3 MANAGEMENT ISSUES

Trough field researches, consultation with authorities both at provincial and district level and through participatory meetings with local communities, several management and conservation issues, which constitute the basis of the need for a special management effort in the GRG, have been identified. The six main issues that have been identified are:

- Exploitation of natural resources
- Socio-economic issues
- Biodiversity Conservation issues
- Research and monitoring
- Infrastructure maintenance and development
- Tourism development

3.1 Exploitation of Natural Resources

Most of the rural communities in Sub-Saharan Africa still largely depend on wild resources for their subsistence, where both environmental and development factors, prevent hundred thousand of people from adequate agriculture productions and access to markets. Given that, subsistence hunting, subsistence fishing and gathering activities represent invaluable supports to their livelihood strategies.

Agriculture is the main subsistence activity in the target area. Almost the whole population produces several crops as cassava, maize, pigeon pea, cowpea, groundnut and sweet potato. Commercialisation of agriculture products, as cashew nuts and groundnuts, provides most of the cash necessary to purchase basic goods and pay for social services.

Off-farm income earning opportunities were available in the area until the late 1980s. These activities used to provide significant income. Unfortunately, the civil conflict destroyed most of the productive infrastructures and the ones remaining had to be closed during the last two decades. Nowadays, off-farm opportunities available are of an informal nature (see Box 3.1).

Beside the production and commercialisation of crops, the exploitation of natural resources is the main livelihood strategy in the target area (Carpaneto, 2002; Fusari, 2002; Gallego, 2002; Martins & Ntumi, 2002). Local people living in the neighbouring of the GRG are largely dependent on a vast array of natural products such as timber and non-timber products, bushmeat and fresh water fishes.

Box 3.1 Off-farm Livelihood Strategies

Although local livelihoods are heavily dependent on agriculture, locals to complement their meagre incomes pursue several off-farm strategies. The majority of households undertake animal rearing, although there is a strong concentration on small species. 80% of households rear small flocks of chicken. Chicken are either eaten on special occasions or sold in local markets. However, the possibility of increasing the average flock size is severely constrained by Newcastle Disease that decimates chicken populations every year. Although the vaccination is relatively cheap (Mts 250 per animal) there is currently no institution or private operator offering veterinary services in the target area. In order to reduce the negative effects of the disease levels, several households also rear other poultry species such as ducks, guinea fowls, and turkeys. The other most common animals reared are pigs (in non-Muslim areas) since many diseases do not affect them. Their meat is commonly traded in local markets or consumed in special ceremonies. Very few households possess goats (less than 10%).

During the colonial period and the first decade of Independence, most households sent one member (usually an adult male) to temporarily work in the plantations existing in other areas of Central Mozambique and Zambézia province. The mines that proliferated in Gilé district also provided significant employment opportunities. Temporary employment provided most of the monetary income available to families to purchase basic necessities and pay for social services. However, the war had a devastating impact on these opportunities, which were further, reduce with the closure of most of these companies after the liberalisation of the economy.

Nowadays, the most common off-farm income generating activity is production and sale of traditional alcoholic beverages. Some crops, such as sugar cane, are grown for the sole purpose of preparing traditional drinks. The other main crop used in traditional drink preparations is the cashew pear. This activity is usually a female task. Another important source of income and food is working on the plots of more affluent neighbours that require hiring labour to cultivate a larger area. This activity is especially important for more vulnerable households that exhaust their food reserves several months before the new harvest, and can access food by preparing other people's land. However, this also creates a vicious circle since vulnerable households have less time to prepare their own fields and therefore will achieve lower production levels.

The other income generating activities available in the area are informal trading (especially in areas close to the coast were fish is traded for food crops), traditional mining, weaving mats, and, as we will see in the following section, hunting and fishing. Remittances are rare and few households have members that have temporarily or permanently migrated to urban areas.

Source: Gallego, 2002.

The importance of wild resources for local livelihoods is even greater than their contribution to household diets suggests since most of them become available at times of food shortages. Most wild products become available during the rainy season when most households suffer from food shortages. The "hunger period" in Gilé lasts from January to March. During this period households become extremely dependent on the exploitation of Non-Timber Forest Products (NTFPs) as food sources. Poorer households are also more dependent upon these resources since they usually experience more acute food shortages and they can undertake fewer livelihood strategies.

Exploitation of wild resources can be better understood as an adaptive seasonally determined livelihood strategy rather than a coping strategy in the event of unexpected livelihood shocks. Therefore, exploitation of NTFPs is better viewed as an integral part of livelihood strategies in normal times rather than as a strategy of last resort in the event of unexpected food shortages.

3.1.1 Community Exploitation of Timber

Exploitation of timber products is an essential activity for the local people. Wood is mainly used for hut construction, as fuel and to produce charcoal. Cutting tree for gathering honey is a further indirect way to exploit timber products. Cutting trees to provide wood for construction and gathering honey is a male task, while providing fuel-wood and grasses for construction, as well as obtaining vegetable fibres is undertaken by both genders. In the neighbouring of watercourses, dwelling people use the barks of the following tree for the construction of dugout pirogues

(***nikule***): msasa (*Brachystegia spiciformis*) (***murotcho***), mfuti and munondo (*Julbernardia globiflora*) (***nampakala***). Barks, flowers, roots and fruits of several plants are essential in the preparation of traditional medicine. The most important species used include: the horn-pod tree (*Diplorhynchus condylocarpon*) (***tokossi***), the monkey pod tree (*Cassia petersiana*) (***reperepe***), the quinine tree (*Rauvolfia caffra*) (***nanvite***), the toad tree (*Tabernaemontana elegans*) (***rekareka***) and several species of the *Acacia* and *Brachystegia* genera. Another relevant timber purpose is the manufacture of furniture using mainly the wood from the wild teak (*Pterocarpus angolensis*) (***umbila***), pod mahogany tree (*Afzelia quanzensis*) (***mussakossa***) and panga-panga (*Millettia stuhlmannii*) (***nampiri***).

3.1.2 Exploitation of Non-Timber Forest Products (NTFPs)

Villagers list over 50 NTFPs commonly used at local level. Most products are used for household consumption although small quantities are sold within the village. NTFPs, as other forest products, are essential goods during periods of food shortage; the mainly harvested in the target area are:

Mushrooms

Mushrooms are a very important complement to household diets during the rainy season, when they become available. Seven types of mushrooms were reported as being edible: ***intxaxe***, ***namua***, ***ntxoromue***, ***naiaria***, ***ehi***, ***eyukule***, ***casuje***, ***navivi***, ***kuzhuze***. Unfortunately only ***namua*** has been already identified: *Termitomyces schimperi*. The survey showed that families consume on average 96 meals containing mushrooms per year. The importance of this resource for local livelihoods is further enhanced by the fact that they become available during the hunger gap period. They are considered as a valuable resource by local populations who appreciate their taste ruling out their categorisation of inferior goods[7].

Mushroom harvesting is mainly a female and children task. However, men may also engage in this activity when they enter the GRG for the extraction of other resources or at times of acute food shortages.

Gathering is done by rooting out rather than by cutting the upper part, which reduces the possibility of reproduction in the same site. A proportion of the daily harvest is directly consumed while the remaining is sun-dried for conservation. Villagers reported that with the traditional drying techniques mushrooms might be kept for a period of up to two months. Some varieties required prior cooking and drying before being edible (no answer was available as to whether this was a taste preference or a necessity).

The daily amounts collected seem to be directly correlated with the proximity of villages to forest areas. Daily harvests tend to be lower in areas neighbouring forest areas but women engage in this activity more repeatedly (it becomes almost a daily activity). Given the effort required to harvest the product in more distant villages, women collect larger quantities that they then store using traditional drying techniques[8].

Mushrooms are rarely sold within the village, although small quantities are traded in the district capital market.

There is a declining trend in mushroom availability in some of the villages visited, especially those lying more distant from the GRG. The decline in availability has not affected a decline in

[7] Inferior goods are those whose consumption declines as income levels rise.

[8] It is quiet common to observe women walking on the roads carrying 15-20 kg of mushrooms from neighbouring forests.

consumption levels but it has increased the time devoted to this activity since villagers need to travel longer distances to gather the resource. There may be two explanations for this decline. First, land clearing for agricultural expansion has reduced forests in the proximity of villages, thereby reducing the habitat of mushroom species. Second, uncontrolled fires affecting forest areas may be affecting the germination of spores.

Wild fruits, Plants and Grasses

A large variety of wild fruits can be found both inside and outside the GRG. They are mainly gathered when undertaken other activities (e.g. hunting and fishing) and they are only actively sought for at critical periods of food shortages. The reason of that reflects the large availability of other fruits (e.g. mango, cashew and oranges) cultivated in the target area.

One species of shrub (***tiki-tiki***) is widely eaten during periods of food shortages and can be usually found in neighbouring forests.

The fronds of the lala palm (*Hyphaene coriacea*), locally known as ***micutxa***, have a special significance in local livelihoods. The importance given to it by the local populations derives from three factors. First, it provides the raw material necessary to weave mats and household furniture. Mats and other accessories have a small market inside the village and in distant communities that do not have access to the raw material. Marketing of mats is an important livelihood strategy, though only for a few households. Second, vegetable fibres, used as ropes for different purposes, are commonly derived from this plant as well as from mfuti (*Brachystegia boehmii*) (***mutchakatcha***), mobola plum (*Parinari curatellifolia*) (***mutchubi***), and from the sisal. Third, and maybe the most important one, it is used as raw material for the elaboration of traditional coffins. All residents accord a high value to this resource emanating from its cultural significance. ***Micutxa*** can only be found along watercourses and it is more abundant within the protected area. Locally, people use wood and mud to construct the main hut structure; the roof is usually covered with different grasses and reeds. All the species utilised are available both inside and outside the GRG. However, locals extract these resources only when they are dry, during the late dry season. The thatching value of such resources is considered elevate by local residents because the impossibility to access to other materials for roof covering.

Roots and Tubers

Two species of tubers were reported as edible by respondents (***miwole*** and ***ncocoza***) and gathered by both men and women alike. These tubers are commonly found within the GRG and along watercourses. They are available throughout the year[9] but only eaten in cases of food shortages from January to March. There is strong dislike for these two tubers owning to their sour taste. Despite this fact, local people recognise their importance as dietary intakes of last resort. They can be considered as inferior goods, and their consumption is likely to decrease as incomes rise.

Honey

Local people differentiate between several types of honey according to the different bees that produce it (***kupuera***, ***nihopy***, ***ohepo***, ***opai*** and ***oravo***). The classification depends on texture and taste. The main harvest period is March and April. It is a very appreciated food item although the majority of households do not eat it in large quantities. A recent study suggests that the average household collection of honey is less than 2.5 kg per year, although consumption tends to be much larger in villages close to the GRG (Fusari, 2002).

[9] However, during the dry season they become very hard and difficult to eat.

Honey is mainly harvested by males that enter the GRG and other forested areas for hunting or fishing purposes. The technique used is relatively simple: when a hive is detected, fire is applied at the base of the tree to send the bees away; the tree is cut and the honey collected. Unfortunately, this technique is not sustainable since it destroys natural hives. A more sustainable technique would involve the construction of artificial hives using barks of indigenous trees. Honey is sold in small quantities both within the village and in district markets. The small quantities traded are a consequence of supply failures rather than to lack of demand. An increase in production levels should be easily commercialised.

Insects and other invertebrates

Several species of caterpillars of imperial moths (Lepidoptera Saturnidae) are commonly eaten in the area (***etova***, ***karara***, ***mafutxi***/***mavutchi***, ***malatala***/***malatalata***, ***mavigi***, ***mihile***, ***mpara***, ***namacusa***, and ***tikili***). Caterpillars are harvested at the end of their larvae cycle when they come down from the tree canopies (Carpaneto, 2002). The period for harvesting caterpillars varies (especially since so many species are gathered). Although they were reported to be available all year, they tend to become more abundant during the months of December to February. All family members undertake gathering of caterpillars. They represent a very important source of proteins for local people and are very appreciated. There seems to be higher consumption levels in villages closer to the GRG as respondents from these villages rank them higher than in more distant communities. If they were more abundant an increase in consumption levels would be expected. There were different reports about temporary changes in availability. While in some villages it was reported that they followed a cycle, becoming more abundant every three to four years, other groups reported an absolute decline. More information needs to be collected to evaluate if current harvesting trends are sustainable and which human effects may be exercising a downward pressure on their availability. Caterpillars are mainly used for household consumption, but they have a small market both within and outside villages.

Villagers reported one species of cricket (Orthoptera Ensifera Grylloidea) locally know as ***yipo*** and five species of grasshoppers (Orthoptera Celifera Acrididae), named ***inteteia***, ***minuny***, ***mpalaga***, ***nawonke*** and ***txoy-txoy***, as edible. They are mainly harvested outside the GRG in cultivated lands. Their abundance was reported as cyclical and they are mainly gathered during periods of food shortages. They represent a minor complement to local diets. The interesting aspect about this resource is that although it may sometimes be a plague for certain crops, it also provides protein complements.

Xylophagous larvae of some longhorn beetles (Coleoptera Cerambycidae), ***awere***, and of *Mecocorynus loripes* (Coleoptera Curculionidae), ***konkoro***, represent a further food source for locals.

Several species of termites are commonly gathered during the rainy season (***anawicorere***, ***hinhamu***, ***mathy***, ***mpepe*** and ***namanoca***). Villagers use sticks for termites to climb that are then emptied in a recipient made out of local material. Although their significance in terms of household consumption is relatively low, they are appreciated for their taste. They become more numerous during the rainy season. The decline in availability reported in most group focused discussions might be the result of the intensification of wildfires although more in depth analysis needs to be undertaken to determine the causes for this apparent decline.

The terrestrial giant snail locally named ***ekoropa*** (*Achantia* sp.), supplement dietary intakes throughout the year. These molluscs are mainly harvested outside the GRG since they are still abundant in neighbouring forests and cultivated lands. The significance of snails in local diets is quite distinct in Gilé and Pebane districts. 82% of households interviewed in Gilé reported eating snails while none could be found in Pebane. The reason for this marked contrast is that most of the villagers in Pebane district are Muslim whose cultural habits prohibit them from consuming

snails. They are gathered by both genders and is reported that they are eaten at least ten times per month during the rainy season in Gilé. However, there seems to be intensification in the harvest of snails during the period of food shortages. Very rarely a household member undertakes snail gathering as a sole activity; they are usually collected at the same time than fuelwood and mushrooms. Since it is a resource widely available and easy to collect, there were no reports of its commercialisation.

Reptiles and Amphibians

All the chelonians are captured and eaten by the Lomwé, including the rare and endemic Zambezian soft-shelled terrapin, which should be protected by the reserve authorities. The hinged tortoise represents a frequent booty of the poachers when they cross the forest to set their traps. During the dry season, tortoises became easy to find because of the fires, which burnt the grass sward. On the other hand, terrapins became easy to capture because of the reduced water level in rivers and streams. Also snakes (mainly the rock python) and monitors became more visible for the same reasons.

In spite of the abundance of amphibians in the area, merely one species is consumed: the African bullfrog (*Pyxicephalus edulis*), locally known as ***nume***, which represents an appreciate food resource for the Lomwé. This large frog (up to 11 cm of length) does not occur in rivers and streams but will appears in great number during the rainy season (November-December) in temporary pools. For most of the year bullfrogs remain buried more than a meter underground encased in a transparent cocoon that completely covers the entire body, closing all the apertures except the nostrils. Like a plastic bag, it reduces moisture loss during the dry season. They breed in pools that are only a few centimetres deep, where there are not fishes able to predate their eggs and tadpoles. The predation by man on adult frogs in rural habitats is not destructive and such harvest is sustainable: in fact man took the place of natural predators as storks, herons, mongooses and snakes. Furthermore, the bullfrog takes advantage from roads because usually breeds in the shallow rain-filled depressions at their sides.

3.1.3 Subsistence and Professional Hunting

Since its establishment in 1932 and until the independence in 1975, Portuguese exploited the Gilé Game Reserve as hunting ground. Both during this period and during the civil conflict, the hunting pressure resolve in serious impacts on the local fauna. Afterward the end of civil conflict, the lack of resources to manage and patrol the area by the governmental institution (Provincial Bureau of Forestry and Wildlife) allows both professional hunters from Nampula and Quelimane and local people to hunt without any regulation and control in the target area. Nowadays, with the coming into force of the new “law of Forestry and Wildlife” the GRG is under total protection. Nevertheless, hunting is still a common practice, even if conducted by local people for subsistence purposes, while professional hunting become very rare.

Subsistence hunting (***ossaia***) is important both as traditional activity and as source of food and revenue. A hunter still holds recognition from other members of the community and still represents manliness values. Bushmeat represents both an essential protein intake in the local diet, also taking into consideration the scarcity of domestic livestock, and a valuable source of income.

Four hunting techniques are used in the area: a) trapping, b) netting c) hound hunting and d) hunting with fire.

Fire weapons for hunting purposes were represented in the area mainly by the well know, war-weapon AK-47 sub-machinegun, inheritance of the long war period in the country. Even if this sub-

machinegun is power-full and simple to use and maintain, its utilization seems to be decreasing in the study area because of three reasons: 1) elevate cost and availability of cartridges; 2) scarcity of large mammals in the area, reducing the profitability of using this weapon; 3) agriculture became once again a profitable activity, as insecurity in the household farm declined and traders once again re-appeared to purchase agricultural surpluses.

The policy inducted technological changes affecting hunting as well as the possibility of diversifying livelihoods on-farm led to a shift in livelihood choices away from hunting activities and increasing household dependence on agricultural resources. These effects can be better explained by declining returns to hunting activities and increasing returns to agricultural based activities (Gallego, 2002).

Trap hunting is a male task. The Lomwé people use three different kinds of traps: 1) neck traps, 2) leg traps and 3) fall traps. In the neck traps a circular wire is placed between two wood-sticks in vertical position so that the animal's neck enters and activates the release mechanism. Local populations also use three different kinds of leg traps. The first type is similar to the neck trap. In this case, the wire is placed in the ground with the release mechanism armed in a small hole in the middle of the ring, which is released by the animal leg pressure. Both this leg and neck traps (***mranko*** = wire) are placed to catch small antelopes, hares and other small to medium size mammals. The second type of leg trap used by locals is very ingenious. A trunk hanging on a wire is placed at the opening of an artificial barrier made with foliage and branches. The release mechanism is armed on the ground and is activated by the animal passage through the opening, allowing the trunk fall on the quarry. Such traps (***nicolope***) are placed to catch small to medium size animals, both mammals and birds (Figure 3.1). The vegetable fibres to manufacture the wires for all the traps described are obtained mainly from the bark of the Mfuti tree and the Mobola-plum tree. The third type of leg trap (***rapito*** or ***langa***) used in the target area is a gin trap (iron-made trap) with a jaw-edge, locally hand-made with materials from abandoned cars and machineries (Figure 3.2). These traps are commonly used and, depending on their size, allow capturing from medium mammals such as bush pigs and warthogs, to very large mammals such as kudus, sable antelopes, waterbucks and buffalos. Fall traps (***inthcepe***) are not commonly used in the study area. These traps are simply constituted by a large hole in the ground whose bottom is armed with several iron-tip spears (***nevaka***). The hole is covered and camouflaged with branches and leafs. Fall traps allow local hunters to kill medium and large animals. Traps are set along animal paths, following traditional knowledge. Normally, baits are not used.

Figure 3.1 The ***nicolope*** trap

Figure 3.2 Gin trap

Net hunting is widespread in the area and is undertaken as a joint activity by all members of the household. Nets (***intchavi***) are hand-made with the same natural fibres used for wires. Nets can reach 15m of length and 1.5m of height and are usually hung out straight-lined through several wood-sticks. During net hunting several households take part in the beating: women and children act as beaters, driving the animals towards the nets, while adult men slaughter the caught quarries by spears. Usually, net hunting is conducted by groups of around 30 persons. This hunting technique allows capturing small to medium animals, both mammals and birds.

Hound hunting is mainly used to capture diurnal primates, such as baboons and vervet monkeys. A group of about 5-10 usually spend several days within the GRG during the beatings that are carried out throughout all the year. The prey is surrounded and injured by dogs and finally killed with spears or machetes by the hunters. The meat from monkeys is locally very appreciated.

Hunting with fire is another technique largely adopted by the local hunters. Fire is used in two different way: 1) to directly kill small animals that live on the ground, as several species of rodents and elephant shrews, or to detect their lairs; 2) to clear the bush, facilitating trap and net hunting.
All hunting activities are carried out mainly between August and November (middle and late dry season) because of the following three reasons: 1) easier forest accessibility; 2) easier animal localization, as animals are more visible and mammals concentrate alongside of watercourses; 3) very dry vegetation that allows using fire techniques. The booty of local hunters comprises mainly rodents and other small and medium mammals and, in some cases birds and reptiles. Wildlife represents both an essential food source and a valuable economic intake, especially for locals that hunt regularly (see Box 3.2).

Box 3.2 - Case Study: Subsistence hunting and bushmeat trade

Eight villages located around the GRG were considered for the present study. Of a total sample of 510 households, 416 (81.6%) declared to harvest game in the study area. The five main animals harvested were mammals: two species of small antelopes, common duiker (*Sylvicapra grimmia*) and suni (*Neotragus moschatus*) by 299 hunters (58.6% of total sample/74% of hunters); the savanna cane-rat (*Thryonomys swinderianus*) (etchetchi) by 272 hunters (53.3%/67.3%); hares (Leporidae spp.) by 268 hunters (52.5%/66.3%); the giant pouched rat (*Cricetomys gambianus*) by 190 hunters (37.3%/47%); and the banded mongoose (*Mungos mungo*) by 120 hunters (23.52%/29.7%). Furthermore, local people harvest several species of small rodents and elephant shrews; these micro-mammals represent an important resource for the local people because of their abundance and the facility of capture through the fire hunting technique.

All these animals are directly consumed by the household or are sold as bushmeat at village level. The common duiker (***nahe***) has another important role in the Lomwé culture. In fact, this species is largely used in traditional rituals and to obtain traditional medicine. Wildlife also represents a significant source of revenue in the study area. A total of 265 households sold bushmeat (52% of total sample/63.7% of the hunters). Game represented both a food supply and an economic income for most of hunters (63.7%). The highest percentages of households selling bushmeat were recorded in Mucurepa (100%) and Gilé (92.7%), whereas the lowest percentage was recorded in Etaga (43.7%). No formal bushmeat markets exist in the target area because hunting activities are carried out illegally. Nevertheless, a hidden bushmeat trade is common at village level, where hunters simply inform other villagers about the availability of bushmeat; sales are carried out in their own residences. Bushmeat from large mammals is usually smoked in the forest during the hunting beating and sold in the village cut in pieces of different size and weight.

Small mammals such as rodents, hares, the banded mongoose and other small animals such as birds and reptiles as usually sold as a unit piece. The five main animals sold during the study were: the cane rat by 164 households (44.5%b of total sample/ 59.4% of hunters) for an average price of 1 USD per each specimen; hares by 133 households (19.8%/63.5%) for an average price of 0.8 USD; common duiker and suni by 104 households (8.4%/67.2%) for an average price of 0.8 USD per kg; the giant pouched-rat by 98 households (6.7%/69.4%) for an average price of 0.4 USD per each specimen; the common reedbuck by 38 households (5.9%/24.2%) for an average price of 0.8 USD per kg.

Source: Fusari, 2002.

Currently, is not easy to asses the real impact of subsistence hunting on the local fauna, because of very few data are available on the prey abundance and distribution. In particular, further information on the mammal abundance would be added in the future both for conservation and exploitation purposes. Therefore, going on with hunting without any kind of regulation and control can have severe consequences for animal populations, for livelihoods and for conservation, also considering the increasing of local population. In fact, the greater the number of dwelling people in the area the greater the game harvest the faster the rarefaction of the local fauna.

3.1.4 Subsistence Fishing

Fishing is undertaken by almost 90% of the local households (Fusari, 2002). Subsistence fishing (***otopela***) is undertaken throughout the year by both male and female with intensification during the periods of August-October and January-April. Fishing is undertaken in the main watercourses although local populations consider that catches within the GRG are substantially larger than those achieved outside the protected area because of intense exploitation of closer watercourses.

As it could be expected, there seems to be a higher degree of specialisation on fishing activities in the villages closer to watercourses. In those villages fish was reported as a very important food item, being eaten at least twice a week. Fish is usually consumed at the household level, although small quantities are traded among villagers. Although most of the fish sold in district markets originates from the coast (dried fish) small quantities of fresh water fishes can also be found.

All villagers report a substantial decline in the fish availability over the last decade. It is necessary to analyse the effect that mining enterprises situated upstream of the main watercourses, may be having on the aquatic ecosystem and the reported diminution of catches.

The following four fishing techniques are used: 1) angling; 2) fishing with traps; 3) water poisoning with substances derived from indigenous plants; 4) basket fishing.

Angling is a male task and allows catching small and large size fishes. Anglers practise their activities from the riverside or using a traditional pirogue (***nikule***). Usually, anglers utilize industrial materials for their activity, as nylon-fishing lines and steel-hooks, both available in the district market of Gilé.

Fishing with traps is also a male task and allows the capture of medium to large size fishes. Two traps are manufactured with local materials, mainly wicker, and placed both during the dry and rainy seasons. The first trap (***mutolola***) is placed during the dry season (from June to July) when water levels are low and currents are weak. The mouth of this trap is oriented upstream. One or more traps are placed in the middle of a transverse barrier made with sticks and mud for compelling fish to enter the traps. The second trap (***elema***) is placed during the rainy season (from December to February) and is used for catching fishes that go upstream for breeding. The trap is fixed to the watercourse bottom with the mouth oriented downstream, which is funnel-shaped and pliable-closed by the wicker poles, allowing the fish entrance but not its escape.

Poisoning water is a further fishing technique. Poisonous substances are obtained from local plants as the Scotsman's rattle tree (*Amblygonocarpus andongensis*), the snake bean tree (*Swartzia madagascariensis*), the ordeal tree (*Erythrophleum africanum*) and the green thorn tree (*Balanites maughamii*). The venom obtained either kills fishes (as in the case of the snake bean tree) or is able to stun fishes, allowing their capture (most of the other plants). Local spread the venoms within natural water pools at the margin of the watercourses or they build some small dams using wood-sticks and mud. This fishing technique is conducted during the dry season when

the water flow is low and allows capturing small to medium size fishes. Both men and women often co-operate during this fishing activity.

Another fishing technique (***vhuva***) consists in exploiting shallow ponds and small loops of a stream to capture small fishes and other aquatic animals, such as crabs and shrimps. In this case, a group of women simply remove water by large baskets (***epatche***) until capturing the quarries. Women and children conduct this fishing without the support of any poisonous substances.

Largely the species of fishes captured by locals belong to the following families: Mormyridae (elephant fishes), Gobiidae (gobies), Anguillidae (eels), Clariidae (African catfishes), Mochokidae (squeakers), Cyprinidae (barbies and labeos), Characidae (characins) and Cichlidae (tilapias).

3.1.5 Traditional Medicine and Cultural Value of Bioresources

Local populations are still extremely related and dependent on traditional medicine for health treatments. This reflects both cultural practices and the shortage of modern health services available within their rural areas. Gathering of plants, herbs and tubers for medical treatments is undertaken only by traditional doctors since the medicine is believed to work as part of a ritual. The only input that patients are expected to provide is parts of some wild animals (e.g. common duiker and tortoises) that are used in rituals to prevent mischief and attract good luck. Expenditures incurred on traditional medical treatments were reported as being the largest of all household expenditures by some groups. Prices of traditional treatments vary, as prices tend to increase the farther the distance from health centres. Traditional medicine can be more expensive than its modern substitute.

3.1.6 Geographical and Seasonal Exploitation of Wild Resources

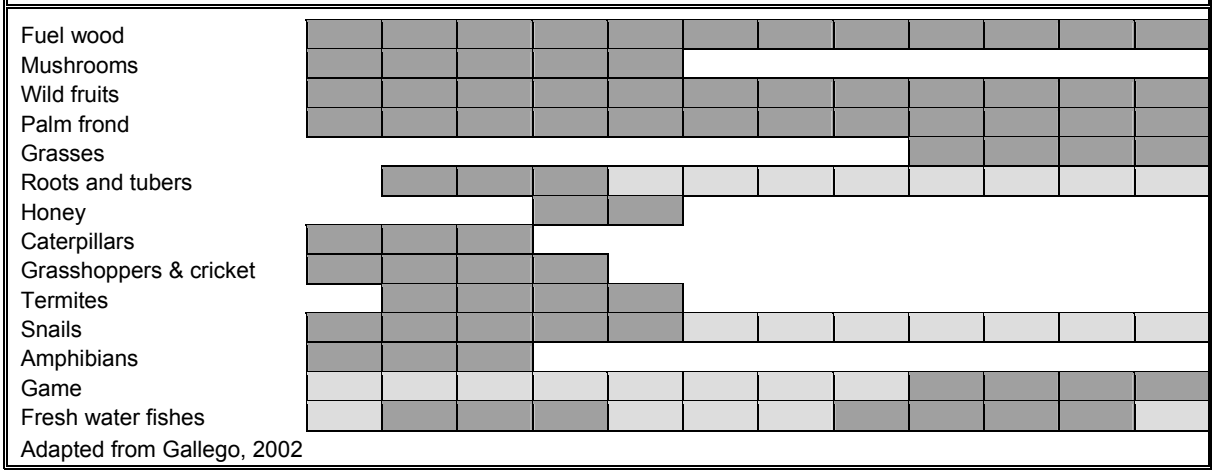
Both geographical and seasonal exploitation varies according to each given resource. Most resources are available in all forested areas. The only resources for which households almost totally depend on the GRG are game and honey. The decline in animal populations in other forested areas is the direct consequence of intense exploitation during the past decade, and destruction of habitats by opening up forests for agricultural purposes. Honey extraction within the GRG because of hunters are the main gathers (see Section 3.1.3) Fishing is another activity that is mainly undertaken within the GRG probably because fisheries are less exploited than in the proximity of villages. Palm fronds are also obtained mainly in the GRG. The extraction of remain resources is conducted both inside and outside the protected area. It is to be expected the closer the distance to the GRG the higher is the dependence of resources available within. Those communities settled within less than one kilometre from the protected area obtain all the products from the GRG. The inverse relationship between distance and exploitation of GRG is explained by the lower effort required to engage in these activities and the higher dividends that can be expected. Furthermore, several communities that settled just outside the protected area used to live within its borders and were relocated during the colonial period when the forests first received protected status.

The exploitation of wild resources is influenced by seasonality due to the following four factors: 1) availability of the resource; 2) availability of other resources for household consumption; 3) availability of family labour to undertake the activity; 4) effort required to engage in each activity.

The only resources that are not affected by seasonal factors are fuelwood and palm fronds since they are perennial resources. Wild fruits are also available throughout the year because different species flower at distinct periods. There is an intensification of hunting activities during the dry

season as wildfires improve visibility and facilitate movements by clearing up grasses and shrubs (Fig. 3.3).

Figure 3.3 Seasonal calendar of the exploitation of wild resources in the target area.
(Dark grey: when the resources are mainly harvested; light grey: other periods when resources are available, but the exploitation level is substantially lower or even inexistent)



3.2 Socio-economic issues

3.2.1 Socio-economic Condition

Mozambique is currently ranked in the 158th position out of a total of 164 countries (UNDP, 2000) signalling not only widespread material poverty but also extremely poor access to basic social services. This situation is the result of both a poor performance by the colonial administration and two decades of civil war.

Zambézia Province is one of the poorest in the country as exemplified by very low levels of basic social indicators (Tab. 3.1).

Table 3.1 Human Development Statistics in Zambézia Province.

Indicators	Value
Birth rate (per thousand)	52.6
Fecundity rate (average Nº of children/woman)	7
Mortality rate (per thousand)	27.5
Life expectancy at birth (years)	37
Infant mortality rate (per thousand)	183.2
Primary enrolment rate (%)	55.8

Source: UNDP, 2000.

Although detailed human development indicators are not available for the districts of Gilé and Pebane, the very limited existence of health centres (one in each district capital) and health posts (12 in Gilé and 9 in Pebane, although mostly not-operational) indicates poor performance of health indicators. There is only one secondary school in Pebane (none in Gilé) and there are very high pupil/teacher ratios in primary schools (72 and 61 respectively)[10].

[10] The statistics for the two districts are slightly outdated since they date from 1997 (UNHCR/UNDP)

The road network in both districts is composed by a series of tertiary roads, some of them in very bad state of repair, which constrain access of vehicles. There is a tertiary road crossing the GRG from North to South linking both districts and it is commonly used by some vehicles and pedestrians engaged in trading activities (mainly trade of dry fish).

Electricity is lacking in all but the two district capitals, Gilé and Pebane, where only the governmental infrastructures and most influent domestic houses are connected (however electric supply is usually not available 24 hours).

Agriculture is considered as the main economic activity in Gilé and the interior areas of Pebane. All households that possess at least one able-bodied adult engage in agricultural production. The traditional authority allocates land to any household that needs access to it. Land can be cultivated but under traditional systems it cannot be sold. Immigrants are also welcomed into the community as long as they accept local customs. Women also have access to this resource. Agricultural production is characterized by manual technologies that constraint the amount of land cultivable by each household to an average of one and a half hectares. The main crops cultivated are: cassava, maize, pigeon peas, cowpeas, groundnuts and sweet potatoes. Cassava represents the staple food for local populations that utilize both root and leaves. The main cash crop in the target area is cashew (formerly cotton play an important rule as source of revenue). However, this culture suffered of several constraints during the last decades (lack of orchards renovation and arising of the Powdery Mildew).

The use of agricultural inputs is virtually non-existent. Seeds are usually stored from year to year and for most crops they have already severely degenerated. Improved seeds are not available since no local trader sells them in the target area. The only fertiliser used is the ash that remains after burning a plot as part of the land preparation process. Pesticides and herbicides are also non-existent in the local production systems. Agricultural yields are relatively low given the low level of inputs used.

The system can be characterised as shifting cultivation but with certain limitations. Plots are usually cultivated for a period of up to five years and then abandoned. The reason for abandoning the plots is a decrease in yields that is further attenuated by improper inter-cropping patterns and the lack of tradition of crop rotation over several seasons.

The decline in the terms of trade for most tropical agricultural commodities is a trend that has affected most African countries, reducing export receipts and increasing the pressure to produce more quantities to obtain the same level of foreign exchange earnings. At the local level, declining cashew prices have severely affected rural incomes since it was traditionally the main source of revenue.

Both animal drawn and large animal husbandry are prevented by the occurrence of tsetse flies (*Glossina* spp.) and the related bovine trypanosomiasis. Animal husbandry is limited to small species as goats, poultry and, in non-Muslim area, pigs. Slaughtering of animals for household consumption unless when done for special ceremonies and events. Small amounts of these animals are also traded at local markets.

This socio-economic situation presents a key threat to the vision of sustainable exploitation of bioresources. Despite of declining forest resources, the narrow income-generating base compels local people to increase pressure on wild resources and adopt ever more destructive extracting techniques. If correct forest resource use is to become a reality, local communities need technical assistance to broaden their income base and develop new sustainable livelihood strategies.

3.2.2 Economic Value of Wild Resources

Wild resources have direct use value. Their total value for local populations is estimated at Mts 2,658,425 (US$113)[11] for the average household per year (Gallego, 2002). This datum underlines once more the irreplaceable importance of bioresources for local people. The most important resource in economic terms is fuelwood, followed by game and fresh water fisheries. Fuelwood and construction materials constitute almost 50% of gross income derived from natural resource exploitation, the remaining being NTFPs used for own consumption and/or as a source of revenue (Fig 3.4).

Figure 3.4 Percentage of Economic Value by Source

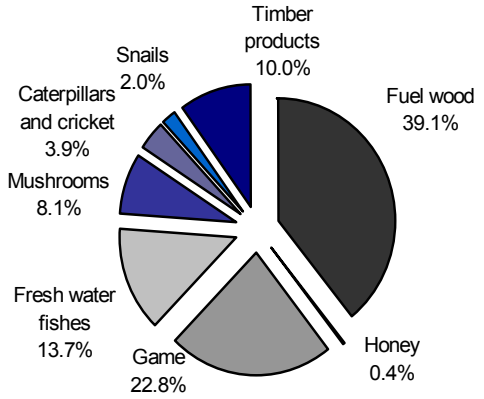
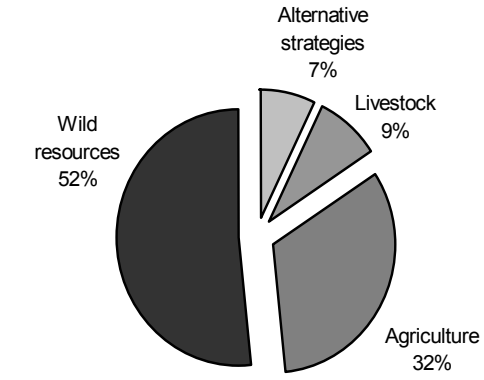


Figure 3.5 Percentage of Gross Income by Source



The economic value of each resource is determined both by the quantities used and the price of the resource. The price of the resource is affected by demand and supply functions. Therefore the price for game is substantially higher than for the other resources because supply is limited and there is strong local demand derived from strong taste preferences and cultural values. This price effect leads to substantial differences between the economic significance of a resource and its contribution to local diets. Furthermore, differences in average consumption per meal reflect disparities in edible parts and nutritional content of different products. For instead, the edible wild resources contribute as follow in the local diets[12]: mushrooms 96; fresh water fishes 91; bushmeat 81; caterpillars and crickets 42; snails 28 and roots 8. Hence, the aforementioned resources assure some 346 meals per household per year, which means one third of the whole requirement[13].

The overall direct value of the exploitation of wild resources is assessed at US$ 52 per household. There are an estimated 32,000 people leaving in the surroundings of the GRG, which is equivalent to around 7,100 households[14]. Therefore the total economic value of the wild resources used by the local populations within the GRG is US$ 457,000 per year. This value is expected to further increase as non-protected forests are opened up for subsistence agriculture and commercial timber logging. The value of wild resources is equivalent to US$ 2 per hectare. However, it is important to note that this only refers to the present exploitation of resources and not to the potential value that a sustainable exploitation of wild resources could entail.

[11] Average exchange rate 1US$= 23,500 Mts.
[12] The numbers represent the average number of meals per household per year assured by each resource.
[13] Considering an average of three meals per day per household.
[14] Each household has an average of 4.5 members (Gallego & Rasul, 2001).

Although, there may be little room for an increase in hunting activities, there seems to be a lot of scope of intensifying the exploitation of certain resources such as mushrooms without endangering their sustainable use. It must be borne in mind when comparing to other uses (e.g. logging). Several studies have found values between US$ 20 and US$ 400 per hectare through the sustainable exploitation of NTFPs in other tropical forests (Bojo, 1993; Peters et al., 1989).

A comparison between the gross income deriving from natural resources, agricultural production and other alternative livelihood strategies (e.g. livestock and off-farm strategies) adopted in the target area shows that wild resources contribute more than half (52%) to the whole gross income per households, while agriculture provides the second income (32%) as in Figure 3.5.

3.3 Biodiversity Conservation issues

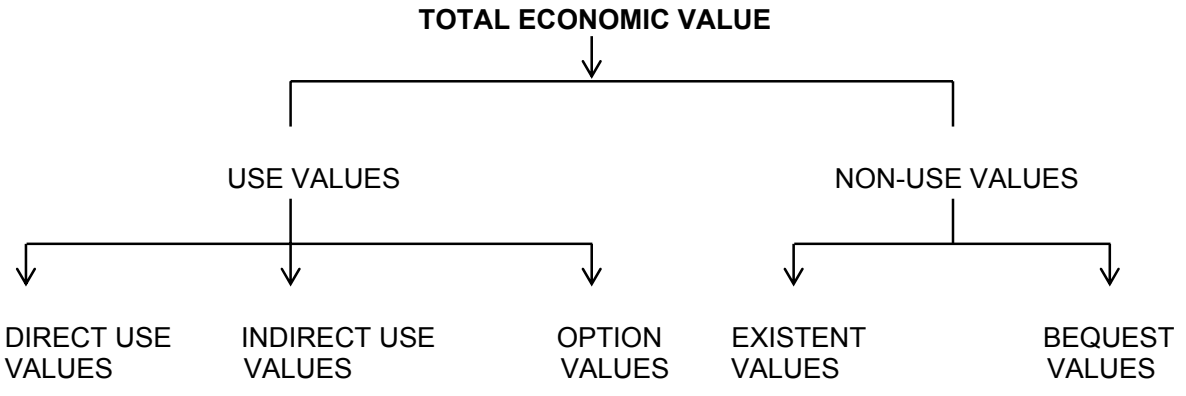
Biodiversity conservation is the primary intend of both National Parks and Natural Reserves worldwide. This is the essential aim of the GRG, which nowadays owns the status of National Reserve and has been classified in " Management Category II" of the IUCN. The Law of Forestry and Wildlife (*Lei* 10/99) provides the legal base for the protection of biodiversity and resources exploitation in Mozambique and defined, within the Art. 12/Comma 1, the National Reserve as follow:

"*National Reserves are areas of total protection meant for the protection of certain species of rare, endemic endangered and evidently diminishing flora and fauna and fragile ecosystems, such as wetlands, dunes, mangroves and corals, as well as the conservation of the flora and fauna found in those ecosystem.*"

3.3.1 The Value of Biodiversity

The 2,100 square km of the GRG host a remarkable biodiversity both in terms of fauna and flora. This biodiversity needs to be preserved for both its use and non-use values, which constituted the Total Economic Value of a protected area (see Figure 3.6).

Figure 3.6 Components of the Total Economic Value (TEV) of a Protected Area



Adapted from Emerton, 1999.

Indigenous resources used for household consumption by local populations, such as timber and non-timber products, bushmeat and fresh water fishes, represent the direct use values of the

GRG. The issues related with the extraction of indigenous resources have been already discussed in previous sections.

Indirect use values are represented by ecological functions performed by the environment of the GRG, such as carbon storage and sequestration, watershed protection, erosion protection, and micro-climatic regulation.

Forests worldwide store carbon in their vegetable biomass, playing a crucial role in both the CO_2 cycle and in maintaining macro-climatic conditions. For such reasons, deforestation implies high indirect cost at medium and long terms (see Box 3.3).

Box 3.3: Carbon storage vs. Deforestation

Forests store carbon in trees, plants and grasses. A conversion of forest to other land uses would lead to a release of carbon dioxide, which would accelerate the greenhouse effect and global warming. The value of this function is directly related to the net carbon that would be released if land were converted to other uses and the economic value assigned to the carbon released to the atmosphere.

The carbon released to the atmosphere is contingent on the original value stored by forests and the carbon stored on the land conversion alternative. Average benchmark values were calculated by Brown (1992), Brown & Pearce (1994) and Pearce & Moran (1994) for different conversion scenarios. They calculated that a conversion of closed primary forest to permanent agriculture would release around 220 Ton of carbon per hectare. The release of carbon from a conversion of closed secondary forest to permanent agriculture would be 152 Ton per hectare.

Contrary to most ecological functions, carbon storage benefits are enjoyed at the global level and therefore do not depend on where the forest location. As a result, the value of carbon storage benefits can be extrapolated from specialised studies that have calculated the relationship between this function and economic activities (including effects on human health). Recent studies suggest an average value of US$ 20-34 per Ton of carbon released (Fankhauser, 1994; Clarkson, 2000). An alternative would be to use values from carbon markets that have emerged in developed countries following the establishment of global and national legislation on reduction of carbon emissions.

The woodland vegetation that covers most of the GRG can be considered closed secondary forest since closed primary forest tends to refer to the even denser tropical rainforest. The economic cost of a land conversion to shifting agriculture would be between US$ 1,050 and US$ 3,570 per hectare. The cost would increase to US$ 1,510-5,134 if land were to be converted to permanent agriculture. Therefore, the total economic value of carbon storage by the GRG would be between US$ 220 million and US$ 750 million if the immediate threat were conversion of land to shifting agriculture.

These large values refer to the global costs that would be suffered due to the effects that a release of carbon dioxide would have on global warming. It also suggest that if efficient transfer mechanisms or markets for carbon could be created, it would be more beneficial to protect the GRG just for its carbon storage capacity than a conversion to either agriculture or timber logging. Unfortunately, since the benefits are enjoyed at a global level, transfers are constrained by the existence of free rider problems.

Source: Brown (1992); Brown & Pearce, 1994; Pearce & Moran, 1994.

Forests play an important role in watershed regulation through functions as flow regulation, flood protection, water supply, water quality including nutrients outflow. Forests play an important role in watershed regulation.

Removal of vegetation cover would directly deteriorate the level of protection provided affecting a series of economic activities undertaken at local and regional level. For instance, a decline in the levels of nutrients in GRG watersheds would have serious effects on both the riverine and costal fisheries, decreasing availability of fishes at local level and the level of catches in the coastal areas in Pebane district (especially catches of traditional fishermen that tend to carry out their activities in the proximity of river mouths). Deforestation would also have effects on agricultural production in areas situated further downstream as they would be more prone to flooding.

Forests play an important role in avoiding erosion from climatic elements. Soils within the GRG and in the neighbouring are sandy, thin and relatively poor. Exposure of these soils to intense rains would lead to substantial erosion with a consequent loss of soil leading to desertification. The consequences that deforestation and bush clearing are having on soil erosion can be easily seen in the areas that have been cleared for agriculture in both Gilé and Pebane districts, were farmers are constrained to use special techniques to avoid the drastic effects of rains on soil erosion.

Forests maintain very important edaphic factors such as soil humidity and evaporation rates thereby balancing local micro-climatic conditions. Although Gilé and Pebane districts do not suffer from intense drought, agricultural production is rain-fed and yields are largely dependent on rainfall patterns. Given the large area covered by the GRG, forest removal would have a direct influence on rainfall patterns and agricultural yields are likely to decline, as precipitations become more erratic. The effects on local livelihoods would be quite dramatic as almost 100% of fields rely on known rainfall patterns and there are no irrigation infrastructures.

Option values are represented by future uses of the GRG resources, such as recreation and tourism activities and utilization of biodiversity for research purposes, including pharmaceutical and agricultural researches.

Non-use values are represented by existence value and bequest values. Such values are represented by the willingness of people to pay for biodiversity conservation worldwide. Even more people in developed countries attach some value to the protection of nature because of its own value and in order to preserve natural areas for future generations. Their “willingness to pay” for the conservation of a certain area depends on several factors, such as proximity to their area of residence and uniqueness of the area. The highest “willingness to pay” tends to be associated with small natural reserves in developed countries or well-know unique wildlife areas such as various African National Parks, varying from US$ 1 to over US$ 200 per hectare of protected area (Pearce & Pearce, 2001).

3.3.2 Threats to Biodiversity Conservation

The major threats to Biodiversity conservation in the GRG depend on the following human activities: 1) exploitation of indigenous resources by local populations, 2) wildfires, 3) commercial exploitation of timber, 4) mining, 5) agriculture activities.

Within this section the point 2, 3, 4 and 5 are discussed, while the management issue regarding the use of indigenous resources by dwelling people has been already treated in previous Sections within this chapter.

Wildfires

Fire is one of the most important ecological factors affecting miombo (Chidumayo, 1997). The use of fire in the miombo region dates back to the Early Stone Age, about 60,000 years ago (Phillipson, 1971; Clark, 1975. *Cited by* Chidumayo, 1997). Climate and flammable biomass determine the event of wildfires. The highest temperatures and lowest humidity occur during the hot, late-dry season from August to November and the biomass fuel increases mainly during the same period. Such factors determine the compulsory conditions for the occurrence of annual wildfires within the GRG.

While lightning is an important source of ignition and does occur as evidenced by trees that have been struck, fires caused by lightning can be assumed to be rare. In contrast anthropogenic

sources of ignition cause the majority of fires in the GRG (Trollope & Trollope, 2002). Local populations use fires during the late dry season for several purposes: a) cleaning fields from grasses and felt trees for cultivation purposes; b) cleaning from grasses around huts; c) cleaning roads and paths; d) cleaning bush for hunting purposes; e) gathering of honey. Moreover, abandoned bonfires used by people moving throughout the GRG ignite accidental fires.

Fire used for field cleaning difficulty reaches the GRG because of the absence of human settlements within the protected area and the presence of several bordering watercourses that works as natural firebreaks. Only few evidences of burned areas by external fires are recorded around the Namurrua locality (north sector of the GRG) where the local population live nearby the GRG limit. Instead, fires used for the other purposes are ignited directly within the protected area.

Fires are ignited as point ignitions that result in a mosaic of surface fires burning as head and back-fires in relation to the direction of the prevailing wind and the topography. The GRG is generally flat but with some areas dissected by shallow ravines resulting in gentle slopes all of which would promote the development of a mosaic of surface fires. No signs of crown fires are observable and this type of fire would be a rare occurrence, if it did occur because of the gentle topography. The intensity of fires can be assumed to be highly variable in response to variable grass fuel loads and season of burn. Generally the four different plant communities had noticeably different grass fuel loads that would result in significantly different fire intensities (Trollope & Trollope, 2002).

Despite the general accepted (and likely correct) idea that frequent fires are useful for vegetation regeneration in miombo woodlands, late dry season wildfires seem to have severe impact on the GRG vegetation, mainly when fires occur firstly during late September and October (Figure 3.7). At that time of the year, the above ground flammable biomass, which is composed mainly by wood litter, leaf litter and standing dry grass, is elevate and with low moisture content. Under such condition, wildfires could be intense and modify the vegetation structure of the GRG. The effect of fire seems to be dissimilar within the different woody vegetation types: higher within the woodland and decreasing in the open forest and finally in the closed forest. Likely, the higher canopy cover prevents the standing of the grass layers, which is the main flammable biomass during the late dry season. On the other hand, fire seems to induce opening in the canopy cover. This results in direct implication of trees survival, as decreased tree density seems to be associated with an increase in the fire-induced mortality of trees (see Figure 3.8).

Furthermore, even if no data are available, it is realistic to correlate the occurrence of wildfires to a severe impact on the local micro-fauna, mainly considering insects, reptiles and micro-mammals.

Figure 3.7 Effect of wildfires on the vegetation of the GRG

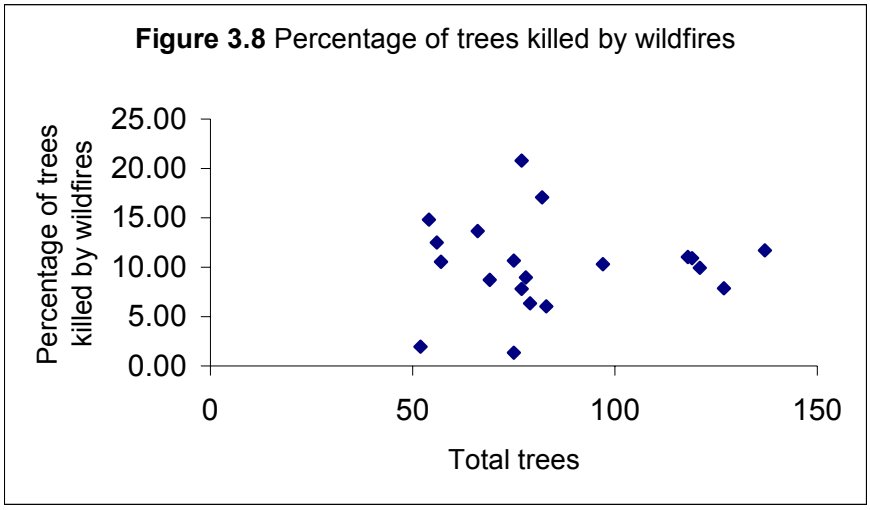


Figure 3.8 Percentage of trees killed by wildfires

Commercial Exploitation of Timber

Logging concessions are wide spread in the whole Zambézia Province and represent one of the most important sources of revenue for the provincial finances. Sacket (1994) suggests that some 88,014 m^3 of timber could be logged annually for commercial purposes in this Province.

The regime of complete protection preserves the GRG from timber concessions within its limits. However, several logging licences have been released during the last years in Pebane and Gilé districts. Most of the exploitation areas are located in the proximity of the GRG and several of them are partially within the proposed buffer zone, reducing the effectiveness of his instrument to minimize conflicts between human activities and conservation. This situation threats the biodiversity conservation within the GRG because of three major reasons: 1) heavy deforestation could result directly in lost of biodiversity (both fauna and flora); 2) lost of forested areas results in decreasing of habitats availability for most animals and in the consequent limitation of their distribution range in the target area; 3) clearing forests, mainly nearby human settlements, prevent local populations from a vast array of essential products and likely increases their dependence on the bioresources within the protected area.

Benefits for local population represent a further problem. The Article 31/Comma 3 of the Law of Forestry and Wildlife declares: "*The management shall ensure the participation of the local communities in the exploitation of forest and fauna resources and in the benefits resulting from such use*", while the same Law at the Article 35/Comma 5 foresees: "*A specific diploma established the percentages of the value resulting from the fauna and forest exploitation fees, for the benefits of the resident local communities in the respective exploration areas*". Nevertheless, the supposed benefits to local people deriving from logging concessions are far to be evident. First, the areas allocated are not chosen with the involvement of local communities. Second, the promised benefits, that usually take the form of grain millers or rehabilitation of social infrastructure, seldom are provided to local populations. Finally, most likely the only benefit deriving from logging concessions in the target area consists in some occasional, normally bad-paid, employments.

Mining

Historically, Gilé and Ile districts hosted mines for the extraction of precious and semi-precious stones. Nowadays, several mines have been established within both districts mainly for tantalite

and aquamarine prospecting. Most of these mines use watercourses that flow across the GRG (Mulela, Lice and Molocué) to clean impurities. Dutton reported in 1973 a significant level of soil silt pollution in the Mulela and Lice watercourses from the Morrua mine (Dutton *et al*., 1973). Unfortunately, there are no evidences of recent investigations on the status of the watercourses in the target area. Although, the current regulation establishes that mineral cleaning requires the use of appropriate filters, it is important to regulate the health of watersheds to avoid increases in water pollution and the consequent biodiversity degradation.

Agriculture Activities

There is no evidence that land is currently being cleared within the GRG for agricultural purposes. The threat of deforestation due to the extensification of agriculture is relatively low because there are no permanent populations leaving inside the protected area. However, clearing of land for agricultural purposes in unprotected areas may increase the pressure on NTFPs exploitation in the GRG since the loss of habitat will also lead to declines in availability of most wild resources. On this subject, Sacket reports that, during the period 1972-1990, the area devoted to agriculture increased 32% in Zambézia Province with a rate of bush cleaning of 6.55% (the second higher value in the whole country after Maputo Province) and that negative performance was mainly achieved by Gilé and Pebane districts (Saket, 1994).

Given the occurrence of bovine trypanosomiasis and lack of traditional knowledge for large animal husbandry, forest clearing for cattle ranching is absent in the area.

3.3.3 Threats to Mammal Conservation

Direct and indirect human pressures threaten wildlife in the GRG. Direct pressure consists mainly of unsustainable hunting activities by local populations, including the use of wildfires, whereas indirect pressure consists of increasing land demand for agricultural production and logging concessions within the neighbouring of the protected area. The mammalian fauna primarily undergoes the aforementioned pressures because of two reasons: 1) both large and small mammals provide the essential booty of local hunters; 2) generally speaking, mammals are more demanding for land than other terrestrial animals for a large array of activities, such as feeding, matting, breeding and resting.

Elephant (*Loxodonta africana*) is a charismatic animal within all African conservation areas where this species occurs. In the last decades, elephants were abundant and wide distributed in the target area, from Murrupula and Mecuburi (Nampula Province) to Gilé and Maganja da Costa (Zambézia Province). Their former movement range accorded with the vegetation patterns, suggesting that these areas were formerly forested and with low human density (Wild & Barbosa, 1967). Presently, the number of elephant within the GRG is estimated at 20-30 (see Section 2.7.1).

Professional hunting for tusks and slaughtering by armoured troops during the guerrilla period were the major factors depleted the elephant population in the target area. Two major factors endanger the elephant conservation in the GRG. The first one is represented by the conflict with local populations for land use (see Box 3.4). Allowing populations increase within the elephant use range could be a serious hazard for their conservation.

Box 3.4 Case Study: Human-Elephant Conflict in the GRG

Hoare & du Toit (1999) provide interesting data to predict arising conflicts between human beings and elephants in African rural areas; they consider that a population density of 15.6 inhabit./km^2 is the crucial threshold over which elephants occurrence is locally threaten. Because of the lack of data, it is difficult to assess the population density around the GRG; however, both Pebane and Gilé districts have densities above 15, which is likely the same in the neighbouring of the protected area.

In the past decades, the whole southern-west sector outside the GRG was forested and without human settlements. Nowadays, several villages are settled in this area: Macuruco, Calane, Mutagane B, Macujuco, Sacane and Necuco, and local people annually report elephant raids within their cultivated fields. Fortunately, human-elephant conflict is seasonal and limited to some areas. Normally, elephants come into cultivated area from November to March, attracted by mature crops, spending 2/3 weeks raiding the same area until most of crops are consumed. Martins and Ntumi (2002) confirmed crop damages in two communities within Mucubela administrative post. A herd of 13 elephants spent 3 consecutive nights cropping a variety of agricultural products, such as bananas, cassava, maize, rice, groundnuts, sugar cane, sweet potatoes, papaya, mangos and cashew nuts. Local people report that such raids have a serious influence in their food security because of the severe crops damages. Crop availability and palatability is full attractive for elephants and demanding for this resource arise the main conflict between wildlife and local populations in the target area. However, it is important to underline that, despite the common idea that elephants are the intruders; the local populations are invading the use-range of elephants. This aspect is fundamental and need to be considered for the conservation and management of such species in the GRG.

Curiously, local communities express their availability to move far from the reserve boundaries to leave space for elephant's movement. Despite this unexpected availability, the relocation of local communities within other areas seems very difficult further than too expensive. Moreover, the small number of elephants still occurring in the area, as well as the damages they cause, doesn't justify this kind of operation. On the other hand, local residents suggest as solution to install electric fences along the reserve limits. Unfortunately, also this solution appears not practicable because of both ecological and economic reasons. At present, the more viable solution seems the creation of a well-equipped team of rangers that can quickly reach the area invaded, frightening and driving away elephants with the support of fire weapons. The slaughter of elephants by local people or policemen, as unfortunately reported in recent past, need to be strictly avoided, except in case of serious risk for humans.

Source: Martins & Ntumi, 2002.

Antelopes seem to have suffered during the last decades from heavy hunting pressure both from local and professional hunters, as well as from well-armoured troops quartered in the area during the guerrilla period. At present, antelopes, together with large and small rodents, represent the main quarries for local hunters (see Box 3.2), while professional hunting seems disappeared within the GRG. Local people are able to catch both small and large antelopes using different hunting techniques. Nets and traditional traps are commonly used by a large part of the local population to capture small species; whereas gin traps are mainly used by more devoted hunters for capturing large species (see Section 3.1.3).

Eleven antelopes species are quoted for the GRG (Carpaneto, 2002). Five of them are small species, less than 25 kg, and represent the main booty of most local hunters, they are: Bushbuck (*Tragelaphus scriptus*), Bush duiker (*Sylvicapra grimmia*), Natal red duiker (*Cephalophus natalensis*), Suni (*Neotragus moschatus*) and Klipspringer (*Oreotragus oreotragus*). The other six species are: Greater kudu (*Tragelaphus strepsiceros*), Eland (*Taurotragus oryx*), Southern reedbuck (*Redunca arundinum*), Waterbuck (*Kobus ellipsiprymnus*), Lichtenstein's Hartebeest (*Alcelaphus lichtensteinii*) and Sable antelope (*Hippotragus niger*). They are all large animals, including the Eland, the larger antelope in Africa, which can exceed 600 kg. All these species were heavily depleted during the past by the use of fire weapons and are nowadays clamped by local hunters through gin traps. In table 3.2 we report the conservation status and the population trend for Mozambique of the eleven antelope species aforementioned, accordingly with the data provided by East (1999). From the table emerges: a) no species are listed as "Endangered", b) nine species are listed by the IUCN between "Lower risk" and "Conservation Dependent", while two species are listed between "Lower risk" and 2least concern", c) the population of four species is declining in Mozambique, whereas for the others is stable or declining. Small species are

essential resources for local populations and their conservation status, as well as their population trend in Mozambique appear satisfactory. Instead, the conservation status and populations trend of large species appear more critical, confirming the priority to protect them in the GRG as in the whole country. A special effort needs to be placed by the managers of the GRG to preserve these species, mainly avoiding the utilization of unsustainable hunting techniques (e.g. gin traps), even considering their relevance for both cynegetic and sighting tourism.

Table 3.2 Conservation Status (Red List Status) and Population Trend in Mozambique for eleven antelope species recorded within the GRG. (LR = Lower risk; LC = Least Concern; CD = conservation dependent).

Scientific name	Common name	Red List Status	Population Trend in Mozambique
Tragelaphus scriptus	Bushbuck	LR – LC	Stable/Declining
Tragelaphus strepsiceros	Greater Kudu	LR – CD	Declining
Taurotragus oryx	Eland	LR – CD	Declining
Sylvicapra grimmia	Bush Duiker	LR – LC	Stable/Declining
Cephalophus natalensis	Natal Red Duiker	LR – CD	Stable/Declining
Neotragus moschatus	Suni	LR – CD	Stable/Declining
Oreotragus oreotragus	Klipspringer	LR – CD	Stable/Declining
Redunca arundinum	Southern Reedbuck	LR – CD	Stable/Declining
Kobus ellipsiprymnus	Waterbuck	LR – CD	Declining
Alcelaphus lichtensteinii	Lichtenstein's Hartebeest	LR – CD	Declining
Hippotragus niger	Sable Antelope	LR – CD	Stable/Declining

Source: East, 1999.

Among the aforementioned antelopes, the bush duiker, locally called ***nahe***, plays an important rule in the traditional culture of Lomwé people (see Section 3.1.5). It must be borne in mind this aspect since management actions for antelope conservation are undertaken in the target area.

Other two species of hoofed ungulates need urgent attention for protection. Both the African buffalo (*Syncerus caffer*) and the Burchell's zebra (*Equus burchelli*) still occur within some restricted areas of the GRG. However, their populations are very reduced and likely near the eradication from target area. Both these mammals represent important target for sighting tourism; furthermore, the African buffalo could be a primary goal for cynegetic tourism. Given that, the conservation and restoration of these species need to set as priority in the management of the GRG.

Small carnivores, such as genets and mongooses, are commonly caught and eaten by local hunters. However, these carnivores are still abundant within the GRG and not threatened at present.

Both lion (*Panthera leo*) and leopard (*Panthera pardus*) still occur in the area. Unfortunately, their conservation status in the GRG is critical. Local populations report those species were abundant in the past, representing a serious threat for the communities living nearby the protected area. Nowadays, their populations are extremely reduced, likely not exceeding 10 for lion and 20-30 for leopards (more accurate surveys need to be conducted to assess their real number). Although, locals do not hunt these large carnivores, the present situation likely resulted from the increase of human settlements around the GRG: directly through culling of individuals that exit from the protected area, and indirectly depleting their preys (herbivores) for subsistence purposes. This matter was likely more relevant for lions than leopards, specially considering they are more demanding for food and unable to evolve prides without the presence of herds of large animals to support them.

Both lion and leopard represent appropriate symbols for conservation of the unique African fauna. These wild cats need to be well monitored and preserved within the GRG, even considering the opportunity of restocking programmes. Their presence is an irreplaceable value both for conservation and for future tourism development in the GRG.

The occurrence of the African wild dog (*Lycaon pictus*) within the GRG has been recently confirmed by the sighting of a pack of 14. Really, 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 should be monitored and special efforts devoted to its protection. Fortunately, such species is neither hunted nor eaten by local populations who have a traditional respect for it. Also culling persecution seems to be avoided because the lack of large domestic animals, which represent the main cause of conflicts between wild dogs and humans in several rural areas of Africa. For these reasons, the GRG could be an optimal site for restocking such endangered species, but not before an accurate feasibility study. The latter should assess both the availability of preys and the presence/absence of dog diseases. The first step for the conservation of the wild dog in the GRG goes through an assessment of the exact number of individuals and their strict monitoring. A strong effort needs to be placed to avoid the use of gin traps, which could result fatal for this dog, and to avoid hound hunting, preventing the spreading of diseases.

A severe control against the utilization of unselective hunting techniques (i.e. gin raps and fall traps) is essential to promote, in addition to herbivores recovering, the natural restoration of large carnivores within the GRG.

3.4 Research and Monitoring Issues

The Game Reserve of Gilé received very little scientific attention since it was established; there are no evidences of scientific studies during the whole period from the GRG establishment and the early 1970s and only three surveys were conducted in the period between 1973 and 1999. Dutton conducted the first general recognisance of the GRG in 1973 (Dutton *et al*., 1973); a team of the Ministry of Environment conducted a second faunistic survey in 1997 (Chande, *et al*., 1997), while a team of the Ministry of Environment carried out a vegetation recognisance in 1999 (MICOA, 1999).

More scientific data have been added since the PRPGRG onset in 2000, through an array of field studies focused on several topics, such as a better knowledge of the fauna and flora composition, wildlife status and management, wildfires impact and management. Special highlights have been dedicated to the identification of bioresources exploited and their relevance within the livelihood strategies of the local population. However, the GRG is still far to be well studied and the management activities to date have been inevitability planned without a complete understanding of ecosystem functions and, consequently, of threats to bioresources.

For a conservation and management perspectives, several data need to added, in particular regarding:

- Complete information on human demography and livelihoods
- Constant monitoring of the levels of natural resources exploitation, including the commercial exploitation of timber
- Exhaustive study on the invertebrate micro-fauna
- Exhaustive study on the elephant population and its dynamic during the next five years;

- Exhaustive study on the number and conservation status of meso- and mega- herbivores; also in prevision of future re-stoking programmes;
- Exhaustive study on large carnivores, with particular emphasis on the African wild dog;
- Constant monitoring of wildfires and their impact on the vegetation cover.

Most of the aforementioned research activities are, and will always be, beyond the capacity of the GRG management staff. Collaboration with relevant national and foreign research institutions is essential, in terms of conducting researches, training local personnel and developing databases facilities.

3.5 Infrastructures Maintenance and Development

During the colonialism, the Portuguese Administration provided several wardens camps within the GRG to allow the patrolling of the protected area, including a main camp used as base by the Reserve Administrator. At that time, 18 wardens and one administrator, responsible for patrolling and management, were permanently employed and some 30 auxiliary workers were assigned to roads and other infrastructures maintenance. Unfortunately, during the guerrilla phase, all the camps were severely damaged or even completely destroyed in the strikes of RENAMO against the FRELIMO troops quartered in the area. The period following the signature of the peace agreements (1992) was characterised by a dramatic socio-economic condition in the whole country, which avoid the Government to allocate resources for protected areas and for nature conservation in general. Such a situation determined the complete abandonment of all the infrastructures within the GRG and the impossibility to take up any management action.

Throughout the implementation of the PRPGRG, the infrastructures still existent have been recuperated. Four wardens camps and the main camp have been rehabilitated, as well as a new small camp has been build in the remote core zone of the GRG. The 97 km main road of the GRG, which suffered of twenty years of lack of maintenance, has been made accessible and two small bridges rehabilitated. One path of six km has been opened to reach the Lice camp and a road of approximately 60 km has been opened in the core of the GRG to connect the main road with the main camp of Musseia.

The infrastructures available are adequate to accommodate and provide logistic support to the staff of the GRG, which will be composed by 12 wardens and one administrator. The location of the six camps (including the main camp) allows both the control and management of the whole road network and the different sectors within the GRG. Given the recent rehabilitation, the camps will need just basic maintenance during the next five years (i.e. one complete painting), which could be provided by the wardens.

The present road network covers some 180 km and is useful for both patrolling and management. These unpaved roads need to be cleaned and partially rehabilitated yearly at the end of each rainy season to assure its accessibility and several occasional workers need to be contracted for the execution of this maintenance. Instead, the three small bridges already rehabilitated will need only vegetation cleaning before the rainy season to consent to the increasing water level to flow without damaging the bridges structures. The main road that crosses the GRG from Namurrua (northern gate) to Mulela (southern gate) is one of the connections between Gilé and Pebane districts. Despite the traffic of vehicles is low, the accessibility of this road need to be strictly managed in the future, allowing the entrance to private vehicles only under specific permission.

Because of the extensive drainage basin, which in the interior consists mainly of a number of seasonal watercourses, it is difficult to assure the complete roads accessibility during the rainy season without the construction of a series of small and medium bridges. Increasing and improving the road cover could be a disadvantage without an appropriate and well-operating patrolling system. That could result only in providing facilities for improper exploitation of resources within the protected area. This point needs to be considered before provide new roads within the GRG.

3.6 Tourism development

For developing countries, a rapidly growing tourism industry has proved to be an increasingly source of foreign exchange inflows. Nature tourism, a particularly dynamic sub-sector, is an important tool for generating employment and income biodiversity-rich, underdeveloped countries, because it requires comparatively small investments (Wunder, 2000).

Tourism in Mozambique is still in its infancy after three decades of conflict. However, the trends are positive and new investments have been made in the past years especially in coastal areas. Although the bulk of the investments occurred in Southern Mozambique, due to its proximity to South Africa, recently there have been important investments in tourist infrastructures in the northern provinces. Consequently, the number of tourists visiting Northern Mozambique has substantially increased in recent years and is expected to accelerate since there are areas with strong tourist appeal. Mozambique can compete at the regional level providing a unique combination of beach/history/nature, that no other country in Southern Africa is in the position to offer.

The GRG supports a host of large mammals, including the endangered wild dog. Black rhinoceros and blue wildebeest all seems to have become locally extinct within a period of 30 to 40 years. However, the uniqueness of the Reserve does not stem from the large mammal fauna that it supports or use to support, but rather from the intactness of the landscape and the ecoregion. The apparent pristine state of most of its vegetation is impressive and it also supports a range of bird, reptile and amphibians typical of the region. Most of these are rare or absent from surrounding areas dominated by man. The Reserve is not inhabited by man and is probably the only large area of miombo woodland in southern Africa that as yet has not suffered important changes due to human exploitation. Though annually disturbed by wild fires most of the woodlands within the Reserve appears intact, while the presence of exotic trees and a range of disturbances induced by man dominate areas surrounding the Reserve.

The Reserve's remoteness seems to protect it from unwanted attention by exploitive agencies while at the same time providing little opportunity for the development of a profitable and regular tourist enterprises.

The GRG does not have a traditional history of tourism and presently does not possess any accommodation for catering tourists. The only catering facilities are in the district capitals of Gilé and Pebane and can offer only minimum comfort facilities. The area was first devised as a hunting reserve and was mainly used by colons leaving in Northern Mozambique. There are also some reports that few hunters arrived from Portugal.

It has also been argued that the GRG lacks the characteristics necessary to promote viewing tourism because the visibility is restricted to less than 50 metres by dense vegetation cover and because animal density is too low. Although, it is true that the vegetation features do not provide the same possibilities offered to sightseeing tourism by the savanna environment, the argument about animal populations is less evident. Given these limitations, it would be wrong to expect the

mass tourism that is observed in few of National Parks in East and Southern Africa. Nevertheless, a correct management and control of the exploitation activities would improve the conservation status of the fauna during the next years, allowing more easy sightings of large animals.

There are mainly three types of tourism that could be developed in the GRG and that would require heavy involvement of local communities. These types are not mutually exclusive.

Ecotourism and Cultural Tourism

Over the past few years there has been a growth in low budget tourist choosing Mozambique as destination. The number is likely to increase considerably as Mozambique has been incorporated in the main Nairobi-Cape Town axis following recent political troubles affecting Zimbabwe. Mozambique is also rapidly loosing its previous reputation of “landmine zone”. Local communities can benefit greatly from budget tourists because they can offer basic food accommodation at affordable prices and they directly benefit from it. Localities edged of the GRG as Namurrua (northern gate), Mulela (southern gate) and Mussea (main camp) should be firstly considered for this kind of tourism. The level of investment necessary to start community-managed is relatively low. The materials chosen could be either traditional huts or standing tents.

The level of services offered could include:

- Hiking safaris both inside the GRG and in neighbouring forests. Tours could combine animal and landscape sightseeing
- Canoeing safaris through the Mulela, Molocué and Malema watercourses. Tours, using traditional canoes, could combine bird watching and landscape sightseeing
- Educating activities on community conservation
- Representation of local cultures and customs. Representations could include the demonstration of traditional hunting and fishing techniques, manufacturing of traditional traps, traditional music instruments and other handicrafts, representation of traditional dances and rituals

The main problem would be how to reach the GRG. Although, access roads are improving in the area, public transport remains scarce. It would be necessary to involve the transport means of the GRG that could collect groups in Nampula once a week or provide transport from Gilé or Pebane.

Adventure tourism

Adventure tourism has also strong possibilities in the area. The inselbergs that surround the NRG are very suitable for conducting sports such as rock climbing and ala delta. Although these services need to be provided by specialised tour operators, tourists could use the same facilities as described in the previous paragraphs.

Cynegetic tourism and Game farming

Cynegetic tourism could have an interesting development in the GRG in the future. However, the actual population size of large mammal doesn’t provide high quality conditions to attract professional hunters. We suggest that such an opportunity will be better evaluate in five years time, afterward a exhaustive study that will be assess the status and number of large mammals and the effects of the efforts devoted for their conservation.

The present socio-economic and conservation climate in the Gilé and Pebane Districts, as well as in the Reserve are not favourable for a game-restocking programme. Future developments that may ensure the control of wild fires and of consumptive use of wildlife in the area may provide an opportunity for large-scale investments into the restocking of the region with game (van Aarde, 2002).

A preferred option would be one of an extended period of protection to enable the natural recovery of species population followed by the development of a conservation management programme that will allow for the selected consumptive use of some species, preferably through properly arranged hunting operations which may result in incomes beyond the value of a portion of protein to the diet of a selected few in the region. Trophy hunting, even at the low rates proposed above for consumptive hunting may contribute significantly to the income of the region. Coupled with the suggested programme of alleviating natural predation pressures to enhance the recovery of natural populations, such protective actions should see to the recovery of locally extant wildlife population. Restocking with species that are locally extinct should be preceded by research directed at identifying the forces responsible for their decline to extinction. These forces should then be manipulated to enhance the recovery of such populations following restocking.

Game farming may provide: a) a source of protein for local consumption, b) individuals for relocation and the re-establishment of free-ranging populations of indigenous mammals, and c) enhance the *ex situ* conservation status of rare species typical of the region. Captive breeding operations can be expensive, time consuming and laborious but do provide opportunities for local conservation capacity building, the establishment of local industries, the generation of an income and the alleviation of hunting and poaching pressures on free-ranging populations. Given socio-economic climate of the region, the relative poor status of the soils of the region and its relative isolation and therefore its distance from potential markets for game species, game farming do not seem to be an viable alternative land use practise. Added to this the costs of game proof fencing to control stock the establishment of a game farming enterprise seems not a profitable option under the conditions of isolation prevailing around the GRG (van Aarde, 2002).

One sector of the *Buffer Zone* has been identified having potentiality for future investment as a game ranching area. Such area is low settled and harbours the same habitat that occurs within the GRG. The vegetation cover, as in the protected area, is unable to support large herds of herbivores and consequently consistence number of large carnivores. However, the occurrence of certain species of cynegetic value such as leopard, kudu and sable could encourage investments to valuate the feasibility of re-stoking programmes under controlled conditions and to start game ranching activities. Several private investors have already expressed interest for such opportunity that could be considered for the future development of the GRG.

3.6.1 Tourism links

The GRG could be linked with several valuable tourism sites, both inside and outside Zambézia Province. Four main sites have been identified considering their proximity to the GRG and their tourism value: 1) Moebase, 2) Pebane, 3) Gurue and 4) Ilha de Moçãmbique.

Moebase is a very pleasant beach, with white sand dunes, located immediately south of the GRG; about 70 km (~ 2 hours) far from the Mulela camp and around 50 km (~ 1 and half hours) from the Musseia camp (Fig. 3.9). Only some huts of fishermen occur among the dunes surrounded by evergreen psammophilic vegetation. The inertial zone has not rocks but only white and soft sand, making this place a valuable and still unexploited bathing site. Large marsh lowland with scattered lala palms and temporary pools extends between the coastal dunes and an evergreen costal forest. A mine of titanium exploited by a South African society occurs at the forest border. This

interesting area has a high tourism potential because offers both an opportunity for bathing relax and wildlife observation, mainly birds but even mammals and crocodiles in the permanent water pools. Moreover, the occurrence of a remnant of evergreen coastal forest gives the area a high conservation priority: such a small-forested patch should be received total protection and included within the management and control programme of the GRG.

Pebane, the capital of the homonymous district, is 90 km (~ 2 hours) far from Mulela camp (the southern gate of the GRG) and 140 km (~ 2 and half hours) and from the Musseia main camp, through an unpaved road in good conditions. The wonderful white sand-beach between Ponta Maverane and Ponta Matirre is only 2 km far from the centre of town (Fig. 3.10). Beside seaside activities, the beach offers the possibility to assist to traditional fishing activities, such as the collective net fishing from the shore. Crossing the Moniga River by traditional boats to reach the Bajone beach is a further attractive possibility. Unfortunately, according to local residents, sea turtles do not occur anymore in he area: probably the human density and pressure determined a local extinction of the sea turtle lineage that was breeding there. The currently available reception is only adequate to backpackers and adventure tourists and can accommodate around 30-40 guests.

Gurue, the capital of the homonymous district, is around 290 km (~ 5 and half hours) from Gilé, through an unpaved road in acceptable conditions. The Gurue district host the larger tea plantations in the country, which are been recuperating after the long period of abandonment due to the civil conflict. The full-green tea plants and the numerous spectacular flowering Jacaranda trees give a wonderful landscape view of the Gurue Mountains (Fig. 3.11). The impressive Monte Namúli, with 2,491 m a. s. l., is the higher peak in Mozambique. Although a large proportion of the original vegetation as been replaced by plantations of eucalyptus, used as fuel wood for tea desiccation, the fascination of such mountain remains unaltered. 2-3 days hiking gives the opportunity of a great landscape view and an extremely interesting bird watching, including the possibility to sight the rare and endemic Namuli apalis: *Thyolo* (*Apalis*) *alethe*. The accommodation capacity of Gurue is still very limited (at present only one small hotel is available), but is presumable to increasing because both its tourism potential and the vehicles traffic through the Malawian border.

Ilha de Moçambique is located in Nampula Province and is 200 km (~ 2 and half hours) from the provincial capital and around 410 km (~ 6 hours from Gilé). Because of the impressive degree of cohesiveness between architecture and culture of many peoples through the centuries, the island was designated a UNESCO World Heritage Site. Ilha de Moçambique “Ilha” is one of the country’s most fascinating sites, where nature, history and archaeology mixed together composing a profile of uniqueness. Almost all the historic buildings were constructed between the early 16th and late 19th centuries when the Portuguese occupied the island. Nevertheless, a strong influence of Arabic, Indian and African styles is reflected on this architecture and documented by archaeological vestiges. Ilha is rapidly becoming one of the principal tourism destinations in the whole countries, visited by an increasing number of tourists mainly from South Africa and Europe, offering at the present an array of accommodation places, from a well-organized and managed hotel to several chipper resorts. The presence of several small islands, such as Ilha de Goa and Ilha de Sena, where both snorkelling and scuba diving are available, and a number of beautiful and unexplored sand beaches in the neighbouring, complete the unique scenario of Ilha de Moçambique. Linking Ilha to Gilé and *vice versa* may be a synergic strategy of conservation of both these sites through an integrated natural and historical tour initiative.

Figure 3.9 The Moebase Beach

Figure 3.10 The Pebane Beach

Figure 3.11 The landscape of Gurue