hectare (trees > 2 m). The tree phytomass (TE/ha) is 12,862 kg/ha.

The grass phytomass is some 3,224 kg/ha and the grass layer is mainly composed by: *Themeda triandra*, *Schizachyrium jefferysii*, *Digitaria* sp. and *Setaria* sp.. The grass layer in the woodland presents a high forage score, indicating its capacity to host grazers and very high fuel score, and its importance for producing fuel biomass for supporting fires.

**Closed Forest**

Closed Forest represents the third larger vegetation type within the GRG and it is completely enclosed within the Open Forest vegetation type (Figure 2.9).

As observed for the open forest, there is no well-defined species dominance. Common species occurring are: the Pride-of-De Kaap tree (*Bauhinia galpinii*), panga-panga (*Millettia stuhlmannii*), mobola plum (*Parinari curatellifolia*), munondo (*Julbernardia globiflora*), glossy flat-bean (*Dalbergia nitidula*), wild seringa (*Burkea africana*) and variable bushwillow (*Combretum apiculatum*). As for the open forest, the endemic species *Ozoroa reticulata* is quoted for this vegetation type.

Both the species diversity and evenness are elevated, showing the value of this vegetation type in terms of biodiversity.

The canopy cover is usually higher than 70%, with tree density of 1,305 per hectare (trees > 2 m). The trees phytomass (TE/ha) is 22,902 kg/ha.

The grass phytomass is some 1,192 kg/ha and the grass layer is mainly composed by: *Setaria* sp., *Digitaria* sp., *Schizachyrium jefferysii*, and *Cyperus* sp.. The grass layer in the closed forest presents a high forage score, indicating its capacity to host grazers, and a high fuel score.

**Riverine Vegetation**

Riverine Vegetation occurs along the whole riverine systems of the GRG (Figure 2.10).

The screw pine (*Pandanus livingstonianus*) dominates the Riverine Vegetation mainly in the southern sectors of the GRG. This is the only species belonging to Pandanaceae family whose distribution in southern Africa is limited to some marsh areas of Mozambique. No clear species dominance is recognizable in the other sector of the GRG covered by Riverine Vegetation; common tree species include: the red-heart tree (*Hymenocardia ulmoides*), munondo (*Julbernardia globiflora*) and mobola plum (*Parinari curatellifolia*).

**Figure 2.9** The Closed Forest of the GRG

The costal-plain grewia (*Grewia transzambesica*), endemic in Mozambique, is quoted for this vegetation type.

The grass layer is mainly composed by: *Hypoxis multicets*, *Phragmites mauritianus*, *Imperata cylindrica*, *Themeda triandra* and *Cymbopogon caesius*. Common aquatic plants occurring in the watercourses are: *Nymphaea* sp., *Hydrostachys polymorpha*, *Pistia stratiotes*, *Trapa natans, Ceratophyllum* sp. and *Lemna* sp..

The species richness of Riverine Vegetation is the highest for the GRG because of the number of microhabitats occurring along the watercourses.

Tree species diversity, evenness and biomass are also higher, with the canopy cover comprised between 40 and 70%.

**Figure 2.10** The Riverine Vegetation of the GRG

**Dambos**

Grassed dambos is the smallest vegetation type within the GRG (Figure 2.11). This vegetation type occurs in seasonally waterlogged depressions where the underground water comes near to surface and hampers the tree growth.

**Figure 2.11** The Dambos of the GRG

Few or a part of them may remain boggy throughout the year but most of the surface becomes dry and very compact during the dry season (Dutton et. all, 1973; Carpaneto, 2002).

The canopy cover is typically less then 10% with a very low tree density.

The grass phytomass is clearly elevate, some 5,563 kg/ha and is mainly composed by: *Stipa* sp., *Cyperus* sp., *Schizachirium jefferysii*, and *Eragrostis* spp.

Sedges or water grasses (Cyperaceae) are also common in dambos (*Cyperus natalensis*, *Cyperus* spp.).

The grass layer in the dambos presents a low forage score, indicating low capacity to support grazers. Such datum could appear in contradiction with the high phytomass available in dambos, but is justified by the very poor quality of the grass species. In fact, this vegetation type is dominated by very coarse and robust growing grass species that are unpalatable for grazers. Dambos present very high fuel score, indicating its importance for producing fuel biomass.

## 2.6.3 Special environments

Around and above termite mounds a distinct community of living organisms occurs: some plants (e.g. *Costus* spp. and some orchidaceae) and mushrooms are usually present in this specialized habitat; some tree species often occur on termite mound even though are not exclusive of this habitat (e.g. *Tamarindus indica, Afzelia quanzensis, Diospyros verrucosa, Manilkara mochisia, Pteleopsis myrtifolia, Mimusops* sp.). These peculiar plant communities are becoming rare in Mozambique because the soil fertility of termite mounds is very appreciated by cultivators who are use to cultivate maize and other crops on them.

The presence of the baboon tail (*Xerophyta retivensis*) is another important element of this landscape because of the particular form of this species with its stumpy trunks that resist to fire and because it hosts a very interesting orchid species (*Polystachya dendobiflora*). Several cycads species (Zamiaceae) occur on the top of some high rock hills and outcrops within the GRG. These cone-bearing plants belong to an ancient order (Cycadales), which flourished between 300 and 200 million years ago and were dominant plants in past environments. The species, which exist today, represent only a remnant of this ancient taxonomic group. The occurrence of cycads in the

GRG is a relevant ecological datum due to the potential presence of endemics. The endemic cycad (*Encephalartos turneri*) is found on some of the surrounding inselbergs (IUCN, 1987; Goode & Comrie-Greig, 1989). Patchily distributed epiphytic ferns and orchids contribute to the uniqueness of this woodland.

# 2.7 Fauna

The invertebrate fauna of the GRG is not yet well recognized, even considering the complexity of the subject and the complete lack of related literature. Several species of insects, used as food by local populations, have been identified and are reported in Section 3.1. An exhaustive study on the invertebrate fauna of the GRG is required.

The variety of vertebrates occurring in the GRG is considerable. In the present section we report only the descriptive list of mammals recorded, considering their importance for conservation and their relevance as food source for local populations. A brief description of birds and reptiles quoted for the GRG is also provided and the present checklists of reptiles and birds are annexed (see Annexes 2 and 3 respectively). Several species of amphibians and freshwater fishes were quoted for the GRG and here considered in the section 3, discussing the exploitation of the natural resources by local populations.

## 2.7.1. Mammals

During the last three decades, large mammals within the GRG seem to have severely suffered by uncontrolled hunting. During 1980s and early 1990s, increasing guerrilla hostilities and the civil conflict, the large mammals in the GRG have been heavily hunted to support the food requirement of the troops quartered in the area (as reported by Reserve's rangers and local populations). Afterward, the lack of financial resources and the consequent low institutional capacity to manage and patrol the GRG area resulted in the increase of illegal hunting activities conducted by both professional hunters from Quelimane and Nampula cities and local populations.

However, as a dystrophic savanna on relatively poor soils with high leaching potential and relatively high rainfall, the miombo woodlands in and around the NRG is expected to support low intensity of herbivores. Most of the biomass (and probably also most of the minerals) in the region is captured within trees forming a 15 to 30 meter high canopy, and well out of rich of most mammalian grazers and browsers typical of the region (van Aarde, 2002).

Presently, the checklist of mammals of the GRG (Annex 4) includes 59 species: 5 primates (3 monkeys and 2 galagos), 2 elephant shrews, 2 hares, 12 rodents, 17 carnivores, 16 ungulates (excluded 2 extinct species), 2 hyraxes, 1 pangolin, antbear and elephant. Several other small mammals, mainly shrews, bats and rodents, could be added to this list in the future after further specialized researches. The present mammals checklist has been compiled throughout two different series of data gathered: 1) direct observation (sighting of a species in the field, identification of its signs or tracks, identification of remains as skins, hooves, horns, bones, etc.); ethnozoological data (selected information elicited from interviews with local villagers and gathered by ethnozoological methods of enquiry (see: Carpaneto, 1994; Carpaneto & Germi, 1989, 1992).

**Primates (Primates)**

Diurnal primates are represented by three species: the yellow baboon (*Papio cynocephalus*), the vervet monkey (*Cercopithecus pygerythrus*), both largely distributed in Sub-Saharan Africa apart

from dense rain forest areas of West and Central Africa and from desert and sub-desert regions of the Southern Africa sub-region, and the white-throated monkey (*Cercopithecus albogularis*), which still occurs in the riverine forest along the Molocué River. This latter species is a taxon of conservation concern in Mozambique because restricted to certain habitat types (i.e. riverine and humid forests) that were severely affected by logging and degradation in all country. Nocturnal primates were represented by two species of bushbabies: the greater galago (*Otolemur crassicaudatus*) and the South African galago (*Galago moholi*).

**Elephant shrews (Macroscelidea)**

Two species of elephant shrew are recorded in the GRG: a four-toed elephant shrew (*Petrodromus tetradactylus*) and a chequered elephant shrew (*Rhynchocyon cirnei*). However, the list of these micro-mammals is largely incomplete.

**Hares (Lagomorpha)**

Both the Natal red rock hare (*Pronolagus crassicaudatus*) and the Scrub hares (*Lepus saxatilis*) are common in the GRG. Nevertheless, these populations, especially that of red rock hare should be investigated in order to verify their taxonomic status.

**Rodents (Rodentia)**

Large rodents are represented in the GRG by the cane rat (*Thryonomys swinderianus*), the giant pouched rat (*Cricetomys gambianus*), and the South African porcupine (*Hystrix africaeaustralis*). Three species of squirrels are quoted: the striped bush squirrel (*Paraxerus flavovittis*) and two species belonging to the bush/red squirrel complex (*Paraxerus cepapi/palliatus*). On the other hand, the presence of the mutable sun squirrel (*Heliosciurus mutabilis*) and the Lord Derby's anomalure (*Anomalurus derbianus*) need to be confirmed. The latter species was recorded by Dutton (Dutton et al., 1973), but there was no its evidence during the field survey conducted during the Project implementation.

Small rodents are represented by several species, which play an important role in the Lomwé diet (see Section 3.1). Due to the difficulty in the identification of these micro-mammals (as for shrews and bats) without specialized researches, only few species are nowadays identified: *Tatera* sp., *Lemniscomys griselda, Acomys spinosissimus, Heliophobius argentocinereus*.

**Carnivores (Carnivora)**

Two canid species still occur in the reserve: the side-striped jackal (*Canis adustus*) and the wild dog (*Lycaon pictus*). Dutton (1973) recorded the occurrence of the black-backed jackal (*Canis mesomelas*), but this quotation may be due to a misleading deduction. In fact, the GRG falls into the geographic range of the side-striped jackal, while the black-backed lives south of the Zambezi River and usually occurs in arid environments (Smithers & Tello, 1976). The jackal is considered common by the natives, while the wild dog is told becoming rare in the last decade. The last sighting by the Reserve rangers of this endangered African carnivore was in 1997, when a pack of 6 was recorded in the sector between the southern border of GRG and Mualama. More recently (September 2002), two rural hunters engaged by the PRPGRG to conduct faunistic surveys reported the occurrence within the GRG of a pack of 14 wild dogs. Presently, the wild dog is a species of conservation concern because it has disappeared in large areas of its geographic range, owing to persecution by wildlife managers and to the spread of diseases transmitted by domestic dogs. The presence of the wild dog within the GRG should be monitored in-depth and the species protected; its cubs should be reared in captivity and accustomed to the presence of tourists as a flagship species. Such an operation should be possible because this species is neither eaten nor hunted by Lomwé who have a traditional respect for it. For this reason, the GRG

could be an optimal site for restocking or reintroducing this endangered species afterward a complete feasibility study.

Two otter species occur in the GRG: the African clawless otter (*Aonyx capensis*) and the spot-necked otter (*Lutra maculicollis*). These two species are common within all the watercourses of the GRG.

Other two species of mustelids present are the striped polecat (*Ictonyx striatus*) and the honey badger or ratel (*Mellivora capensis*).

Three species of mongooses occur in the GRG: the marsh mongoose (*Atilax paludinosus*), the large grey mongoose (*Herpestes ichneumon*) and the banded mongoose (*Mungos mungo*).

The occurrence of the miombo genet (*Genetta angolensis*) was verified by direct observations. The occurrence of a second species, i.e. the blotched genet (*Genetta tigrina*), was deducted by ethnozoological enquiries.

The occurrence of the African civet (*Civettictis civetta*) was confirmed by direct observation.

The occurrence of the spotted hyaena (*Crocuta crocuta*) was assessed throughout ethnological data; no direct sight of this species was recorded during the field surveys.

Among wild cats, both the leopard (*Panthera pardus*) and the lion (*Panthera leo*) occur in the GRG. Other cats, according to ethnological information, are the serval cat (*Leptailurus serval*) and the African wild cat (*Felis sylvestris caffra*).

**Scaly ant-eaters (Pholidota)**

According to ethnozoological data, the ground pangolin (*Smutsia temminckii*), one of the four African species of pangolins, is present within the GRG, but rare. An individual of this species was found for sale in the rural market of Nicoadala, located along the main road that connects Quelimane and Gilé, during April 2002, the seller affirmed to have captured the animal inside the GRG.

**Aardvark (Tubulidentata)**

Given the ethnozoological data, the aardvark (*Orycteropus afer*), is present within the GRG, but rare. Most of the local people inform they have not seen this animal since many years. This unmistakable species is the only one of the order Tubulidentata; whish is an endemic order of the Afrotropical Region.

**Hyraxes (Hyracoidea)**

Two species of hyraxes live in the study area, according to the natives who use two different vernacular names for them: the rock hyrax (*Procavia capensis*) and the bush hyrax (*Heterohyrax brucei*), both present on the rock outcrops inside and around the GRG.

**Elephants (Proboscidea)**

Unfortunately, official censuses of the elephant population in the area are not available. Information on population size, movements and range use derive merely from local informants and former game rangers of the GRG. Given that, the following data are provided simply as indications. Elephant population has been estimated in 200-300 during the 1960s according to Mr. Sansão Bonito, former administrator of the GRG. As a result of the civil war their number

**Box 2.2 Case Study: Elephant Range Use within the GRG and neighbouring areas**

A preliminary assessment of elephant movements and range use within the GRG and neighbouring areas has been provided by Martins and Ntumi (2002) during a field research conducted in the contest of the PRPGRG.

The area comprised between Etaga and Maganja da Costa, crossing Molocué River on East and Muipige, Lice and Malema Rivers on West delineates the elephant range use. No elephant occurrence has been observed from Nakololo warden camp (centre of the GRG) to Namurrua camp (north of the GRG) during the last decade (António Varinfo, pers. comm.).

Within the whole 20 plots where the vegetation has been studied no trees damaged by elephant have been observed, indicating the low abundance of the species. By means of fresh dung examination and from ranger and local residents information, nine tree species have been identified as main food used by elephants: *Vitex payos*, *Ximenia caffra*, *Parinari curatellifolia*, *Margaritaria discoidea*, *Sclerocarya birrea*, *Annona senegalensis*, *Albizia glaberrima*, *Brachystegia spiciformis* and *Kigelia africana*.

The distribution pattern of suitable and available of food plays a crucial role in the elephant range use in the area (see Figure 2.12). Unfortunately, attracted by food availability, which is higher in the woodlands southern of the GRG, elephants occasionally move into agricultural fields and human settlements, rising conflicts with local populations. Elephants are very cleavers animals, learning quickly that crops are more palatable than the natural vegetation because of their high protein content and low percentage of fibres (Sukumar, 1990). Given that, food availability both in the woodland vegetation type and in cultivated areas influences the range use of elephants within the GRG and in the neighbourhoods.

*Source*: Martins & Ntumi, 2002.

decreased dramatically becoming 50 during the 1980s (António Varinfo, ranger of the GRG). This quota accords with the one provided by Mr. Carlos Teixeira Napreino (former ranger of the GRG), who reported 60 elephants as a result of a survey carried out in 1982 by the National Directorate of Forestry and Wildlife (DNFFB). Nevertheless, the present population of elephant in the area has been estimated between 20 and 30 (Martins & Ntumi, 2002).

Although maintaining at low levels, the human density in the area increased during the last decades. The causes of this population increase include vaccination campaigns, which reduced infant mortality rates, very high fecundity rates, a positive migratory inflow, as well as, during the colonialism, an economic enforcement of the area due to the establishment of several mines and cotton estates. This resulted in progressive habitat loss for wildlife (in general) and elephants (in particular), which have been confined in small-undisturbed closed forests like the GRG (Martins & Ntumi, 2002). Besides the conflict for habitat, human increase reflected in amplified poaching for ivory (local informants and SPFFB).

**Odd-toed ungulates (Perissodactyla)**

The black rhino (*Diceros bicornis*) and the Burchell's zebra (*Equus burchelli*) were still present in the early 1970s; according to Dutton (1973), who recorded 3 rhinos and 81 zebras during his aerial survey. At the present, the black rhino is surely extinct in the GRG. On the contrary, local informants sighted 2 zebras in August 2002 nearby the Malema watercourse (central sector of the GRG), confirming the occurrence of the species within the GRG.

**Even-toed ungulates (Artiodactyla)**

The hippopotamus (*Hippopotamus amphibius*) was considered eradicated from the area since more than 30 years (Dutton et al, 1973). Nevertheless, the evidence of this large mammal was recorded through the observation of the footprints of two individuals near Lice camp in 2001. Another site where hippopotamuses are frequently seen, according to the local population, is some kilometres SW of the Mulela camp (the southern gate of the GRG). Probably these animals came from the low course of the Mulela watercourse where these animals are present and

considered as pests by the local population since these animals usual plunder cultivations along the riverbanks. During the rainy season, considering the higher water level, hippos use to go back up the Mulela watercourse to the Lice camp, occasionally reaching the locality of Kaiane northward.

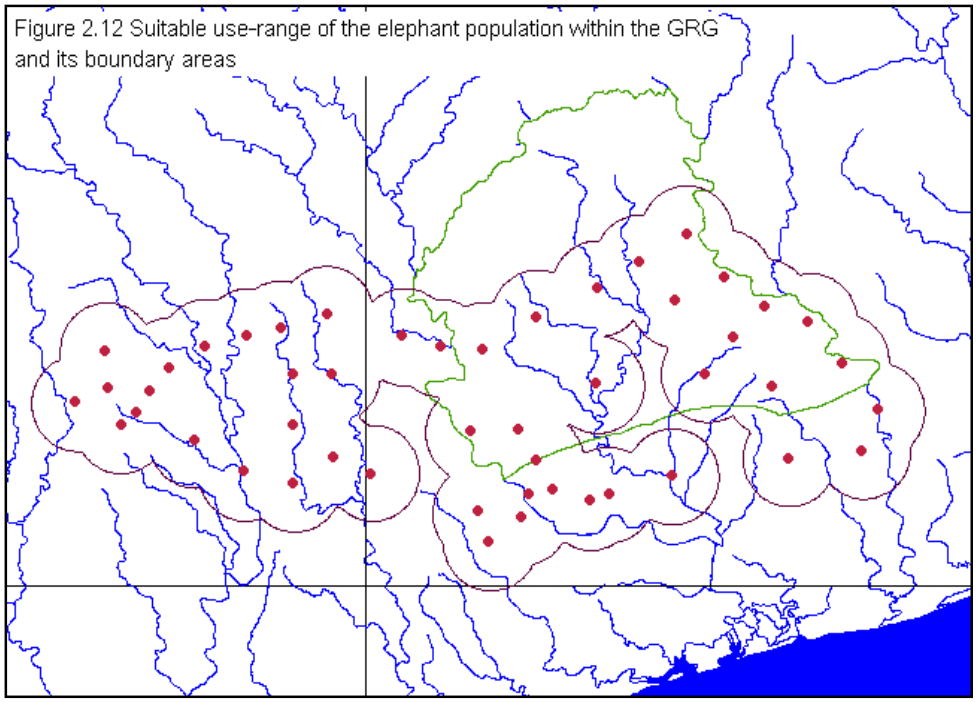


Figure 2.12 Suitable use-range of the elephant population within the GRG and its boundary areas

Two species of pigs were directly recorded within the GRG: the bush pig (*Potamochoerus larvatus*) and the common warthog (*Phacochoerus africanus*). According to information from the local population the first species is more common than the second one.

The occurrence of the African buffalo (*Syncerus caffer*), represented in Mozambique by the Southern Savannah buffalo subspecies (*S. c. caffer*), was confirmed through dung examination. Nevertheless, the population of this large ungulate in the GRG seems to be very reduced. Although, this subspecies is listed as "Lower risk (conservation dependent)", its population in Mozambique is considered decreasing (East, 1999).

Several species of antelopes occur within the GRG. All of them are a major component of bushmeat and hence a major source of protein for human population in the area. For this reason, they suffered from high hunting pressure. Nevertheless, some of them are still common within the GRG as the bush or grey duiker (*Sylvicapra grimmia*), the southern reedbuck (*Redunca arundinum*), the greater kudu (*Tragelaphus strepsiceros*), the waterbuck (*Kobus ellipsiprymnus*) and the sable antelope (*Hippotragus niger*). Less frequent are the bushbuck (*Tragelaphus scriptus*) and the eland (*Taurotragus oryx*). According to the ethnological data, the klipspringer (*Oreotragus oreotragus*) is uncommon and localized to rocky outcrops. According to the rangers' information, the Lichtenstein's hartebeest (*Alcelaphus lichtensteinii*) is rare but still present. The occurrence of the Natal duiker (*Cephalophus natalensis*) and suni (*Neotragus moschatus*) is possible in the southeaster sector of the reserve, especially in riverine forest, but it needs a confirmation. According to the residents, these two species are present and mainly occur out of the southern limit of the GRG. The blue wildebeest (*Connochaetes taurinus*) is likely extinct in the GRG. This situation seems to be confirmed by the complete lack of direct observation as well as by the information of the local population. The wildebeest was likely represented in the area by an endemic subspecies, the Mozambique gnu (*Connochaetes taurinus johnstoni*). The wildebeest was still present in the area in early 1970s, when Dutton (1973) estimated 141 specimens.

## 2.7.2. Birds

Presently, the checklist of birds within the GRG includes 114 species. Of them, 72 are non-passerines and 41passerines. However, the avifauna of the GRG is far to be totally known and, with all probability, several species will be added to the present checklist in the future, mainly passerines species.

Non-passerine birds include most of the species that represent an ecotourism potential. The success of bird-watching tours usually depends from the frequency of non-passerine records, which strike the visitors for their large size, unusual shape and/or colours. Passerine birds require specialized surveys. Most of non-passerine species are represented by aquatic birds, which occur along the various watercourses within the GRG. Between them two beautiful birds of prey occur, even if their sighting is difficult: the African fish eagle (*Haliaeetus vocifer*) and the osprey (*Pandion haliaetus*). Common aquatic species are: the reed or long-tailed cormorant (*Phalacrocorax africanus*), the grey heron (*Ardea cinerea*), the little egret (*Egretta garzetta*) the great white egret (*Egretta alba*), the hamerkop (*Scopus umbretta*), the African jacana (*Actophilornis africanus*) and several ducks and kingfishers. Some birds of prey, more adapted to terrestrial habitats, that occur within the GRG are: the yellow-billed kite (*Milvus migrans parasitus*), the palm-nut vulture (*Gypohierax angolensis*), the Southern banded snake eagle (*Circaetus fasciolatus*), the bateleur (*Terathopius ecaudatus*) and the gymnogene (*Polyboroides typus*). Other terrestrial species are: the hadeda ibis (*Bostrychia hagedash*), several species of francolins (*Francolinus* spp.), both the crested Guinea fowl (*Guttera pucherani*) and the helmeted Guinea fowl (*Numidia meleagris*), the purple-crested turaco (*Tauraco porphyreolophus*), the crowned hornbill (*Tockus alboterminatus*), the pale-billed hornbill (*Tockus pallidirostris*), the trumpeter hornbill (*Ceratogymna bucinatur*), the ground hornbill (*Bucorvus cafer*) and a array of swallows (*Hirundo* spp.) and bee-eaters (*Merops* spp.).

## 2.7.3 Reptiles

The Nile crocodile (*Crocodylus niloticus*), one of the two species of true crocodiles occurring in Africa, is common in all the major watercourses of the area. This large reptile represents a problematic animal in several communities nearby the watercourses. Attacks to humans are not infrequent. This species, as all the crocodilians, is endangered and now protected by international laws and agreements. Nevertheless, the crocodile is hunted in the target area as food source.

Three species of chelonians occur within the GRG: a terrestrial (tortoises) and two aquatic (turtles and terrapins). The terrestrial species is the Bell's hinged tortoise (*Kinixys belliana*); the aquatic species are the serrated hinged terrapin (*Pelusios sinuatus*) and the Zambezi soft-shelled terrapin (*Cycloderma frenatum*). The latter species is a rare East African endemic, occurring from southern Tanzania to the Save River, unfortunately hunted by the local populations in the area.

The African rock python or Northern African python (*Python sebae*) has become rare in the GRG, probably owing to over hunting and wildfires occurrence, being the only snake consumed as food by the Lomwé. This python is the largest snake of the Afrotropical fauna: its status is considered "Vulnerable" by Branch (1988) because of his species is threatened for meat consumption, skin, medical purposes and pet trade throughout Africa; moreover, it is often killed because considered dangerous for people and small domestic animals.

On the contrary, other snakes are common mainly in the neighbouring of settled areas. Several species are harmless, whereas others are moderately poisonous or very poisonous. Up to now, only ten species are quoted for the area. Harmless species are: the spotted bush snake (*Philothamnus semivariegatus*), the green water snake (*Philothamnus hoplogaster*) and another

unidentified species of the genus *Philothamnus*. Moderately poisonous or slightly poisonous species are represented by the olive grass snake (*Psammophis mossambicus*) and the stripe-bellied sand snake (*Psammophis subtaeniatus orientalis*). Highly poisonous species are: the vine snake (*Thelotornis capensis mossambicanus*), the boomslang (*Dispholidus typus*), the snouted cobra (*Naja annulifera*), the Mozambican cobra (*Naja mossambica*) and the puff adder (*Bitis arietans*).

Two species of monitors occur within the reserve: the Nile monitor (*Varanus niloticus*), usually found nearby the watercourses, and the rock monitor (*V. albigularis*) often found on rock hills.

Both flat lizards (*Platysaurus maculatus*) and plated lizards (*Gerrhosaurus validus*) live on rock outcrops and find their shelter into natural crevices. They are very abundant and easy to watch along the rocky riversides of the Lice and Mulela watercourses.