# Assessment of the Forest Reserve Network in Mozambique

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# Executive summary

The Forest Reserve Network of Mozambique was established during the late fifties. Apart from a few of the reserves that were established for protection of water catchments, most of them were established as timber production areas. Forest reserves are one of the categories of conservation areas, together with National Parks and Game Reserves, covering an area of about 73,000 Km2 (approximately 11.5% of the country's surface).

The Forest Reserve Network was abandoned during the armed conflict, turning some of the forest reserves as refuge for local communities or hideaways for the guerrilla fighters. As a consequence, the population pressure within the forest reserves increased in most of the cases. However, it is important to note that there are some of the reserves that did not experience any human settlement, therefore, maintaining their conservation status.

This study was commissioned by WWF Mozambique Coordination Office with the objective to evaluate the coverage of the forest reserve network in Mozambique along the major woodland or forest types in Mozambique and to evaluate if the forest reserves are of size and distribution that would facilitate ecological function, conservation of habitats and plant genetic resources, as well as utilization functions where applicable. Specific objectives included (a) identification of gaps in the representation of forest types in the national forest network and recommend, if applicable the proclamation of additional ones, (b) development of a system of forest reserves that meet economic, ecological, social and cultural needs of the present and future generation of Mozambicans, (c) assessment of the status of management or protection of the major reserves and propose actions to improve protection or sustainable production of goods and services, (d) identification of opportunities and justify policy or legislative reforms to manage and protect the reserves network, and (e) explain the links and contribution of Mozambique's forest reserve network to biodiversity conservation, tourism, energy, hunting, soil and water values.

Two weeks were used for field assessment of the conservation status of 11 of the 13 forest reserves comprising the Mozambican forest reserve network. Transects were used to assess the forest condition. Plant species were identified to species mainly within the forest while others were identified at the Herbarium of the Eduardo Mondlane University (LMU). Additional information was collected from reports of previous studies. These gave additional information on the community involvement and conservation status as well.

The general findings of this evaluation show that the forest reserves differ in their condition depending on the presence of human settlements, the agricultural potential, accessibility, and previous logging history. Therefore, there are forest reserves, such as the Baixo Pinda, Zomba, and Mucheve Forest Reserves, that have been severely destroyed as result of expansion of human settlements and agriculture. However, there are also forest reserves that either did not have a significant human settlement (e.x. the Inhamitanga Forest Reserve) or the agricultural expansion affected only a small part of the reserve (e.g. Mecuburi and Moribane).

Apart from the forest reserves that have been severely modified by agriculture, species diversity is high within the forest reserves. Previous studies show evidence of high plant species richness and diversity. This was found to be evident in most of the forest reserves that were visited, particularly in Maronga, Moribane, Mecuburi, and Matibane Forest Reserves. These forest reserves also protect rare species, such as *Icuria dunensis* found only in Matibane, that deserve protection measures.

Community participation in Forest Reserves is a process that initiated in the late nineties, with the objective to engage local communities in the management of the forest resources. This was mainly with the objective to improve the conservation status of the Forest Reserves through co-management between the Forest Service and the local communities. The Mecuburi, Matibane, Moribane and Licuati Forest Reserves were pioneers of these experiments. Although there was deficient continuity in some of the reserves, the results show that in general, local communities are willing to collaborate in protection of forest reserves. Challenge has been to maintain the interest of community high while not seeing tangible benefits from forest reserve management. Therefore, identification of income generation activities compatible with forest protection has been indicated as a major priority activity within the forest reserves where community participation has initiated (e.g. Moribane, Mecuburi, Matibane).

Evaluation of the representativity of the Forest Reserve network shows that most of the forest reserves are located in the Coastal Forest Ecoregion and the Miombo Ecoregion. Mangrove and Mopane are not represented. However, considering that forest reserves are only one of the categories of protected areas, other categories were also scrutinized. National parks, game reserves, and hunting areas were considered as complementary to the Forest Reserves in protecting plant species. Definition of new forest reserves should be evaluated in the context of the protected forest in general, however, detailed work is required to evaluate the threatened species and ecosystems, and biodiversity inventory should be done to support the need for additional forest reserves and their location.

General recommendations for the rehabilitation of the Forest Reserve Network include measures like the following:

- Considering the pressure of local communities on the forest reserves, it should also be recommended that an action be taken to halt the continuation of the degradation of the Forest Reserves that still protect areas clearly valuable for biological purposes (e.g. Moribane, Mecuburi). This can be attained by coordinated efforts with local authorities to identify alternative sources of income without converting forests and mechanisms to promote sustainable use of forest resources.

- Forest Reserve management schemes must be evaluated in view to benefit local communities. Co-management schemes can be privileged where pre-conditions exist. However, co-management must not be obligatory where the individual institutions show ability to protect.

- The IUCN categories of protected areas should be taken into account for the definition of the Forest Reserve objectives and management schemes. Therefore, Forest Reserves should also provide opportunities for scientific research,

education, monitoring of ecological processes, ecotourism, among other purposes, accordingly.

- The actual suggestion of categorization of the Forest Reserves (see Section 8) classifies the current forest reserves within IUCN categories IV, V, and VI. These categories include some forms of usage of the forest resources, to accommodate the needs for local communities, at the same time that the initial objective is partly preserved. Categories I, II, and III are missing in the current forest reserve network, meaning the need to identify areas with high biodiversity that can be additionally established for the main purpose of protection of biological diversity.

- The role of institutions devoted to conservation is to be recognized in view to synergize across institutions. Therefore, the participation of all stakeholders should be encouraged and strengthened. For instance, Forest Reserves with potential for ecotourism should be managed in schemes that include the Ministry of Tourism, and Forest Reserves with potential for resource utilization should be managed in accordance with forest management principles. In addition, the participation of conservation NGO's such as IUCN and WWF should be motivated and establish linkages with the international conservation networks. Collaboration with Universities and research institutes should also be encouraged in view to incorporate research themes in biodiversity conservation and encourage teaching, training of professionals with vision for conservation, and promote monitoring of long term ecological processes.

- Payment for Environmental Services (PES) should be evaluated as an option to improve the management of Forest Reserves and increase income.

- The conservation strategy should be in line with the National Biodiversity Strategy and Action Plan (NBSAP) in view to contribute to the implementation of the Biodiversity Convention. Therefore, the Ministry of the Environment should be a key institution in defining strategy for conservation and implementation of activities.

- The boundaries of the Forest Reserves are not always known or sometimes within the known limits there are activities not compatible with conservation purposes including the existence of Administration Posts, agriculture, and other activities which do not coexist with conservation measures. In these cases, review of the boundaries will be required. Alternative would be to define a zoning strategy in which within the Forest Reserve a core area is differentiated from the buffer zone and multiple use zone. Experiences for zoning exist in Mecuburi and Derre Forest Reserves.

It is recognized that there are differences among the Forest Reserves. Therefore, specific recommendations are given for all the forest reserves. In summary, it is recommended to degazette the Nhampacue, Mucheve, Zomba, and Baixo Pinda Forest Reserves. This recommendation is based on the current conditions of the Forest Reserves, which is

highly degraded and converted into agriculture. For the other Forest Reserves, Mecuburi, Inhamitanga, Moribane, M'palue, Ribaue, Matibane, and Maronga, a priority action list is provided for each reserve. Priority actions include strengthening of community participation (e.g. in Mecuburi, Matibane and Moribane), redefinition of the Forest Reserve boundaries to make the more resilient (e.g. Inhamitanga), participatory zoning (e.g. Moribane), and inventory of biodiversity. IUCN protected areas categories IV, V, and VI are suggested to different Forest Reserves in view to provide opportunity to generate income for local communities through a sustainable use of timber and non-timber forest products and wildlife management. The differences are essentially based on current human pressure in a way that Forest Reserves with little pressure should be managed for ecosystem protection, while those with high human pressure should be managed to generate income for local communities.

# 1. Introduction

With the extensive destruction of natural ecosystems in most parts of Southern Africa, mainly due to agriculture, but also charcoal burning, timber logging, mining and construction, there is increasing concern about the loss of biodiversity.

In Mozambique, there are thirteen Forest Reserves, which are administered by the National Directorate of Forest and Wildlife (DNFFB) within the Ministry of Agriculture. Other protected areas, including National Parks and Transfrontier Conservation Areas, are the responsibility of the Ministry of Tourism. The Forest Reserves were essentially created to safeguard timber reserves from advancing agriculture for future sustainable utilization. The possibility that these Reserves can make a significant contribution towards biodiversity conservation has been recognized. However the DNFFB itself has expressed interest in maintaining an appropriate and effective management of these areas. There is limited information about the state of the vegetation and ecosystem condition within these Reserves. The WWF Mozambique Coordination Office (WWF MCO) has offered to support the DNFFB in its efforts to render the Forest Reserves into sites of effective biodiversity conservation. The obvious first step is to make an initial assessment of the Reserves, mainly looking at the state and composition of the vegetation, but also at the various human activities which constitute a threat to the natural ecosystems they contain. The state and composition of the vegetation is of particular importance as far as biodiversity conservation is concerned, firstly, because vegetation is the base on which all natural ecosystems are founded, and secondly, because the state and composition of the vegetation are key factors in deciding if an area is suitable for biodiversity conservation.

In this study, eleven of the thirteen forest reserves were visited with the aim to make a preliminary evaluation of the vegetation condition and species occurrence. The information derived from the visits was used together with the results of previous studies. Because of the unbalanced level of existing information between the Forest Reserves, priority was given to the ones which were the most difficult to access and ones for which the least information was available. The eleven chosen comprised three from the Sofala Province, namely Nhampacue, Inhamitanga and Mucheve; three from the Manica Province, namely Moribane, Zomba and Maronga; and five from the Nampula Province, namely M'palue, Ribaue, Mecuburi, Matibane and Baixo Pinda.

This study contributes to the evaluation of the current situation of the forest reserves and draws general recommendations of actions to be carried out with the objective of improving the conservation status of the Forest Reserves.

# 2. Objectives

## 2.1. General objective

Ensure that the forest reserve network in Mozambique includes all major woodland or forest types in Mozambique and the forest reserves are of size and distribution that would facilitate ecological function, conservation of habitats and plant genetic resources, as well as utilization functions where applicable.

## 2.2. Specific objectives

Specifically this assessment intends to:
1. Identify any gaps in the representation of forest types in the national forest network and recommend, if applicable the proclamation of additional ones.
2. Develop a system of forest reserves that meet economic, ecological, social and cultural needs of the present and future generation of Mozambicans.
3. Assess the status of management or protection of the major reserves and propose actions to improve protection or sustainable production of goods and services.
4. Identify opportunities and justify policy or legislative reforms to manage/protect the reserves network.
5. Explain the links and contribution of Mozambique's forest reserve network to biodiversity conservation, tourism, energy, hunting, soil and water values.

# 3. Background

## 3.1. Forest Reserves in the context of biodiversity conservation

Although the Mozambican Forest Reserve network (see Figure 1) has been established for timber production purposes during the fifties, it is almost clear that these objectives might be outdated. Having the forest reserves been declared as "state forests" (in opposition to private and community land) the current forest reserve network offers a good platform for establishment of forest conservation network, with the main purpose to protect biological diversity of forest ecosystems. Mozambique is signatory of the Convention on Biological Diversity which states that "each contracting party shall, as far as possible and as appropriate … (a) establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity…" (CBD, Article 8). These areas will have, apart from the general purpose of conservation, the role of long term research and observation of ecological phenomena, public education and awareness as areas of demonstration of "good practices".

Based on the principles of CBD, Mozambique developed the National Biodiversity Strategy and Action Plan (NBSAP), which stressed the need to establish and strengthen the conservation areas network. In its Objective 5 (Establishment and management of a representative system of conservation areas, the NBSAP defines as a goal for 2010 the following: (a) deepen our understanding of the current conservation areas, (b) define the strategy for rehabilitation and design of management plans of the conservation areas, (c) improve the management and technical capacity and enhance the infrastructures, (d) define the role of the communities living inside or adjacent to conservation areas, and (e) establishment of a conservation area network that represents the major ecosystems.

Several of the activities suggested above are taking place. The conservation areas network, in general, has been improving, particularly those with relevance for ecotourism (e.g. the Gorongosa and the Bazaruto National Parks). The conservation areas for protection of animals are the ones that have been implementing most of the measures listed above, while the Forest Reserves with the objective of protection of plant species or ecosystems the process of rehabilitation has been slower.

30°0'0"E  35°0'0"E  40°0'0"E

13°0'0"S

Res. Flor. de Mecuburi

Res. Flor. Baixo Pinda

Res. Flor. de Matibane

Res. Flor. de Mupálue

Res. Flor. de Ribáuè

Res. Flor. do Derre

Res. Flor. do régulo Zomba

18°0'0"S

Res. Flor. de Inhamitanga

Res. Flor. de Nhapácue

Res. Flor. de Moribane

Res. Flor. de Mucheve

Res. Flor. de Maronga

23°0'0"S

N
W — E
S

| NOMES | PROVÍNCIA | HECTARES |
|---|---|---|
| Reserva Florestal de Mecuburi | Nampula | 240457.56 |
| Reserva Florestal do Baixo Pinda | Nampula | 20263.80 |
| Reserva Florestal do Derre | Zambézia | 158290.61 |
| Reserva Florestal de Matibane | Nampula | 11109.85 |
| Reserva Florestal de Nhapacué | Sofala | 2620.19 |
| Reserva Florestal do Licuati | Maputo | 14091.48 |
| Reserva Florestal de Maronga | Manica | 15000.34 |
| Reserva Florestal de Mucheve | Sofala | 9194.76 |
| Reserva Florestal do Régulo Zomba | Manica | 2587.60 |
| Reserva Florestal de Moribane | Manica | 16134.22 |
| Reserva Florestal de Inhamitanga | Sofala | 1704.67 |
| Reserva Florestal de Mupalué | Nampula | 27575.33 |
| Reserva Florestal de Ribáue | Nampula | 12955.93 |
| Reserva natural de Chirindzene | Gaza | 100.00 |

Res. Flor. de Licuati

Res. Natural de Chirindzene

30°0'0"E  35°0'0"E  40°0'0"E

República de Moçambique
Direcção Nacional de Florestas e Fauna Bravia
Unidade de inventário Florestal

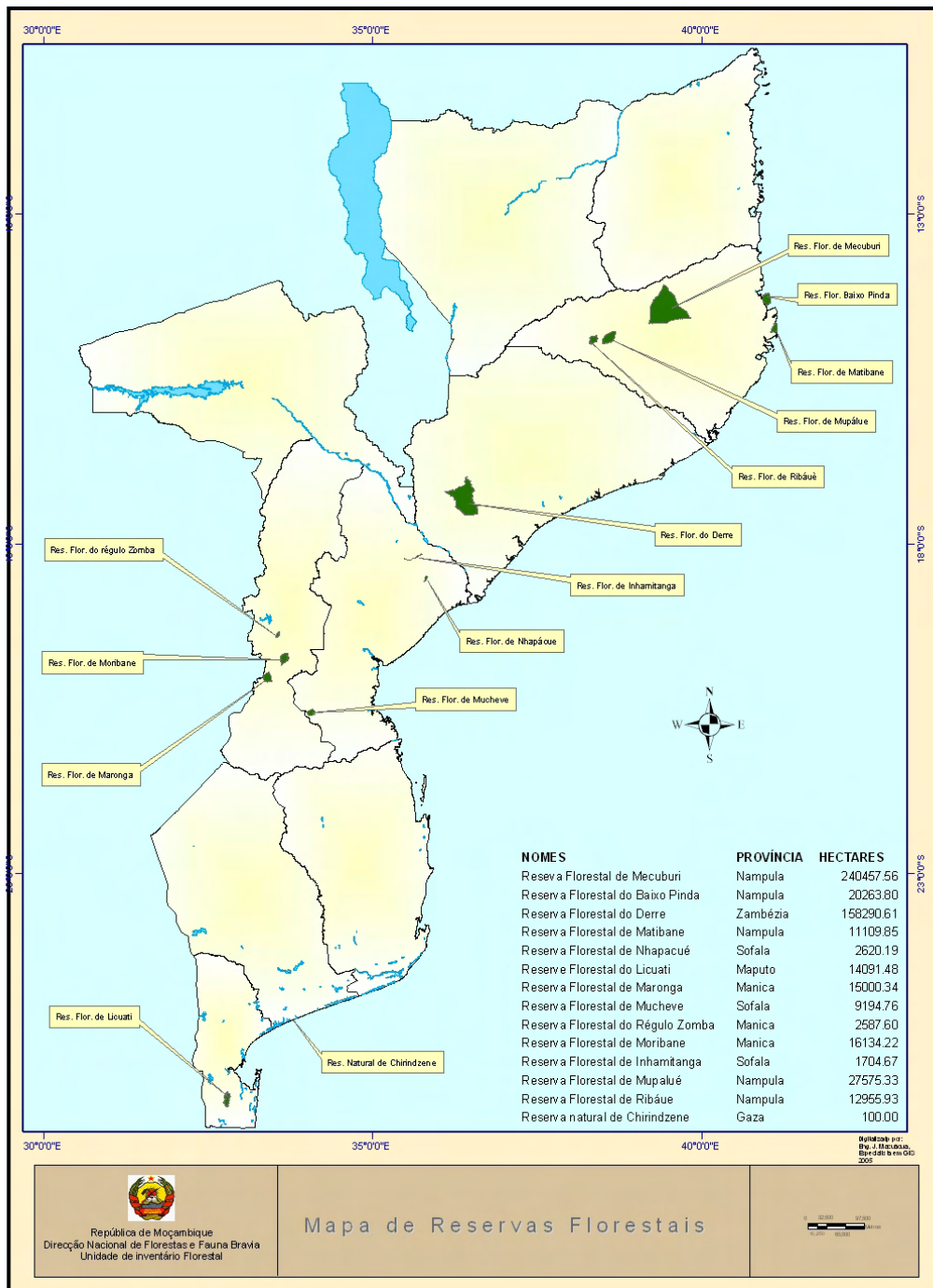M a p a   d e   R e s e r v a s   F l o r e s t a i s

**Figure 1. Location of the Forest Reserves of Mozambique**

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## 3.2. The legislation context of the Forest Reserves

The Forest Reserves, although they are not explicitly defined, are classified within the land use category of "National Reserves" defined in the forest and wildlife law as "total protection, established for protection of rare, or threatened, or endemic species of flora and fauna and fragile ecosystems such as humid zones, mangroves, dunes, and coral reefs" (Forest and Wildlife Law, Article 12). National Reserves are one of three protected areas defined by the Forest and Wildlife Law (Article 10): (a) national parks; (b) national reserves; and (c) areas with historic and cultural value.

The use the resources within the National Reserves is defined in Article 12, nr 3 of the forest and wildlife law, which states that "the existing resources within the national reserves may be used under license based on established rules, provided that the use does not interfere negatively with the purpose of the establishment of the reserve, and in accordance with the participatory management plan approved by the minister" [of Agriculture or Tourism, depending on the category of protected area].

In relation to communities living within the national reserves, the current legislation (land law, law or forest and wildlife, regulation of forests and wildlife) does not provide specific information regarding establishment of human settlements within the limits of the national reserves. However, the legislation establishes that local communities must participate in formulation and implementation of national reserves management plans.

Several possibilities of conservation area levels and institutional arrangements can be considered within the national context. These possibilities can also be in accordance with international regulations such as the IUCN categories of protected areas, which range from strict natural reserve/wilderness (established with the purpose of protecting natural features in areas with none or little human disturbance) to managed resources protected areas (managed primarily for sustainable use of natural ecosystems (see Box 1).

These categories, combined with the national categories can be further explored to define differential categories for the Forest Reserves depending on the current situation and conservation status.

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**Box 1. The modified system of protected areas categories (Source: SARDC, IUCN, SADC 1994)**

I. Strict nature reserve/wilderness areas: areas of land or sea possessing outstanding or representative ecosystems or species available primarily for scientific research or environmental monitoring (…) which are protected and managed so as to preserve their natural condition.

II. National parks: protected areas managed mainly for ecosystem conservation and recreation (…) designated for (a) protection of ecological integrity of one or more ecosystems (b) exclude exploitation or occupation and (c) provide foundation for spiritual, scientific, educational, recreational, and visitor opportunities.

III. Natural monuments: protected areas managed mainly for conservation of specific features. Areas containing one or more specific natural or cultural feature which is of outstanding or unique value (…)

IV. Habitat/Species management area: protected areas managed mainly for conservation through management intervention. Areas subject to active intervention for management purposes so as to ensure the maintenance of habitats to meet the requirements of specific species.

V. Protected landscape/seascape: protected areas managed mainly for landscape conservation and recreation. Areas of land or sea where interaction of people and nature over time has produced an area of distinct character with significant aesthetic, cultural or ecological value and often with high biological diversity.

VI. Managed resource protected area: protected areas managed mainly for the sustainable use of natural ecosystems. Areas containing predominantly unmodified natural systems, managed to ensure long term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

## 3.3. Payment of Environmental Services

Forest protection can also be used as base for Payment of Environmental Services (PES), a mechanism for compensation for the provision of a variety of ecological services (CIFOR 2005). The type of environmental services may include the following:
   a) Carbon sequestration
   b) Biodiversity protection
   c) Watershed protection
   d) Landscape beauty
PES is based on a negotiation process between service providers (e.g. community) and buyers (e.g. an international agency). Although there are still few schemes in the tropics, successful examples can be found in Costa Rica and México. These experiences can eventually be used to enhance the ability for the forest reserve management.

Institutional arrangements may range from State management to several options of co-management schemes where local communities, private entities, NGO's, and the State establish a memorandum of understanding with common objectives of resource conservation and management.

## 3.4. Overview of previous studies

Sitoe and Enosse (2003) provide an overview of the current management status of the forest reserves in Mozambique. In general, the study shows that there are ongoing initiatives to promote community management of forest reserves. Of the 13 existing forest reserves, five (Licuáti, Derre, Moribane, Mecuburi, and Matibane) have been co-managed between the Forest Service and local communities. Only two of the forest reserves (Inhamitanga and Nhampacue) are not currently inhabited. All the forest reserves (including those under management and the ones uninhabited) show different degrees of human disturbance, particularly clearing for agriculture, human induced fire, collection of firewood and charcoal, and logging. The disturbance resulted in more or less impact from not clearly visible changes to almost completely lost original forest structure. Among the causes of degradation of the forest reserves are abandonment of the forest reserves by the Forest Service during the civil war, use of forest reserves as hideouts of communities and guerrilla fighters, promotion of agriculture within the communities living inside the forest reserves, illegal logging, and poaching, among others.

Costa (2000) evaluated the conservation status of the five forest reserves located in Nampula province. He listed the plant and animal species found in all five reserves and interviewed local community to evaluate their willingness for conservation. His conclusions show that the Baixo Pinda forest reserve has been severely cleared for agriculture so that does not justify continuing as a forest reserve. On the other hand, he recommended the protection of other four forest reserves but with necessary arrangements for community participation and adjustments of the forest reserve boundaries and conservation objectives.

Other studies such as Costa (2000), Doddema-de Guia (2000), Ribeiro et al (2002), Sitoe and Enosse (2003), Guedes (2004), Muhate (2004), SEI (s.d.) made significant contribution to the knowledge of the current situation of the forest reserves. In addition, these studies report the significance of the contribution of the community management schemes for the preparation of management plans and conservation of forest resources. In general, the forest reserves that established community management committees of forest resources benefited in terms of sensitization of communities living inside the boundaries of the forest reserves either to accept a resettlement outside the reserve or to adopt land use measures that minimizes the negative impacts on forest structure and cover. There are few experiences of implementation of co-management schemes within Forest Reserves (e.g. Mecuburi, Licuáti). Most of the existing community forestry initiatives have been implemented in community land (e.g. Pindanyanga, Mahel), out of the Forest Reserves.

Presently it is undergoing a process to declare the Matibane Forest Reserve as a biological reserve that includes not only the forest area but the marine ecoregion as well, for protection of plant and animal species. The draft management plan (SEI s.d.) stresses the need for a community management scheme that includes exploitation of non-timber forest products (NTFP) such as medicinal plants, building materials, fibers, fruits, among others. This initiative aims at merging different conservation initiatives, in this case, the East Africa Marine Ecoregion and the East Africa Coastal Forest Ecoregion. Similar initiatives are encouraged within the conservation organizations, particularly the WWF. Therefore, such synergies should be encouraged where possible.

The transboundary conservation initiative can be of particular importance for areas bordering with protected areas in neighboring countries. This is the case of the Chimanimani area (including the forest reserves of Moribane, Maronga, and Zomba), which is a protected area of international relevance, linking up with the Chimanimani National Park in Zimbabwe.

In general, all previous studies recognize a series of challenges, particularly human pressure over the forest resources, lack of human and technical capacity within the Forest Service, deficient articulation between Forestry Services and other land-use sectors such as agriculture. It is, however, also recognized that there are strengths that ought to be valued for the rehabilitation and conservation of the forest reserves. These include the willingness of local communities to cooperate in co-management of the forest reserves, presence of little disturbance areas still hosting large number of plant species that maintain the ecological functions of the ecosystems.

# 4. Methods

Each of the eleven Forest Reserves was visited.  The visits took place during a 14 -day trip from the 17th June to the 29th June 2005.  The assessment was made along transects that varied from 250m (e.g. in Inhamitanga) to about 19 Km (e.g. in Mecuburi), either on foot or if roads were available, by car with frequent stops. Along the transects, all species which could be instantly identified, were recorded. Herbarium specimens were taken, for later identification of species which were important to characterize the vegetation type concerned.  The condition and state of the vegetation were noted, using tree canopy cover and age structure as the main criteria. Note was also taken of habitat diversity, species composition, variation within a vegetation type and difference between vegetation types where more than one type was present. The transects were discontinued, once no more new information could be gained. In the case of Zomba, Maronga, M'palue, Ribaue, and to a lesser extent Nhampacue Reserves, where the investigation proceeded on foot, it was not possible to make a satisfactory estimate of the extent of the moist evergreen rainforest and assessment of habitat diversity in the short time available.  Aerial photographs would have been essential to extrapolate the information gained on the transects over the entire area. Cognizance was made of existing information from previous investigations where this was available.

# 5. Current status of the forest reserve network

This Section presents the evaluation of the current conservation status of the plant resources. Although based on small scale evaluation it gives the preliminary description and a general overview of the conservation status in terms of occurrence of plant species, woodland structure, and canopy cover.

The findings of the study can not be generalized for all the reserves as each has its own problems, potentials, and perspectives. However, a few issues can be drawn as being common for most of the forest reserves such as follows:

   (a) For some of the reserves, the coordinates given by Gomes e Sousa (1968) do not match the reality (e.g. Maronga, Zomba, Ribaue, and M'palue)

   (b) People in neighborhood of forest reserves have vague information of the reserves and their limits (e.g. Zomba and Mucheve), but others, especially those with natural boundaries (e.g. roads, rivers), the current limits are well known and local community has information (e.g. Mecuburi, Moribane). The forest reserves where the limits are well known to local communities are those where there were recent initiatives of community forest management that carried out work on the conservation of forest resources.

   (c) Some reserves have been severely destroyed that are not worth preserving them (e.g. Mucheve, Baixo-Pinda, Zomba). The original ecosystems within these forest reserves, however, are valuable that would be important to identify similar forest types with none or little human pressure to be set up as forest reserves. Further work is needed for this purpose.

   (d) In general, the Forest Service has little control of the forest reserves (e.g. Sofala province).There are, however, areas where intensive work is ongoing to protect the forest reserves (e.g. Nampula).Under the current legislation, Forest Reserves fall under the category of conservation areas, which currently is under the Ministry of Tourism. Although there are no currently tourism activities within the forest reserves, there are some with high potential (e.g. Maronga). Therefore, there is need for institutional coordination between DNFFB and DNAC especially in the forest reserves that are within TFCA.

## 5.1. Nhampacue Forest Reserve

### 5.1.1. The Site

The Nhampacue Forest Reserve is located in the district of Marromeu and Cheringoma, in the transition between the undifferentiated coastal forest and the Zambezi inundated grasslands. The reserve is located between the hunting areas (Coutadas 11 and 12). The roads to the coutadas facilities are used to access this forest reserve from Inhamitanga. The topography is mainly flat to slightly undulating.  The Nhametia stream is the main watercourse crossing the Reserve in its northern parts and flowing eastwards towards the

Zambezi River Delta. The soils are sandy over most parts, changing towards more clay rich soils in limited areas and to dark grey mottled clays in the natural grasslands.


## 5.1.2. Evaluation of the Vegetation

The vegetation was assessed and investigated along one transect, commencing at the Reference point 18°33'23"S / 35° 37'3"E, progressing approximately 1.5 Km. southwards and returning to the original latitude along a line about 200m to the east. Knowledge gained from observations made during the drive to and from the site was also used in the assessment.

The main vegetation type of this Reserve is typically miombo woodland dominated by *Brachystegia spiciformis* Woodland. Typical associated tree species were *Millettia stuhlmannii, Pteleopsis myrtifolia*, *Xeroderris stuhlmannii* and occasionally *Albizia adiantifolia*. The woodland also contained an evergreen component. This comprised mature specimens of *Erythrophleum suaveolens, Inhambanella henriquesia* and *Synpetalum brevipes.* Common smaller trees were *Markhamia obtusifolia, Ozoroa obovata, Tabernaemontana elegans* and *Voacanga africana.* There was a species rich shrub layer also with a significant evergreen component. The most common shrub species were *Hymenocardia ulmoides, Keetia gueinzii, Landolphia kirkii, Rourea orientalis* and *Ziziphus pubescens*. There was a dense 1-2 m tall grass layer consisting essentially of *Hyparrhenia ssp*.

The woodland was interspersed with roundish patches of open grassland, containing widely scattered specimens of *Hyphaene coriacea* (Figure 2). Typical trees at the edges of these openings were *Maprounea africana, Parinari curatellifolia, Piliostigma thonningii, Pseudolachnostylis maprouneifolia, Uapaca kirkiana, Uapaca nitida* and *Vitex payos*.

The woodland had an average canopy cover of below 30% and mature trees specimens were widely scattered. The general impression was that the woodland had been extensively degraded, fits by logging and subsequently by wild fires, which were fuelled by the additional grass cover created by the removal of timber.

On traveling to the Reserve site, a similar type of woodland was observed over most of the area, often in a better state of preservation than what was seen at Nhampacue. The woodland was occasionally interspersed with *Millettia stuhlmannii* and *Pteleopsis myrtifolia* - dominated dry forest, or sometimes with patches of moist evergreen forest. Where these evergreen patches were sizeable, it was observed that they had been largely destroyed by cultivation and settlements. Where they were small, they were relatively well preserved. The similar pattern of vegetation distribution was observed during extensive driving over a large portion of the Hunting Commission adjacent to the Zambezi River Delta in 1999.

It is likely that similar lenses of dense dry and evergreen moist forest occur in the Napacue Reserve. This, however, could not been confirmed, since the road ended almost as soon as the Reserve was reached from the north, and there was no time available for longer walking transects.

| A. Open area with grass layer of *Hyparrhenia* sp. and the palm *Hyphaene coriaceae* | B. *Erythrophleum suaveolens* is among the dominant tree species |
|---|---|
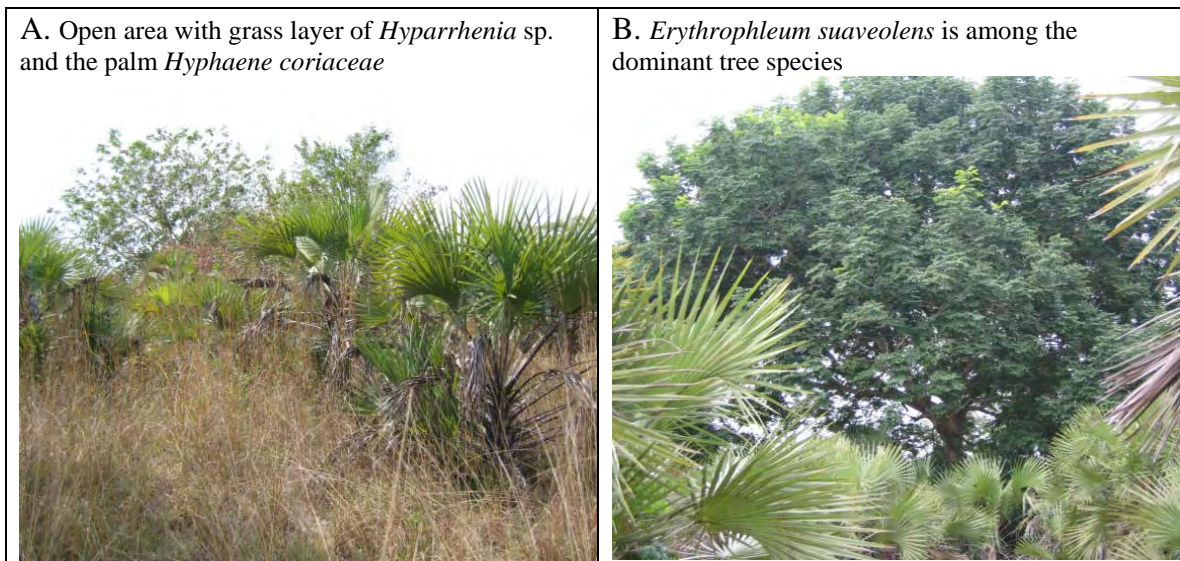
**Figure 2. General characteristics of the Nhampacue forest reserve**

## *5.2. Inhamitanga Forest Reserve*

### 5.2.1. The site

The Inhamitanga forest reserve falls within the Sofala Province in a narrow stripe along the Inhamitanga-Marromeu road. It is 32 Km long and 250 m in each side of the road, making it highly vulnerable for disturbances associated with the road construction and traffic. This situation led Gomes e Sousa (1968) to suggest strong measures to control fire to maintain this reserve. The topography is flat and the soils vary from sands to clayey loams.

### 5.2.2. Evaluation of the Vegetation

The vegetation was assessed and investigated along four transects, two to the south of the road and two to the north.  Each transect was at right angles to the road and extended for 250 m, to the limit of the Reserve, from where it looped back along a different route to the starting point.  The state and the composition of the vegetation were also looked at by slowly driving twice along the road for the whole length of the Reserve.

There were three main vegetation types within the Reserve. Going eastwards from Inhamitanga, the first approximately 850 ha were covered with extremely degraded open woodland.  Adjacent to it were some 500 ha of moist evergreen forest and the eastern most 250 ha consisted of a dense dry deciduous forest.

## 5.2.2.1 Moist Evergreen Forest (Rainforest)

The forest was essentially evergreen, but contained a substantial proportion of deciduous species, some of which are more often found in dry forest or deciduous woodland. The most common evergreen tree species were *Celtis mildbraedii* and *Drypetes gerrardii*. Other less frequent but typical evergreen tree species were *Chrysophyllum viridifolium*, *Milicia excelsa*, *Morus mesozygia*, *Cola mossambicensis*, *Pleiocarpus pycnantha*, *Strychnos henningsii*, *Strychnos usambarensis*, *Synsepalum brevipes*, *Uapaca sansibarica* and in wetter places *Khaya anthotheca*. The most common deciduous species was *Millettia stuhlmannii*, other typical deciduous tree species were *Berchemia discolor*, *Celtis gomphophylla*, *Cordyla africana*, *Dalbergia boehmii*, *Fernandoa magnifica*, *Millettia mossambicensis*, *Millettia usambarensis*, *Pteleopsis myrtifolia*, *Sterculia appendiculata* and *Xylea torreana*.
The shrub layer was conspicuously evergreen, consisting mainly of *Rinorea elliptica* with *Warneckia sansibaricum* and *Tabernaemontana ventricosa* also common (Figure 3.B).
The most common lianas were *Landolphia kirkii*, *Tiliocora funifera*, *Uvaria lucida*, *Cissus* ssp and two species of *Dalbergia*.
The forest contained, for this floristic region, an unusual richness in woody plants, which as yet has not been fully explored. The mixture of typical moist forest species with plants more often found in dryer habitats, constitutes a most unusual, almost unique plant association. Within it, remarkable vegetation patterns existed, probably created in response to differences in available moisture, which could be due to variation in clay content within the soils.

Despite the substantial component of deciduous trees, physiognomically the forest looked like moist evergreen forest (rainforest), and on the whole was reasonable well preserved. In some areas, the lack of mature trees and the presence of even-aged stands of young trees, indicated past disturbance. There were also fairly numerous, often coppicing stumps of *Millettia stuhlmannii*, obvious signs of past logging.

## 5.2.2.2. Dry Deciduous Forest

The dominant tree species in this dense dry forest were *Millettia stuhlmannii* and *Pteleopsis myrtifolia*. Other typical tree species were *Afzelia quanzensis*, *Amblygonocarpus andongensis*, *Cassia abbreviata*, *Cleistochlamis kirkii*, *Millettia usamarensis*, *Philenoptera bussei*, *Schrebera trichoclada*, *Sclerocarya birrea*, *Sterculea appendiculata*, *Strychnos madacascariensis* and *Xylea torreana*.
There was a dense well-defined, mainly deciduous shrub layer. The main shrub species were *Artabotrys brachypetalus*, *Brackerridgea zanguebarica*, *Deinbollia xanthocarpa*, *Flacourtia indica*, *Grewia* ssp. *Holarrhena pubescens*, *Hugonia busseana*, *Lecaniodiscus fraxinifolius*, *Markhamia obtusifolia*, *Monodora junodii* var. *macrantha*, *Monodora stenopetala*, *Rourea orientalis* and *Synaptolepis kirkii*. The ground cover was very sparse, almost devoid of grasses and composed mainly of leaf litter (Figure 3.A).
This deciduous dry forest had its structure still well preserved, with a tree canopy cover of up to 80% and only relatively few gaps where large trees had been removed.

| A. The dry deciduous forest ground covered by leaf litter | B. Moist evergreen forest with a dense understory dominated by *Rinorea elliptica* |
|---|---|
| | |
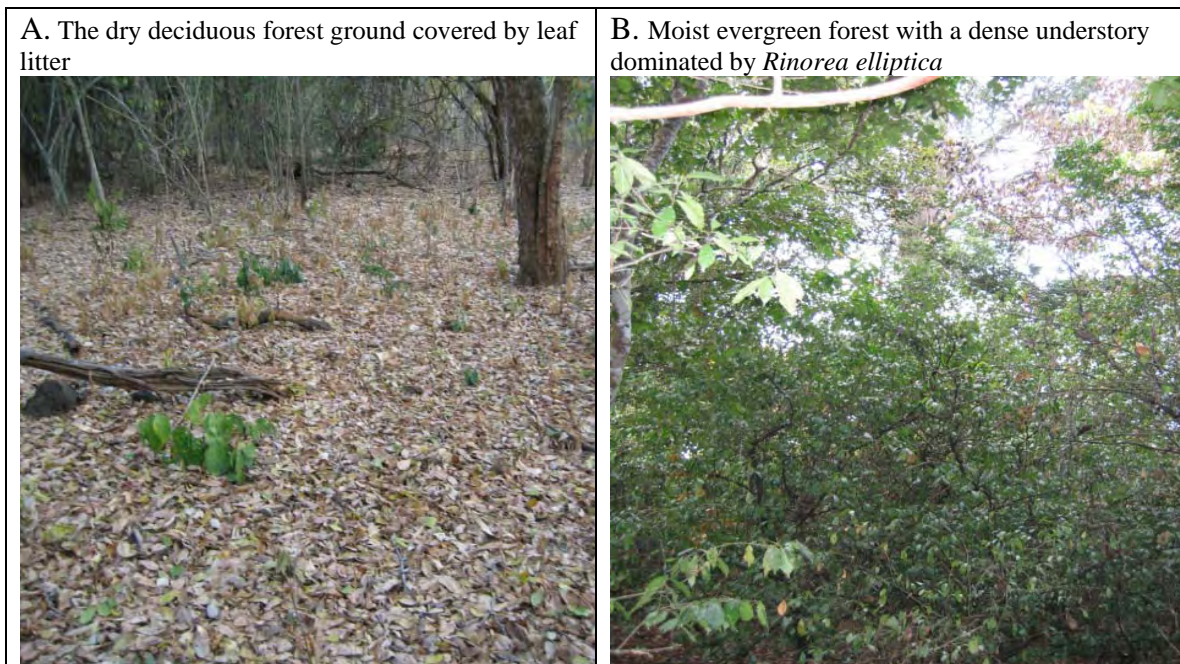
**Figure 3. Two of the three vegetation types of the Inhamitanga forest reserve**

## 5.2.2.3 Open Woodland

The entire western position of the Reserve, slightly over half of the total area, is covered with open woodland. Tree species recorded were *Albizia adianthifolia, Afzelia quanzensis, Amblygonocarpus andongensis, Borassus aethiopum, Boscia salicifolia, Cordyla africana, Diplorhynchus condylocarpon, Ekebergia capensis, Kigelia africana, Millettia usamarensis, Millettia stuhlmannii, Philenoptera violacea, Piliostigma thonningii, Pseudolachnostylis maprouneifolia, Pterocarpus angolensis, Pteleopsis myrtifolia, Schrebera trichoclada, Sclerocanya birrea, Vitex payos* and *Ziziphus mucronata*.

Shrubs were widely scattered, common species were *Annona senegalensis, Antidesma venosum, Dichrostachys cinerea, Grewia* ssp, *Holarrhena pubescens* and *Ximemia caffra* var *natalensis*. There was a dense grass cover of up to 2.5 m in height mainly dominated by *Panicum* sp.

This woodland was highly degraded over its entire length. Over large areas there were only isolated trees standing sometimes up to 100 m. apart, in other parts there were occasional clumps of denser vegetation. It was not possible to determine what type of mixed woodland had been the original cover and whether there had been dry forest in places. There were occasional specimens of *Brachystegia spiciformis* close to Inhamitanga, indicating that there could have been Miombo Woodland in the western most section. There was evidence that the woodland had been subjected to regular and intense wild fires.

## 5.3. Mucheve Forest Reserve

### 5.3.1. The Site

The Mucheve forest reserve is located in the district of Chibabava, southern Sofala. It is accessed through the road between Muxungue and Chibabava. The forest reserve, which was established for timber production, is described by the local community as to have had two sawmills that operated until the late seventies. Presently, no logging size trees can be seen. Apart from the signs of heavy logging in the past, the local community converted most of the area into agricultural land, and there are no signs of coppicing of commercial tree species.

The topography is flat to very slightly undulating, with an eastward flowing watercourse in the southern most part of the Reserve. The soils are mainly sands.

### 5.3.2. Evaluation of the Vegetation

Initially an approximately 600 m long transect was made, looping from about the middle of the northern boundary southwards for some 300 m, and from there back to the starting point. Along the transect, all species that could be instantly identified were recorded. Subsequently the vegetation was assessed, on a slow drive for approximately 4 Km towards the South. Further investigation was carried out during a 3.5 Km walk in the same direction as far as the watercourse.

The remaining woodland are patches of dry forest with sparsely distributed small to medium size trees. As far as could be assessed, the vegetation type of this Reserve was a dry forest. The dominant tree species were *Kirkia acuminata* and *Combretum zeyheri*, other typical trees were *Afzelia quanzensis, Albizia forbesii, Albizia hervei, Albizia versicolor, Amblygonocarpus andongensis, Cleistanthus schlechteri, Combretum molle, Commiphora neglecta, Diplorhynchus condylocarpon, Ekebergia capensis, Markhamia obtusifolia, Millettia stuhlmannii, Pseudolachnostylis maprouneifolia, Pterocarpus angolensis, Pterocarpus lucens* subsp. *antunesii, Schrebera trichoclada, Sclerocarya birrea, Strychnos madacascariensis, Strychnos potatorum, Tabernaemontana elegans, Vitex payos* and *Xeroderris stuhlmannii*.

The dense shrub layer consisted mainly of *Hymenocardia ulmoides, Alchornea laxiflora* and *Hippocratea* ssp. Other characteristic species were *Dichrostachys cinerea, Holarrhena pubescens, Hugonnia orientalis, Landolphia kirkii, Lecaniodiscus fraxinifolius, Rourea orientalis* and *Tiliocora funifera*.

Over half of what was once a large area covered with dry forest, consisted of agricultural land. The fields were interrupted and surrounded by extremely degraded natural vegetation, which had been reduced to irregular clumps of dense growth, generally 3 to 4 m in height and consisting of a mixture of shrubs and regenerating tree species, from which widely scattered mature trees emerged. This pattern was occasionally interspersed with small fragments of the original forest. In a 3.5-Km transect within the forest reserve

there were more cultivated areas than forest. From the vegetation which had remained, it could be concluded that the Reserve was once covered with a species rich and relatively rare type of dry forest which would have been of considerable value for conservation.

| A. *Combretum zeiheri*, one of the dominant species | B. Agriculture fields on what seems to have been a dense gallery forest |
|---|---|
|  |  |
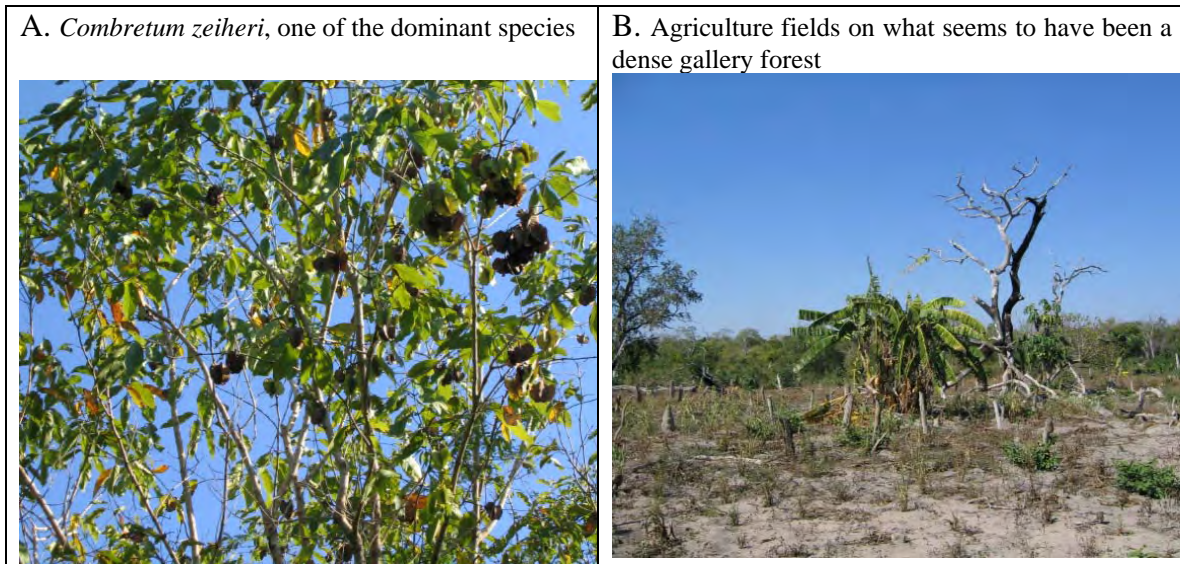
**Figure 4. Common views of the Mucheve Forest Reserve**

From the literature, and from personal communication with the local chief, it could be inferred that the sides of the stream in the south of the Reserve, were once occupied with gallery forest consisting of trees such as *Breonadia salicina, Khaya anthotheca* and *Milicia excelsa*. At the time of this investigation there were no trees left but remainings of dead standing trees were still visible and the streambed was practically obliterated by fields and could hardly be discerned (see Figure 4).

## 5.4. Moribane Forest Reserve

### 5.4.1. The site

The Moribane forest reserve is located in the district of Sussundenga. It is crossed by the Sussundenga-Dombe road. Extensive damage was caused, in some parts of the forest, by a devastating fire which occurred some 13 years ago, subsequent to the very severe drought of 1992. The signs of the fire are still visible with the dead standing large trees with fire scars. Natural forest regeneration is taking place, with pioneer species such as *Macaranga capensis, Harungana madagascariensis,*and *Trema orientalis* dominating the area, sometimes in pure stands of even-aged stands (Figure 5.A). The age of these trees corresponded with the time which has elapsed since the fire. In spite of the fire disturbance, large area of the forest reserve is well preserved, with closed canopy cover and a woody understory dominated by Rubiaceae (e.g. *Tarenna pavettoides*), and Apocynaceae species (*Tabernaemontana ventricosa, Voacanga africana*). In the

southeast of the Reserve substantial tracts of land had been cleared to establish banana plantations (Figure 5.B). Clearing additional land was proceeding during the visit. Without the aid of aerial photographs it was not possible to make an estimate of the size of the plantations.

The Moribane forest reserve is among the largest lowland forest in existence in Mozambique, especially on the base of the mountains. The topography consists of hills and valleys with streams. The soils vary from pale brown to reddish brown clayey loams. Muhate (2004) evaluated the effect of altitudinal variation and found three vegetation types associated with soil characteristics and the altitude. Guedes (2004) found 55 tree species (dbh > 10 cm) and a species diversity index (Shannon index) of 4, which was found to be higher compared with the neighboring Forest Reserves of Zomba and Maronga.

## 5.4.2. Evaluation of the Vegetation

The vegetation was assessed and investigated by slowly driving twice across the reserve along the main Sussundenga-Dombe road, which lead from the northern tip of the Reserve more or less through the centre, to a point along the western boundary which was about 2 Km north of the southwest corner. Apart from this, four approximately 400 m long transects were made, on foot, from the road into the forest. The first at the northern edge of the Reserve, the other three at intervals of about 2 Kms along the road. On the transects, the species composition was recorded and the state of the forest taken note of.

## 5.4.2.1. Transitional Forest

At the northern edge of the Reserve, there was an interesting example of a rarely seen transitional forest, a few hectares in extent and consisting mainly of species normally found toward the edge of rainforests. Typical tree species were *Bersama abyssimica, Cordia abyssimica, Croton sylvaticus, Ekebergia capensis, Millettia stuhlmannii, Prunus africana, Pteleopsis myrtifolia, Rauvolfia caffra, Tabernaemontana elegans, Voacanga africana* and *Xylopia parviflora*.

There was a well-defined shrub layer consisting mainly of *Rothmannia manganjae* and the twining fern *Lygodium kerstenii*.

## 5.4.2.2. Moist Evergreen Forest

The dominant tree species in this forest was *Newtonia buchananii*, other typical canopy trees were *Blighia unijugata, Celtis gomphophylla, Celtis mildbreadii, Erythrophleum suaveolens, Millettia stuhlmannii, Morus mesozygia, Psydrax parviflora* subsp. *chapmannii, Sysnsepalum brevipes, Trichilia dregeana* and *Trilepsisium madagascariensis. Milicia excelsa* was an occasional large tree and *Khaya anthotheca* was common near water courses. *Aidia micrantha* and *Funtumia africana* were prominent in the sub-canopy. In the well-defined shrub layer *Rothmannia manganjae*,

*Tabernaemontana ventricosa* and *Tarenna pavettoides* were prominent with the bamboo-like grass, *Olysa latifolia* also common.

This moist evergreen forest was over most of its extent similar and in an excellent state, and constituted one of the largest and possibly best-preserved lowland rainforests in Mozambique.

In the north of the Reserve, transitional forest was observed to occur between the rainforest and the surrounding woodland. From available reports (Guedes 2004, Muhate 2004) it could be inferred that in other parts of the Reserve the rainforest abutted to *Brachystegia spiciformis*-Woodland or other woodland types. These vegetation types could not be investigated in the time available.

| A. Forest regeneration after fire, even aged stand dominated by *Newtonia buchanani* and *Harungana madagascariensis* | B. Banana plantations in the southern region of the Forest Reserve is the main threat for conservation |
|---|---|
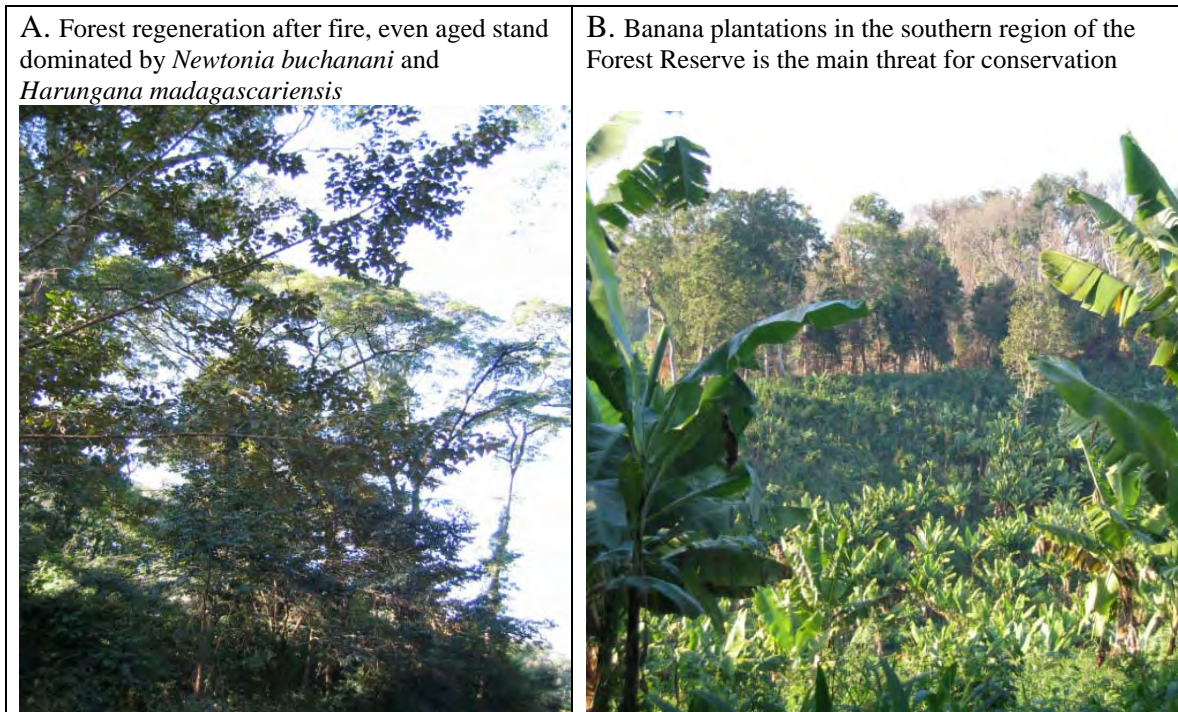


**Figure 5. Moribane Forest Reserve: indications of recovering forest and the expansion of banana plantations within the Forest Reserve.**

## 5.5. Zomba Forest Reserve

### 5.5.1. The site

The Zomba Forest Reserve is located in the district of Sussundenga, Manica Province, approximately 80 Km northeast of Dombe, close to the base of the Chimanimani Mountains. The Zomba forest reserve has difficult access because of its location, on the West side of the Mussapa river, which does not have a bridge to cross during the rainy season. In the dry season of the drier years, vehicles can cross the river and easy the access from the Sussundenga-Dombe road (at Maquina). The high population density is a

reason for land conversion to agriculture. The water streams and the denser forest have been cultivated leaving samples of species that belonged to lowland rain forest and river streams. Approximately 3 Km South of the chief's village there were, along a small stream, the rudiments of a very unusual swamp forest, most of which had been cut down for agriculture. It consisted mainly of *Pandanus kirkii* and some solitary specimens of *Ficus bubu, Ficus lutea* and *Voacanga thouarsii*, and a groundcover of a species of *Cyperaceae* interspersed with occasional clumps of *Costus afer* (Figure 6.B).

Most of the Zomba Reserve consisted of villages with large mango trees and agricultural land. This was interspersed with small fragments of the original rainforest, patches of regenerating forest and, within the fields and along the edges, there were clumps or individual specimens of regenerating woody rainforest species of various heights. The southern section of the Reserve was still covered with well preserved moist evergreen forest, the extent of which could not be estimated in the time available. At the interface of forest with agricultural land, clearing of forest by the slash and burn method was in progress at the time of the investigation. It was assumed that lowland moist evergreen forest covered most of the Reserve in a not distant past.

It was also not possible to investigate the western boundary area, and to establish how much of the base of the Chimanimani mountains, if any, is included in the Reserve.

The topography is mainly flat to slightly undulating. Two main eastwards flowing streams cross the Reserve, the Mucutuco stream in the northern part and the Mevumozi stream in the South. The soils vary from sandy loams to sandy clay loams.


## 5.5.2. Evaluation of the Vegetation

The Zomba Forest Reserve was reached on foot some 2 Km South of the middle of its eastern boundary. From there the vegetation was assessed and investigated along a transect which went westward from the boundary for about 1.5 Km to the chief's village and from there in a south/south-easterly direction for approximately 4 Km from where it returned to the chief's village along a slightly different route.

The main vegetation type of the Zomba Forest Reserve was moist evergreen lowland forest. The dominant canopy tree was *Newtonia buchananii* (Figure 6.A), other typical tree species were *Albizia glaberrima, Blighia uniugata, Celtis gomphophylla, Milicia excelsa, Millettia stuhlmannii, Khaya anthotheca, Synsepalum breviper* and *Trilapisia madacascariensis*. Characteristic trees of the sub-canopy and sapling layer were *Aidia micrantha, Aporrhiza nitida, Craterospermum schweinfurthii, Funtumia africana, Glenniea africana* and *Rothmannia mangangae* (also common in the shrub layer). The dominant species in the well-defined shrub layer was *Rinorea ferruginea* with *Coffea salvatrix, Dracaena mannii, Erythroxylum emarginatum, Tabernaemontana ventricosa* and *Tarenna pavettoides* also common. The lower shrub layer was occupied by softer plants such as *Aframomum albiflorum, Afromomum angustifolium, Costus afer, Olyra latifolia, Pseudoranthemum subviscosum* and *Psychotria peduncularis*.

The most common lianas were *Acacia pentagona, Keetia gueinzii, Landolphia kirkii* and *Saba comorensis*.

The tree species in regenerating forest were *Albizia adianthifolia, Harungana madagascariensis, Macaranga capensis* and *Trema orientalis*. Among them there were seedling and sapling of *Newtonia buchananii*.

| A. Forest fragment dominated by *Newtonia buchanani* in the Southern part of the Reserve | B. An unusual swamp forest dominated by *Pandanus kirkii* |
|---|---|
|  |  |
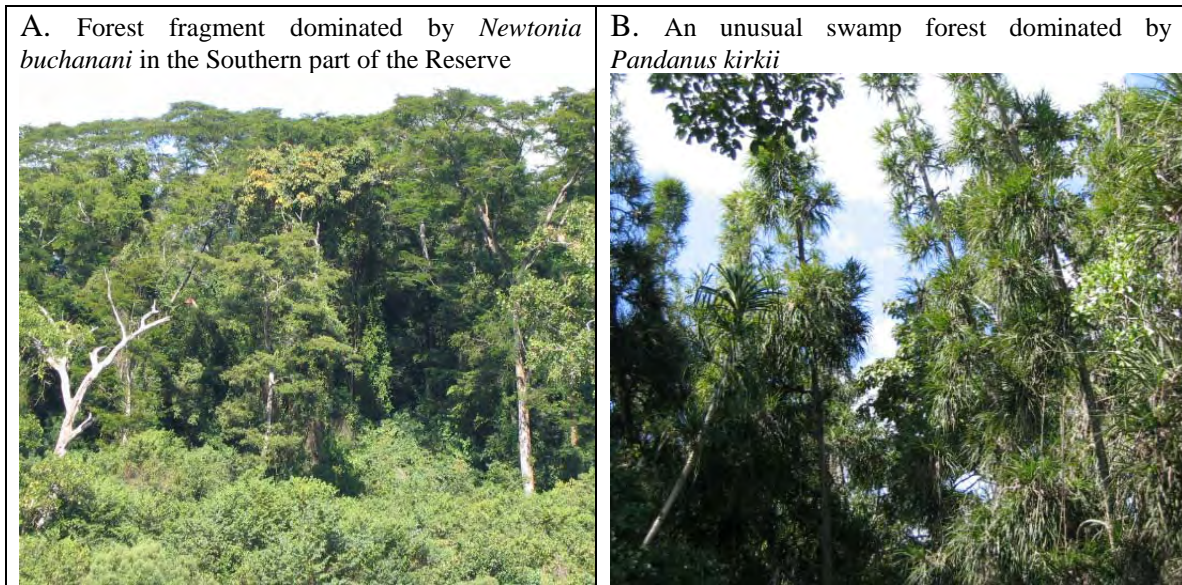
**Figure 6. Zomba Forest Reserve vegetation types**

## 5.6. Maronga Forest Reserve

### 5.6.1. The site

The Maronga Forest Reserve is located in the foothills of the Chimanimani Mountains, Manica Province, approximately 100 Km South-West of Dombe. Its accessibility is limited by the lack of the bridge on the Mussapa river. However, it can be easily accessed from Zimbabwe, from the village of Vimba, where the Horoni and Macurupini rivers border Zimbabwe and Mozambique.

The topography is hilly and the soils are quartzitic sands along the Chimanimani mountains and reddish clayey loams in the hills to the east of them.

The Maronga forest reserve is among the least disturbed by human activities. Its vegetation shows high variability, associated with the steep topography and water streams. The forest was generally very well preserved. Except in the vicinity of the Macurupini Falls, where the forest thins out, there was an area of recently cleared and burned land, about 5 ha, which previously had been pristine vegetation, partly rainforest and partly ecotonal forest between rainforest and the adjacent woodland. The Macurupini Falls are a feature of exceptional scenic beauty, a focal point for eco-tourism. The setting is now partly spoiled and the scars will take many years to heal. Considering the existing plans for a Transfrontier Park and eco-tourism, it is difficult to understand how this destruction could have taken place.

## 5.6.2. Evaluation of the Vegetation

The vegetation was assessed and investigated along a transect which commenced near the centre of the western boundary at the Horoni River, from where it went northwards for approximately 4 Km to the Mucurupini Falls at the base of the Chimanimani mountains, then westwards for about 1.5 Km, from where it went back to the starting point along a route to the east of the one taken at the beginning.

Since this Reserve could only be visited on foot, only a small portion of it was assessed. From what could be seen, it was assumed that the hills of the reserve were essentially covered with *Brachystegia spiciformis*-Woodland. There was also some well-preserved lowland moist evergreen forest along the base of the Chimanimani Mountains.

| A. view of the Chimanimani mountain from underneath the *Uapaca kirkiana* stand | B. Partial view of the moist evergreen forest close to the Macurupini Falls |
|---|---|
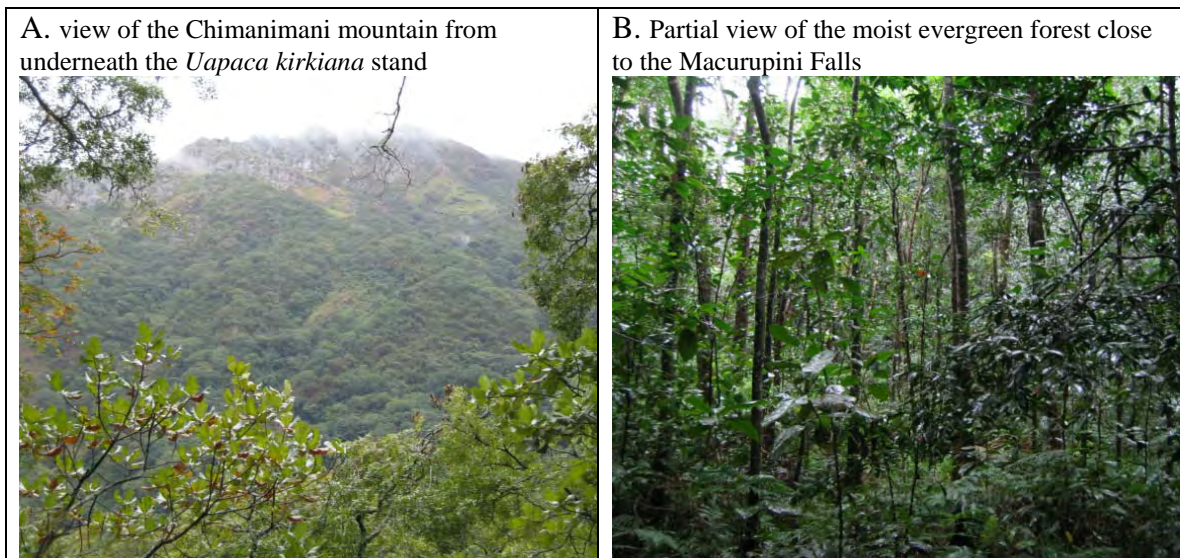


**Figure 7. The Chimanimani Mountain and Macurupini moist evergreen forest**

### 5.6.2.1. *Brachystegia spiciformis – Burkea africana* woodland

The dominant tree species in this woodland was *Brachystegia spiciformis* with *Burkea africana* sometimes dominant. Other common trees were *Diplorhynchus condylocarpon, Maprounea africana, Millettia stuhlmannii, Pterocarpus angolensis* and *Uapaca kirkiana*. Typical shrub species were *Brackenridgea zanguebarica, Canthium ngonii, Flacourtia indica, Hymenocardia acida* var. *mollis, Hymenocardia ulmoides* and *Vernonia muelleri* subsp. *muelleri*. Along drainage lines there were mainly evergreen species such as *Craterospermum schweinfurthii, Erythroxylum emarginatum, Englerophytum magalismontanum, Erythrophleum suaveolens, Garcinia kingaensis* and *Synsepalum brevipes*. Small specimens of these species persisted through out the woodland in the shrub layer. There was a well-developed ground cover consisting mainly of *Hyparrhenia* ssp.

The woodland was generally well preserved. However in some areas, the absence of *Brachystegia spiciformis* and the increase of *Burkea africana* and *Uapaca kirkiana*, as well as occasional even-aged stands of trees, indicated that a low-intensity form of shifting agriculture might have prevailed in the area (see Figure 7.A).

On the slopes towards the Horone River, recent removal of the natural vegetation was observed.  It is likely that this had happened in other parts of the Reserve. Extensive foot patrols or the scrutiny of recent aerial photographs would be needed to establish the extent of land clearing.


## 5.6.2.2. Moist evergreen forest

Moist evergreen forest occurred in the northwest of the reserve against the foot of the Chimanimani Mountains.  The best developed forest was between the boundary with Zimbabwe and the Macurupini Falls (Figure 7.B).  It was part of a larger forest which reached into Zimbabwe, had a size of about 400 ha, of which approximately 200 ha were within the Reserve.  The visit to the forest was brief, and part of the information in this report has been taken from field sheets compiled during previous visits. The dominant canopy tree was *Newtonia buchananii*, other common trees in the canopy were *Maranthes goetzeniana* and *Xylopia aethiopica*, with *Erythrophleum* and *Khaya anthotheca* locally frequent.  Occasional rare species were *Ficus bubu, Ficus vallis-choudae, Morus mesozygia* and *Milicia excelsa*.  *Uapaca lissopyrena*, an unusual tree with stilt roots, was common in wet places and along streams. *Funtumia africana* often formed a high sub-canopy immediately beneath the *Newtonia* crowns. Other common sub-canopy trees were *Aporrhiza nitida, Blighia unijugata, Millettia stuhlmannii, Synsepalum brevipes* and *Trilepisium madacascasiensis*. The sapling layer contained some small trees, the most common of which were *Aidia micrantha, Englerophytum magalismontamum, Craterispermum schwenfurthii, Dracaena mannii* and *Tarenna pavettoides*.  The well-developed shrub layer was dominated by young lianas and young tree species especially *Funtumia*. The bamboo-like *Olyra latifolia* and the sub-shrub *Pseuderanthemum subviscosum* were common throughout.  Locally abundant shrubs include *Synsepalum kassneri, Drypetes arguta, Rinorea convallarioides, Rinorea ferruginea, Tabernaemontana ventinicosa, Tricalysia pallens* and *Vepris drummondii*.

There was a large array of different lianas, the most commonly seen ones were *Agelaea pentagyna, Acacia pentagona, Artobotrys monteiroae, Combretum paniculatum, Hippocretea pallens, Hipporcretea volkensii, Keetia gueinzii, Landolphia kirkii, Ocinotis tenuiloba, Rhaphiostylis beniensis, Saba comorensis* and *Tiliocora fumifera*.

The forest contained over 50 orchids, mainly epiphytes, and 45 different ferns including the very rare *Cyathea mossambicensis*. There were also some rare woody plants of a limited distribution such as *Diospyros hoyleana* subsp. *angustifolia, Combretum coriifolium, Dichapetalum madagascariensis, Rourea minor, Salacia erecta, Salacia* sp.nov.*, Synsepalum Kaessnesi, Tricholscypha ulugurensis* and *Vepris drummondii*.

## 5.7. M'palue and Ribaue Forest Reserves

### 5.7.1. The site

The two forest reserves are located side by side on the M'palue and Ribaue Mountains, at the base of which lays the village of Ribáuè, in Nampula. They are easily accessible, although there are no roads through the reserves themselves. The valley that separates the two mountains gives accessibility to both reserves. Steep slopes are the major constrain to access remote areas of the forest reserves. Investigation of the two reserves was done on foot through the valley in a 6 Km transect with several stops. From the valley it was possible to identify plant species along the transect, while the vegetation on the slopes of the mountains were evaluated only for its percentage of canopy cover and distribution.
The valley area between the two reserves is highly populated and the lower areas of the hills have been converted to slash-and-burn agriculture.

| A. View of the Ribaue Mountain | B. Bamboo is an important component of the Ribaue and M'palue Forest Reserves |
|---|---|
|  |  |
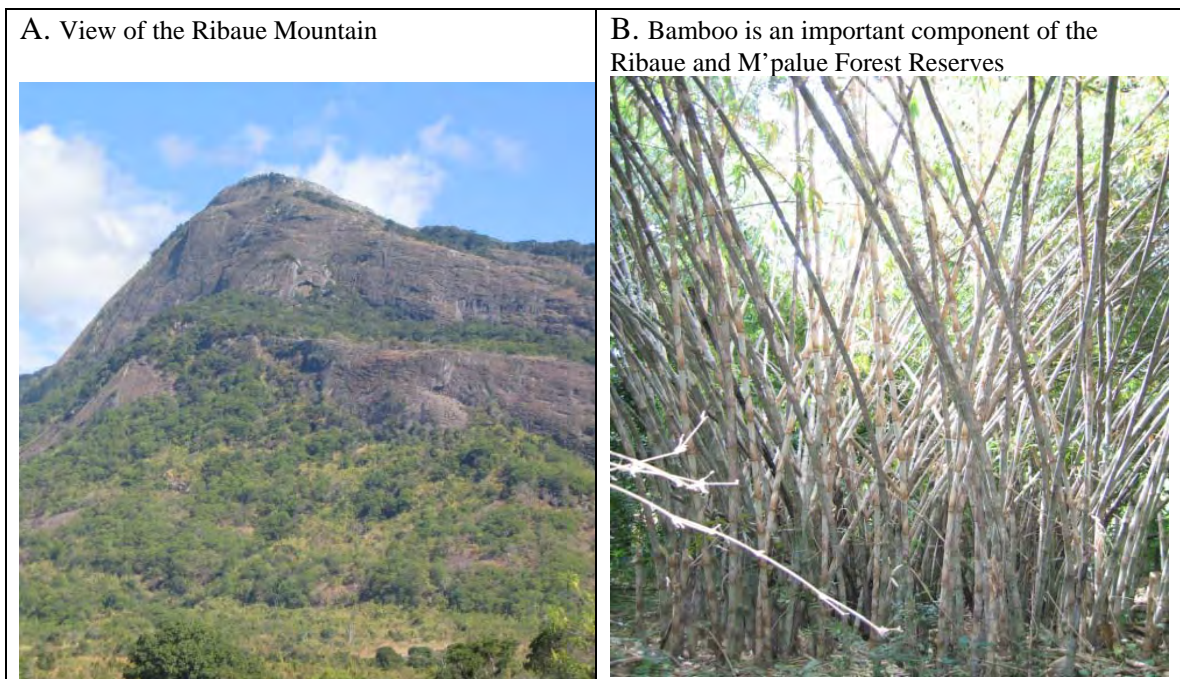
**Figure 8. View of the Ribaue Forest Reserve**

### 5.7.2. Evaluation of the Vegetation

Fragments of the forest show dominance of miombo species, particularly *Julbernardia globiflora, Uapaca, Sterculia*, and pure stands of bamboo (*Oxytenanthera* sp) (Figure 8). There are a series of river streams that have springs on both mountains. The water streams are particularly covered with gallery forest with *Milicia excelsa, Xylopia* sp., *Harrungana madagascariensis, Trema orientalis, Breonadia salicina, Syzygium owariense*, among others. On the mountain slopes patches of closed canopy forests mixed

with bamboo. Accessibility to the mountain steep slopes prevented closer investigation to the forest on the slopes.

## 5.8. Matibane Forest Reserve

### 5.8.1. The site

The Matibane Forest Reserve is located at the Mossuril district, Nampula approximately 30 Km South of Nacala along the coast. It is 4200 ha in extent, but its exact boundary has not been clearly delineated. It is easily accessible from the road to Mossuril. A tertiary road goes through the forest reserve along the coast. The reserve was proclaimed in 1957 to protect *Androstachys johnsonii*, a commercial timber species that was overused in the past for house construction in Nacala and Ilha de Mocambique. *Andostachys johnsonii* is a gregarious species that currently dominates the forest reserve.

The topography is flat to slightly undulating and the soils are deep sands throughout. Although the original area of the reserve had shrunk, it maintains a core protected area well preserved. The Matibane Forest Reserve has been patrolled by the Forest Services throughout the years, and a community forestry project that operated during the period 2000-2003 prepared the two neighboring communities to collaborate in forest conservation.

### 5.8.2. Evaluation of the vegetation

The vegetation was assessed and investigated by driving slowly for approximately 10 Km from South to North and more or less through the middle of the Reserve, then back for 2 Km and from there along a different track westward for 2 Km. Frequent stops were made for closer examination of the species composition.

The main vegetation type of this Reserve is layered dry forest dominated in most parts by *Androstachys johnsonii (mecrusse).* In some areas *Icuria dunensis*, previously believed to be an undescribed species of *Brachystegia* (Doddema-de Guia 2000) was the most common tree species. Other typical trees were *Afzelia quanzensis, Albizia forbesii, Albizia glaberrima, Balanites maughanii, Brenaniodendron carvalhoi (Cynometra), Fernandoa magnifica, Lannea* sp *Markhamia obtusifolia, Mimusops caffra, Monotes* sp. *Ozoroa* sp. *Rourred cuccinea* subsp. *boiviniana, Schrebera trichoclada* and *Sclerocarya birrea*.

*Hymenocardia ulmoides* was prominent in the species rich shrub layer, which contained a large component of evergreens.

There were many trees and especially shrubs that could not be instantly identified. The impression was gained that this forest has as yet not been fully explored and is in need of further floristic investigation.

This Reserve consisted of a core area of between 2000 and 2500 ha, which was covered with well-preserved dry forest, with a canopy cover of up to and in some part over 75%. There was evidence of past logging throughout, but there were also limited areas where the vegetation cover looked nearly pristine. The core area was surrounded by a buffer

zone, which had been opened up by past agricultural activities. It was composed of roundish open areas covered with grassland and surrounded by degenerated or regenerating dry forest and covered with mainly *Hyparrhenia* spp. Close to the core, these areas were 30 to 40 m in diameter, their diameter increased away from the core, to up to 100 m. There were no signs of continued agriculture in the buffer zone and it seemed that the openings are maintained by regular bush fires.

## *5.9. Mecuburi Forest Reserve*

### 5.9.1. The site

The Mecuburi Forest Reserve is situated in the north of the Nampula Province. It forms a triangle with the apex of the triangle pointing to the north and the lower-left corner on the town of Mecuburi. The area covered by Mecuburi Forest Reserve is presently 195400 ha. Additional area initially part of the Reserve has been recommended to be degazetted by Gomes e Sousa (1968) to respond to agriculture pressure, particularly in the Northern tip of the Reserve.
The topography is gently undulating with a number of drainage lines running towards the Mecuburi River, which crosses the Reserve from the southwest corner towards the middle of the eastern boundary. The soils are mainly sands grading to clayey loams in some places.

### 5.9.2. Evaluation of the Vegetation

The vegetation of this Reserve was investigated by driving slowly along two of the tracks which led through it. The first track went from about the middle of the western boundary roughly eastwards for approximately 19 Km. The second branched off the first track 11 Km from the western boundary, from where it went northwards for about 6 Km. During the drive frequent stops were made to have a closer look at the vegetation.
The main vegetation type of this reserve was Brachystegia-Woodland. Throughout the Reserve the woodland showed considerable variation in its species composition. Different sub-types occurred in different parts which graded into each other in some places. Over large area *Brachystegia spiciformis* was the dominant tree species, sometimes co-dominant with *Julbernardia globiflora*. In other parts *Brachystegia bussei* was dominant and sometimes *Brachystegia boehmii* or *Brachystegia utilis* were prominent components. Other typical tree species which were fairly frequently encountered were *Afzelia quanzensis, Burkea africana, Combretum molle, Combretum zeyheri, Cordyla africana, Crossopteryx febrifuga, Diplorhynchus candylocarpon, Erythrina livingstoniana, Hyphaena petersiana, Lannea stuhlmannii, Maprounea africana, Millettia stuhlmannii, Olax dissitiflora, Piliostigma thonmingii, Pseudolachnostylis maprouneifolia, Pteleopsis myrtifolia, Pterocarpus angolensis, Schrebera trichoclada, Sclerocarya birrea, Strychnos madagascariensis, Strychnos spinosa, Swartzia madagascariensis, Terminalia sericea, Uapaca kirkiana, Uapaca*

*nitida* and *Xeroderris stuhlmannii*. The bamboo species *Oxytenanthera abyssinica* occurred sporadically throughout.

Characteristic shrubs or small trees were *Annona senegalensis, Cleistochlamys kirkii, Dalbergia melanoxylon, Deinbollia* sp., *Dielsiothamnus divaricatus, Flacourtia indica, Grewia* ssp. *Holarrhena pubescens, Hugonia orientalis, Monodora grandidieri, Monodora junodii, Ochna* sp. and *Vangueria infausta*. Towards areas with a high water table *Gardenia ternifolia* subsp. *jovis-tonantis, Parinari curatellifolia, Syzygium guineense* subsp. *guineense* and a large leafed *Combretum* species were typical.

In the west and north of the Reserve, there was an approximately 10 to 15 Km wide belt of settlements and agricultural land, which took up almost half of the total area (95 000 ha). This was surrounded by a buffer zone, about 50 000 ha in extent, consisting of mainly even-aged stands of regenerating woodland of various ages. The remainder, the core area of the Reserve, which occupied the central and southern parts, also about 50 000 ha, was covered with generally well preserved mature stands of Brachystegia-Woodland. In some areas the woodland was almost pristine, in others there were signs of various degrees of past disturbance, and there was evidence of past logging almost throughout.

Costa (2000) reported that there was *Millettia stuhlmannii/Pteleopsis myrtifolia* dominated dry forest in the north of the Reserve, unfortunately this area could not be reached and investigated in the available time. According to the abovementioned report, the following tree species have been recorded: *Acacia nigrescens, Albizia adianthifolia, Albizia glaberrima, Albizia versicolor, Breonadia salicina, Cordyla africana, Diospyros mespiliformis, Erythrophleum suaveolens, Ficus syscomorus, Garcinia livingstonei, Milicia excelsa, Parkia filicoidea, Pachystell brevipes, Pteleopsis myrtifolia, Strychnos potatorum, Tabernaemontana ventricosa, Tamarindus indica, Terminalia zambesiaca* and *Trichilia emetica*.

Gallery forests occurred along the Mecuburi River and adjacent drainage lines. These could not be visited during this assessment, but Ribeiro et al (2002), who studied the ecological characteristics of the gallery forest of the Mecuburi River within the Forest Reserve, found 102 species (among trees, shrubs, and woody climbers). They reported *Milletia stuhlmannii* as the most common species along the gallery forest mainly characterized by a three-storey vertical structure. They also estimated the Shannon species diversity index between 3 and 4 depending on the level of disturbance.

## 5.10. Baixo Pinda Forest Reserve

### 5.10.1. The site

The Baixo Pinda Forest Reserve is located in the Nampula Province approximately 40 Km North of Nacala. It is 19600 ha in size and occupies a peninsula, which juts into the Indian Ocean and is mostly surrounded by sea.

The topography is flat with a gentle slope towards the sea on all sides, and the soils consist of deep sands.

## 5.10.2. Evaluation of the Vegetation

This Reserve was reached at a point about 2 Km South of the center of its western boundary. From there the vegetation was assessed and investigated by driving slowly along a track, first eastwards for 5 Km and then South for 3 Km and then back along the same route. Frequent stops were made to identify the plants.

Tree species identified were *Adansonia digitata, Albizia forbesii, Albizia glaberrima, Androstachys johnsonii, Annona senegalesis, Bauhinia petersiana, Brenaniodendron carvalhoi (Cynometra), Cassia afrofistula, Lannea sp., Millettia stuhlmannii, Pteleopsis myrtifolia, Rurrea coccinea* subsp. *boivinianoa, Schrebera trichoclada, Sclerocarya birrea, Securidaca longipedunculata, Sterculia appendiculata, Terminalia sericea, Strychnos madagascariensis, Vitex* sp. and *Ziziphus mauritiana*. There were also numerous species of trees and shrubs, which could not be instantly identified.

Judging from what could be seen, this Reserve consisted essentially of villages with large mature mango, cashew nut and coconut trees and agricultural land. The original woody flora was reduced to widely scattered large trees, isolated narrow strips or clumps of natural vegetation between fields and regenerating scrubby growth within the fields. Along the western boundary, the clearing of original vegetation was somewhat less advanced, there were larger tracts of regenerating natural growth between the fields and the exotic fruit and nut trees were generally less mature.

From the rudiment of the original flora that have remained, as well as from the available reports (Costa 2000) it could be concluded that the peninsula was once covered by a species rich and floristically most interesting dry forest, dominated over most parts by *Androstachys johnsonii*.

# 6. Analysis of the representativity of the present forest reserve network

The National Biodiversity Strategy Action Plan (NBSAP) discussed the conservation strategy based on representativeness of major ecosystem in Mozambique. The strategy recognizes the lack of a national classification of important ecosystems. Therefore, it adopted the WWF ecoregion approach (see Figure 9) to define the major terrestrial conservation units. These are: (a) miombo, (b) mopane, (c) mangroves, (d) coastal mosaic, (e) inundated savannas, and (f) the Tongoland-Pondoland vegetation. The units were defined at sub-continental scale and certainly may have missed floristic units of national importance. Although the units represent floristically recognizable entities, there are variations within each of the units that may be of national significance. As an example, the coastal forest mosaic of the Zanzibar-Inhambane phytocorion is comprised by four forest types: lowland rain forest, swamp forest, scrub forest, and undifferentiated forest (Clarke 2000: in Burguess and Clarke). Another example is the Miombo woodland, which covers large areas within a variety of soil and moisture conditions that may produce different combinations of species association and structure. For instance, Wild and Fernandes (1968) described eighteen miombo subtypes in the Zambezian region, of which seven occur in Mozambique.
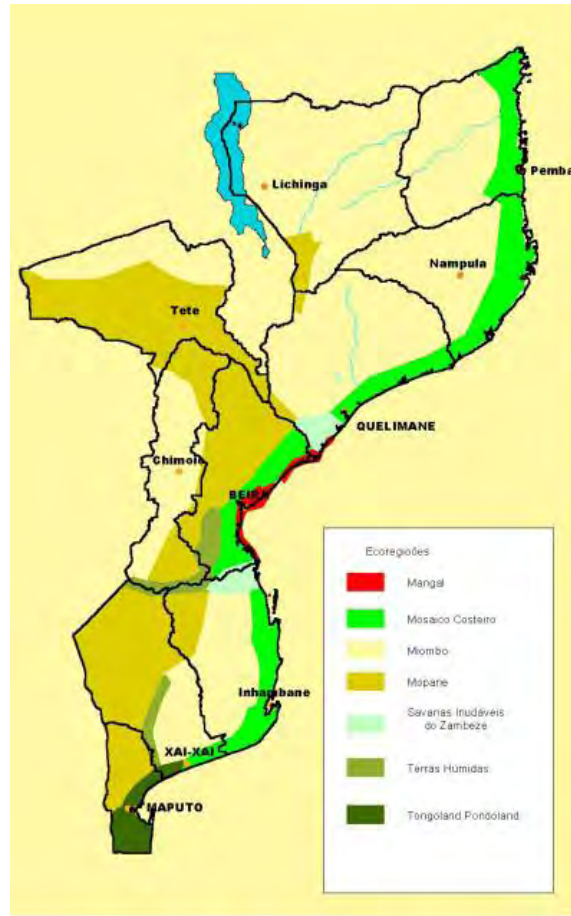
**Figure 9. Ecoregions on Mozambique, based on WWF approach (source: NBSAP)**

The Maputaland Center of Endemism (MCE) a coastal mosaic in Southern Mozambique and Northern Kwazulu-Natal, that includes the Licuáti forest reserve, has been internationally recognized for its conservation value, as it contains high numbers of endemic plant and bird species, five internationally important wetlands and a World Heritage Site. Unfortunately, this unique biodiversity is increasingly threatened by the spread of subsistence agriculture and over-harvesting, which are the product of the region's nutrient-poor soils and high poverty levels (Mosaic Conservation online: http://www.mosaic-conservation.org/maputaland/index.html visited on July 14, 2005). Conservation of this ecosystem is of high importance and urgent given its value and risk.
Like the MCE, there might be other areas with value for conservation for humanity. This situation may be true considering that the ecosystems of Mozambique are scarcely known, especially the region North of Zambeze where little has been done to characterize the ecosystems and species identification.

**Table 1. Current forest reserve network in Mozambique**

| Forest Reserve | Ecoregion | Dominant species | Area (ha) * |
|---|---|---|---|
| Baixo Pinda | Coastal | *Androstachys johnsonii* | 19,600 |
| Derre | Coastal/Miombo | *Brachystegia spiciformis* | 170,000 |
| Inhamitanga | Coastal/Miombo | *Celtis mildbraedii, Drypetes gerrardii, Millettia stuhlmannii* | 1,600 |
| Licuáti | Tongoland-Pondoland/Coastal | *Afzelia quanzensis* | 3,700 |
| M'palue | Miombo | *Brachystegia spiciformis, Julbernardia globiflora* | 5,100 |
| Maronga | Miombo | *Brachystegia spiciformis, Julbernardia globiflora* | 8,300 |
| Matibane | Coastal | *Androstachys johnsonii* | 51,200 |
| Mecuburi | Miombo | *Brachystegia spiciformis, Julbernardia globiflora* | 230,000 |
| Moribane | Miombo | *Newtonia buchanani* | 5,300 |
| Mucheve | Miombo | *Kirkia acuminate, Combretum zeyheri* | 9,057 |
| Nhampacue | Coastal/Miombo | *Brachystegia spiciformis* | 17,000 |
| Ribáuè | Miombo | *Brachystegia spiciformis, Julbernardia globiflora* | 5,200 |
| Zomba | Miombo | *Newtonia buchanani* | 2,850 |

\* The areas refer to the gazetted areas. In most of the cases the current area is less than the indicated here.

The current forest reserve network (Table 1) shows that most of the forest reserves are located in the coastal area and Miombo woodlands. One forest reserve is located in the coastal region of Tongoland-Pondoland in Southern Mozambique. In this network, the mangrove, inundated savannas, and mopane ecoregions are misrepresented. It is important to note that this misrepresentation of certain ecoregions does not mean total absence of conservation measures but the existing conservation areas fall within other categories such as national parks, biological reserves. Therefore, the evaluation of representativeness of the forest ecosystems in the conservation area network should take into consideration other conservation area categories. By doing this, all major ecoregions become represented (see Table 2 below and Figure 10). Note that the wildlife utilization areas (coutadas de caça), most of which are located in Sofala and Manica, although they are not conservation areas *senso stricto* they contribute to protect vegetation types as well. Other areas that also contribute for conservation are the wildlife reserves (reservas de caça) such as the Gilé and Niassa reserves, which are mainly defined for protection of animal species, they contribute to a large extent for the conservation of ecosystems and plant species as well. In addition, there are conservation areas of local interest, such as the Chirindzene Sacred Forest, which is protected by local community for cultural and spiritual purposes. The Forest Regulation provides room for these areas to be declared as "local reserves" and contribute to the network of conservation areas.

**Table 2. Conservation areas by category and their representation by ecoregion**

| Conservation area | Ecoregion | Area (Km$^2$) |
|---|---|---|
| A. National Parks | | |
| Limpopo National Park | Mopane | 10.000 |
| Gorongosa National Park | Grassland/ Coastal | 5.370 |
| Zinave National Park | Mopane | 6.000 |
| Banhine National Park | Mopane | 7.000 |
| Bazaruto National park | Coastal/marine | 1.600 |
| Quirimbas National Park | Coastal/marine | 7.500 |
| B. Reserves | | |
| Maputo Special Reserve | Coastal: Tongoland-Pondoland | 700 |
| Marromeu Special Reserve | Wetlands (Zambezi Delta) | 1.500 |
| Niassa Reserve | Miombo | 42.200 |
| Gilé Reserve | Miombo | 2.100 |
| Pomene Reserve | Coastal | 200 |
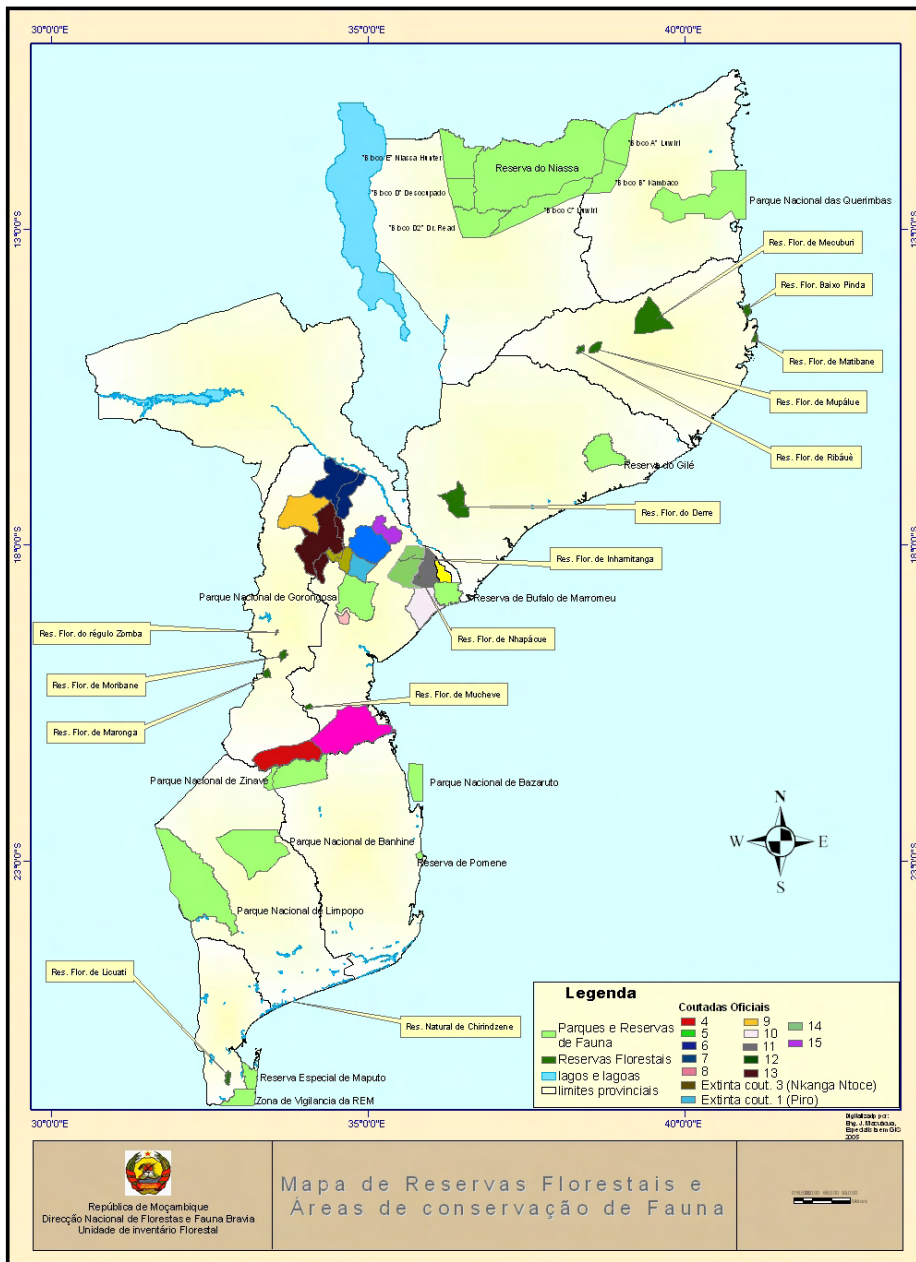
**Figure 10. Conservation areas of Mozambique (National Parks, Wildlife reserves, and wildlife utilization areas)**

Gomes e Sousa (1968) study also included identification of forest areas with potential for conservation. His list of 26 potential sites for conservation includes areas with high diversity, particularly the areas around the main mountains such as Sitatonga, Vumba,

Chimanimani, and Chiluvo, among others, and riverine areas such us Lucite, Furosi, Chicamba, among others. These measures would increase the conservation areas and the significance of representativeness of biologically diverse areas. The current situation of these proposed sites is not known presently, however, some of the sites are known to have been converted for agriculture and other land uses.

Increasing the forest conservation areas is desirable and technically justified. Therefore, additional work must be carried out to come with a list of proposed sites of relevance for conservation. The relevance should include aspects such as (i) high biological diversity; (ii) presence of rare, endemic, or threatened species or ecosystems; (iii) none or low degree of disturbance. Areas with high level of disturbance may be recommended for conservation if endangering particularly important species or ecosystems. In this case, measures of rehabilitation of degraded lands should be central to restore the ecosystem function.

# 7. Recommendations on the future status of the present forest reserve network

Ideally, biodiversity reserves should be selected on the basis of a biological survey or at least a vegetation survey, and the selection process should be integrated into general land-use planning. This rarely happens. Of the Reserves investigated in this study, only the ones in the Manica Province, and the M'palue and Ribaue, in Nampula, were gazetted with the objective of protecting interesting flora or scenic landscapes. The others were established to safeguard timber resources. However all the Reserves have been gazetted and they are therefore available for conservation, which is an important factor in their favor.

Worldwide, biodiversity conservation focuses on areas which are particularly species rich, show habitat and species diversity and contain large numbers of endemics, the so called "hot spots" of biological diversity. However unspectacular and less diverse vegetation units, also contain important genetic resources which need to be preserved (Müller 1994). Clearly to attain comprehensive *in situ* conservation of the biodiversity in any given floristic region, it is important to protect small examples of all major natural vegetation types and also of rare and unusual plant communities. This will result in a better cover of genetic resources conservation, and also create witness areas for all major ecosystems as well as for some of the rare and unusual ones. The Reserves under review in this study fall within the last two categories.

Decision to recover the actual Forest Reserves as well as the definition of new Forest Reserves for biological conservation can be done more easily if floristic data is available and the conservation status of species and ecosystems is known. This study provides basis for this process. However, because of the short time available to conduct the assessment, there are still gaps in regard to the real conservation status and the importance of the forest reserves. In addition to this, there are few studies in the country evaluating the endangered species or ecosystems.

During this assessment, some forest reserves were found to be clearly valuable for biological conservation, while others did not justify the continuity as conservation areas. Because of intense human disturbance either for agricultural purposes or for collection of forest products in the forest reserves, the recommendation given below take into consideration aspects of community use of forest reserves. For an effective management of the Forest Reserves, it should be evaluated within the context of the variability of categories of protected areas (see Box 1 in Section 3). Therefore, there were considered some recommendations, which can be applied to all or most of the forest reserves, and specific recommendations, which were drawn in function of the conservation status of each Forest Reserve.

## 7.1. General recommendations

The Forest Reserve Network is currently with poor management. Timber production is not a viable objective for most of the reserves (but Matibane and Derre can eventually produce timber sustainably) (see Sedano 2004). On the other hand, biological diversity of the Forest Reserves is barely known. Few Forest Reserves have been scrutinized for their potential for plant conservation. Previous studies carried out in Forest Reserves (e.g. Mecuburi, Ribaue, M'palue, Matibane, Moribane, Maronga and Zomba) (see Costa 2000, Doddema-de Guia 2000, Guedes 2004, Muhate 2004) provide initial steps to be followed in view to improve our understanding of the plant species composition and the potential for conservation. Therefore, the general recommendation in regard to this aspect is to provide time and resources necessary for further identification of species and ecosystems as well as the potential for conservation.

- Considering the pressure of local communities on the forest reserves, it should be recommended that an action be taken to halt the continuation of the degradation of the Forest Reserves that still protect areas clearly valuable for biological purposes (e.g. Moribane, Mecuburi). This can be attained by coordinated efforts with local authorities to identify alternative sources of income without converting forests and mechanisms to promote sustainable use of forest resources.

- Forest Reserve management schemes must be evaluated in view to benefit local communities. Co-management schemes can be privileged where pre-conditions exist. However, co-management must not be obligatory where the individual institutions show ability to protect.

- The IUCN protected areas categories (Box 1 in Section 3) should be taken into account for the definition of the Forest Reserve objectives and management schemes. Therefore, Forest Reserves should also provide opportunities for scientific research, education, monitoring of ecological processes, ecotourism, among other purposes, accordingly. Note that IUCN protected areas categories are more flexible than the actual three-classes of the Forest and Wildlife Law, however, at the same time, these can be accommodated easily within the later, to provide legal statute.

- The actual suggestion of categorization of the Forest Reserves (see Section 8) classifies the current forest reserves within IUCN categories IV, V, and VI. These categories include some forms of usage of the forest resources, to accommodate the needs for local communities, at the same time that the initial objective is partly preserved. Categories I, II, and III are missing in the current forest reserve network, meaning the need to identify areas with high biodiversity that can be additionally established for the main purpose of protection of biological diversity.

- The role of institutions devoted to conservation is to be recognized in view to synergize across institutions. Therefore, the participation of all stakeholders should be encouraged and strengthened. For instance, Forest Reserves with

potential for Ecotourism should be managed in schemes that include the Ministry of Tourism, and Forest Reserves with potential for resource utilization should be managed in accordance with forest management principles. In addition, the participation of conservation NGO's such as IUCN and WWF should be motivated and establish linkages with the international conservation networks. Collaboration with Universities and research institutes should also be encouraged in view to incorporate research themes in biodiversity conservation and sustainable forest management, and encourage teaching and training of professionals with vision for conservation, and promote monitoring of long term ecological processes.

- Payment for Environmental Services (PES), although may seem complicated at the first, it should be evaluated as an option to improve the management of Forest Reserves and increase income opportunities.

- The conservation strategy should be in line with the National Biodiversity Strategy and Action Plan (NBSAP) in view to contribute to the implementation of the Biodiversity Convention. Therefore, the Ministry of the Environment should be a key institution in defining strategy for conservation and implementation of activities.

- The boundaries of the Forest Reserves are not always known or sometimes within the known limits there are activities not compatible with conservation purposes including the existence of large human settlements, agriculture, and other activities which do not coexist with conservation measures. In these cases, review of the boundaries will be required. Alternative would be to define a zoning strategy in which within the Forest Reserve a core area is differentiated from the buffer zone and multiple use zone. Experiences for zoning exist in Mecuburi and Derre Forest Reserves.

- The existing maps of the forest reserves are sometimes misleading either with wrong boundaries or with wrong geographic coordinates. An exercise was conducted during this assessment to recover the location maps and the geographical coordinates. However, this revealed to need additional effort to make a coherent definition of the coordinates system and maps.

## 7.2. Specific recommendations

### 7.2.1. The Nhampacue Forest Reserve

The vegetation of this Reserve is generally degraded, and it is likely that the Reserve will be subjected to frequent fires, and consequently further degeneration is expected to take place. Fire management would be needed to allow for recovery. The Reserve, on its own, could not be considered to have much value for conservation.

Since similar, but better preserved vegetation exists in the large Hunting Concession Area which surrounds the Reserve, it is strongly recommended that ways must be found to declare the entire Concession Area, including the Nhampacue Reserve, a Biodiversity Reserve and maintain it as such. This would protect the most interesting vegetation patterns that exist between the Inhaminga-Inhamitanga-Marromeu Road and the Zambezi River Delta, and also consolidate the already protected delta area with its surrounds, into a single unit of outstanding conservation value. The only drawback is that most of the rainforest patches which are scattered throughout the area have been settled and destroyed, and efforts would have to be made to protect the remaining ones, or better still to resettle the people elsewhere.

## 7.2.2. The Inhamitanga Forest Reserve

The moist evergreen forest of Inhamitanga is a most important conservation priority forest; however the shape and size of this reserve, a narrow strip (0.5 x 10 Km), is not satisfactory. The presence of a road going through it makes it highly risky for disturbances associated with the road, either natural (cyclones and strong winds) or human induced (fire caused by passers by). It is recommended that the section of the reserve which contains rainforest should be substantially enlarged, to up to 10 x 10 Km, depending on what is feasible, with a 2 Km wide buffer zone along the western, southern and northern boundary, and a 4 Km wide one along the east. This would also protect an increased area of the well-preserved dry forest to the East of the rainforest. Whether the suggested boundary changes and increase in size are feasible, needs to be checked out by carrying out further field work, and also in discussions with the various stakeholders.
It is also recommended that the 850 ha of degraded woodland West of the rainforest, except for the 2 Km wide buffer zone, be de-gazetted (or defined as multiple land use through a participatory zoning process) and put to other land uses.
The moist evergreen forests of the Inhaminga and Inhamitanga area are considered of very special vegetation type. It is therefore strongly recommended that their total distribution is determined, using recent aerial photographs, and afterward, to examine all that still exists on the ground. This is to ensure that the above suggested conservation measures are sufficient to protect all variations that exist, and if not to allow for suggestions for additional reserves.
Given the low population pressure within this Forest Reserve, it is suggested to be IUCN category IV to allow management activities, particularly fire management, to maintain the forest structure and the associated species.

## 7.2.3. The Mucheve Forest Reserve

This Reserve was once covered with a most interesting dry forest. However the vegetation has been decimated to such an extent, that it is debatable whether, even parts of it, can still be rendered into a conservation area.
It is recommended that a further survey of the Reserve be conducted, to investigate whether there are some areas that have the potential to recover into something resembling

the original dry forest. If such areas still exist, the best one has to be selected and protection measures put in place. If not, de-gazetting of the Reserve is recommended.

It is also recommended that the surrounding areas be scrutinized, initially on recent aerial photographs, to see whether well preserved examples of a similar kind of dry forest still exist within the same ecological environment (especially the same geology). If one is found, a case for its conservation should be prepared.

## 7.2.4. The Moribane Forest Reserve

The moist evergreen forest of the Moribane Forest Reserve, as well as the small areas of dry forest in the north, are generally well preserved and constitute an important conservation priority. It is therefore strongly recommended that efforts are made to protect as much as possible of the natural vegetation which exists within the Reserve. The fact that parts of it are recovering from a major natural catastrophe adds interest as well as biodiversity to the Reserve, and also provides an opportunity to study rainforest dynamics.

The Moribane forest reserve is species rich and represents unique forest type on the slope of the mountain areas. The conservation of this reserve is highly desirable and promising. The previous work done by the TFCA project to sensitize the local communities created the bases for community participation. However, after the term of the project, clearing of the forest increased as people were left without alternatives for living and the bananas appeared promising. Considering these aspects, the protection of the Moribane forest reserve is dependent on the promise for continuity of the activities and community participation. Therefore, a compromise needs to be made with the banana plantations. The suggestion is to:

a) allow 5% (needs to be estimated) of the forest reserve to be converted to banana plantation, this should be located in the Southeastern part where agricultural pressure is high

b) define an expansion area for banana in the lowland, outside the forest reserve, and

c) define a zoning system that includes the community areas including the banana areas.

This Forest Reserve is suggested to be classified under IUCN category VI, to allow sustainable use of forest resources, particularly aiming at generation of income for local communities.

## 7.2.5. The Zomba Forest Reserve

Over most of the Zomba Reserve the natural vegetation has been obliterated to an extent that it can no longer be expected to function as a Nature Reserve. It is recommended that all areas which consist of mainly agricultural land be de-gazetted.

Some well preserved moist evergreen forest still exists in the south of the Reserve, but at least parts of it are under an immediate and serious threat of extinction.

The rainforest which still exists along the eastern base of the Chimanimani Mountains is considered to be a most important conservation priority. Much of it has been destroyed in the recent past and most of the remainder is severely threatened. It is therefore

strongly recommended that a survey be conducted of these forests, including the galleries along the watercourses. The survey should cover the area between the Mussapa and Lucite Rivers and should consist of the interpretation of recent aerial photos, as well as floristic investigations on the ground. Previous botanical work in the area indicated that considerable variation, regarding the species composition, exists between the various forest patches. It also revealed the presence of interesting rainforests between the Zomba and the Maronga Reserves. With the results of the survey in hand, it would be possible to develop a sound conservation strategy for the rainforests that are left in the area. This might include recommendations that part of the Zomba and Maronga Reserves and possibly some of the area between the two, should be incorporated in the Chimanimani TFCA. It would also help to assess the value of the forest in the Zomba Reserve and assist in deciding to what extent its destruction can be condoned. In addition the survey might locate Pandanus dominated swamp forest, to substitute the one which was destroyed at Zomba.

## 7.2.6. The Maronga Forest Reserve

This forest reserve is among the well preserved forest, with little human disturbance. However, the indications of illegal logging and clearing for agriculture that were observed during the visit, shows how susceptible the forest is to disturbance. The uniqueness of the forests, the diversity of ecosystems, suggests the need for measures for conservation. Its peculiar views and the occurrence of waterfalls and scenic views offer it a high potential for ecotourism. However, this needs to be particularly assessed.

The Maronga Reserve protects Brachystegia-Woodland and Rainforest. Both are conservation priorities, but the rainforest particularly so. It might be sensible to hand over the western and north-western parts of the Reserve including a substantial portion of the Brachystegia-Woodland to the Chimanimani TFCA, and de-gazette the remainder. However, further fieldwork would be needed to support this action. For the present it is strongly recommended that utmost vigilance is applied to prevent further destruction of natural vegetation in the vicinity of the Chimanimani Mountains. It is important to note that on the Zimbabwean side, the Chimanimani National Park is in place, with good management, from which lessons could be learnt and joint conservation measures adopted.

The scenic and ecological value of the Maronga Forest Reserve and the low population pressure suggests it to be classified under IUCN category V. Its biological diversity is a value added that should be managed to maintain its value.

## 7.2.7. The M'palue and Ribaue Forest Reserves

The two forest reserves were established with the objective of conservation of water catchments that feed the River Mepuipui, a branch of the Lurio River, apart from protecting the flora and fauna in the area. These objectives continue valid today and should be strengthened. The current danger of the reserves is associated with agriculture, which should be minimized, or if possible, kept out of the slopes and on the valley

between the two mountains. Costa's assessment noted that people living on the valley, or those who use the mountain slopes for agriculture, are willing to abandon the site is presented with an alternative option. This being possible, it would be recommended to join the two forest reserves into one and maintain active the biological corridor between the two mountains.

Conservation of habitat for protection of slopes and water springs and the biological corridor suggest classification of the two Forest Reserves as IUCN category IV, allowing management activities, particularly fire management, to help maintain forest structure.

## 7.2.8. The Matibane Forest Reserve

Its location, along the coastline, inspired Doddema-de Guia (2000) and Costa (2000) to suggest an extension of the reserve to include the marine ecosystem. This suggestion is strongly supported as it would align the Reserve much better to the surrounding landform and make it a more natural landscape unit. Also adding neighboring habitats with their transitional zones (ecotones), enlarges the ecosystems that prevail in the reserve and enhance its value as a conservation site tremendously.It is well preserved, and the two neighboring communities have the will to collaborate in conservation. These aspects are crucial to ensure protection. SEI (s.d.) shows that conservation interest for this forest reserve is high and planning measures are ongoing to produce the management plan for the forest and marine reserve.

This is an example of a Reserve devoted to a rare and unusual vegetation type and therefore constitutes an important conservation priority. Similarly to the Mecuburi Reserve, it consists of a well protected core area and a buffer zone, and is generally well managed. The suggestion to classify it as category V of IUCN gives it an opportunity to preserve the ecological value of the terrestrial and marine ecosystems as a whole while not excluding the local community from collecting products for their own use.

## 7.2.9. The Mecuburi Forest Reserve

The Macuburi Reserve is mainly protecting a generally well preserved and varied example of Brachystegia-Woodland, which is, or was, over large areas of northern Mozambique, the typical vegetation cover. It also protects some good gallery forest and some relatively small areas of dry forest. With its large size and extensive buffer zone, it has the potential to develop into one of the most important Biodiversity Reserves in Mozambique. The Reserve is well managed and the only recommendation that can be made is that it is important to ensure that no logging is taking place in the core area of the reserve. It is also recognized that the success of management is also associated with the co-management scheme with local communities in place, which should also be strengthened for the benefit of the biological conservation and to the benefit of local communities. There are plans in hand to remove all settlements from the Reserve. This might not be a good idea, since it would create some 100 000 ha of under-utilized land, with very little value for conservation. However, should the people remain, it is important that the area of cultivated land does not increase into the buffer zone.

The Mecuburi forest reserve is suggested to be classified under IUCN category VI to allow sustainable management of forest resources for income generation for local communities. Particular emphasis should be given to timber and non-timber products and wildlife as potential products to be generated from the forest.

## 7.2.10. The Baixo Pinda Forest Reserve

Most of the Reserve has been converted to agricultural land and it is uncertain whether a large enough area can still be found which has the potential to recover into the original dry forest. It is recommended that a further survey is conducted, especially of the less degraded western side, to investigate whether an area still exists on which the flora is likely to recover sufficiently, and that it can become a witness area for the original vegetation. If the search is successful, protection measures have to be put in place. If not, the Reserve should be de-gazetted. This might not be a serious loss, since similar vegetation occurs within the well preserved Matibane Reserve.

# 8. Priority actions for the rehabilitation of the Forest Reserves

| Forest Reserve* | Category** | Opportunities | Priority actions |
|---|---|---|---|
| 1. Matibane | V | - Possibility to combine with Marine Ecoregion<br>- Occurrence of endemic species<br>- Community participation in place<br>- Forest Service currently present<br>- MICOA in progress of proclaiming a biological reserve<br>- Low human pressure | - Link up with the marine ecoregion<br>- Strengthen community participation<br>- Identification of local community income generation activities compatible with forest protection<br>- Define zoning to separate the use zones (use Mecuburi experience)<br>- Update biodiversity inventory (include terrestrial and marine ecosystems)<br>- Prepare a management plan in accordance with suggested category needs<br>- Define as ecological monitoring site |
| 2. Inhamitanga | IV | - Rare ecosystem<br>- Neighborhood with private sector with vision for conservation<br>- No agriculture pressure | - Extend the boundaries of the reserve to increase the resilience<br>- Prepare a management plan that includes fire management and protection<br>- Update biodiversity inventory including plant and animal species<br>- Liaise with the neighboring private sector to make the management effective |
| 3. Moribane | VI | - Possibility to link up with he Chimanimani TFCA<br>- Community participation in place<br>- Rare ecosystem<br>- Occurrence of elephant<br>- Protection of water springs and | - Arrest agriculture expansion<br>- Participatory zoning to define core protection area, buffer zone and multiple use<br>- Strengthen the community participation<br>- Update biodiversity inventory (include plant and animal species)<br>- Evaluate the potential for elephant protection |

| | | | |
|---|---|---|---|
| | | - slopes | - Prepare a management plan in accordance with suggested category needs<br>- Identification of local community income generation activities compatible with forest protection<br>- Identify areas for agricultural expansion<br>- Evaluate potential for ecotourism<br>- Define as ecological monitoring site |
| 4. Mecuburi | VI | - Typical miombo woodland<br>- Occurrence of elephant<br>- Community participation in place<br>- Forest Service actively working<br>- High variety of non-timber forest products | - Update biodiversity inventory including animal and plan species<br>- Evaluate potential for elephant management<br>- Strengthen community participation<br>- Enforce the existing zoning<br>- Identification of local community income generation activities compatible with forest protection<br>- Prepare a management plan in accordance with suggested category needs |
| 5. Maronga | V | - Possibility to link up with the Chimanimani TFCA<br>- Potential for ecotourism<br>- Protection of water springs and slopes | - Link up with the Chimanimani TFCA<br>- Update the biodiversity inventory<br>- Liaise with the Zimbabwe National Parks<br>- Evaluate potential for ecotourism |
| 6. M'palue/Ribaue | IV | - Protection of water springs and slopes<br>- Potential to join M'palue and Ribaue<br>- Non-timber forest products | - Assess community participation for management<br>- Evaluate potential to establish a biological corridor on the valley between M'palue and Ribaue<br>- Update biodiversity inventory<br>- Join M'palue and Ribaue as one reserve<br>- Arrest agricultural expansion within the reserve |

\* Numbering refers to priority rank (Forest Reserves not listed are either to be degazetted or were not subject of this study)
\*\* IUCN protected areas categories

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# Annex 1. Terms of Reference for Assessment of the Forest Reserve Network in Mozambique

**Background Information**

In Mozambique the Forest Reserves are protected areas which, in IUCN Categories (category VI) are managed mainly for sustainable use of natural ecosystems, falling under jurisdiction of the National Directorate of Forestry and Wildlife (DNFFB). These are the only "protected areas" under the responsibility of this Department within the Ministry of Agriculture. The other protected areas (National Parks and Reserves, Coutadas) are under the responsibility of the Ministry of Tourism. The Forest Reserves were adopted by the Government of Mozambique as a mechanism to protect and maintain the biological diversity while promoting sound management practices for sustainable production purposes. However, DNFFB itself has expressed having difficulties in maintaining an appropriate and effective management of these forest reserves.

The current forest reserve network comprises 13 forest reserves (see Appendix 1) which can mainly be grouped as coastal forest and miombo woodland. When the most of forest reserves were established, 50 years ago, the majority had predominance of *Afzelia quanzensis, Millettia stuhlmannii, Pterocarpus angolensis,* and *Khaya nyasica* plants species.

Most of the forest reserves were abandoned for long periods of time especially during the civil war and there's presently lack of legal instruments to support the Forest reserves on the current legal framework alongside with insufficient updated information regarding the status of the forest Network, including the availability and extent of the resources that motivated the establishment of the forest reserves. Moreover, the demographic and migratory population's trends from the buffer zones may have shifted into the most of the forest reserves and consequently requiring use of different boundaries and approaches to reconcile the environmental, economic and social needs as an incentive for durable collaboration on behalf of sustainable management of Mozambican forest reserve Network.

Many efforts have been undertaken within DNFFB to have a clear picture of the present forest reserve Network status. In this context, WWF offered the possibility of supporting DNFFB on an assessment of the existing forest reserve Network in Mozambique. Thus, WWF is now preparing the assessment of the Forest reserve Network in Mozambique. The available information regarding the forest reserve network (see Appendix 1) relies on data produced around 1950 and little information regarding the forest reserve network has been updated up to now.

**Overall Objective**

The overall objective of the assessment of the Forest reserve Network in Mozambique is to:
Ensure that the forest reserve network in Mozambique includes all major woodland or forest types in Mozambique and the forest reserves are of a size and distribution that would facilitate ecological function, conservation of habitats and plant genetic resources as well as utilization functions where applicable.

**Specifics Objectives**

Specifically this assessment intends to:
6. Identify any gaps in the representation of forest types in the national forest network and recommend, if applicable the proclamation of additional ones.
7. Develop a system of forest reserves that meet economic, ecological, social and cultural needs of the present and future generation of Mozambicans.
8. Assess the status of management or protection of the major reserves and propose actions to improve protection or sustainable production of goods and services.
9. Identify opportunities and justify policy or legislative reforms to manage/protect the reserves network.
10. Explain the links and contribution of Mozambique's forest reserve network to biodiversity conservation, tourism, energy, hunting, soil and water values.

**Out-puts**

The expected outputs from this consultancy are:
1. Report on the actual Mozambican forest reserve status Network.
2. Recommendations on the future statutes of the present forest reserve Network.
3. Analysis of the representativity of the present forest reserves Network and proposals for improvement.
4. Action plan proposal to ensure sustainable management of forest reserve network reconciling socio-economic and environmental requirements.

**Methodology**

1. Detailed work plan before fieldwork begins (for approval).
2. In-depth consultations and interviews with relevant specialists.
3. Use of Government maps and reports.
4. Two workshops, one at the beginning and another at the end of the exercise to present results and finalize report.

**Forest Reserve Team Reference Group**

The forest reserve team reference group comprises Mozambican experts directly involved in the forest reserve issues in Mozambique that should be consulted for the purposes of this consultancy. The following may constitute the core group:

1. CEF (Forestry Experimental Center).
2. UIF (Unit for Forest Resource Inventory).
3. INIA (National Agrarian Research Institute).
4. DEF/UEM (Eduardo Mondlane University – Forest Engineer Department).
5. IUCN (International Union for Conservation of Nature).
6. WWF (World Wide Fund for Nature).
7. UMC/DNFFB (Community Management Unity, National Directorate of Forestry and Wildlife).

**Time-frame**
The consultant should complete all the research within 20 days, from early June 2005.