PRELIMINARY ASSESSMENT OF THE COASTAL VEGETATION AND MANGROVE FORESTS OF THE PROPOSED CONSERVATION AREA OF THE PRIMEIRAS (1as) AND SEGUNDAS (2as) ISLANDS ARCHIPELAGO

Tereza Alves & Camila Sousa
IIAM – Mozambican Institute for Agrarian Research
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Executive Summary

A preliminary assessment of the biodiversity of the coastal areas of the Primeiras and Segundas Islands Archipelago was conducted from October 15 to 28, 2006. The objective of the study was to gather background information needed for the implementation of conservation/development programs for the archipelago.

The population of this region depends primarily on fishing, subsistence agriculture and cashew plantations for its livelihood. Population growth has led to accelerated patterns of land occupation and exploration for agriculture in the area between Boila and Potone, in Angoche province.

Though counted as a "traditional" activity that provides for the livelihood of a great number of families (80,000), illegal fishing is cause for concern for the Angoche Fishermen's Association and led to the placing of a vessel in the area to patrol the coast. In the Potone forest (approximately 25 km from the city of Angoche), one witnesses an increase in for profit lumber exploration by bearers of regular licenses. This leads to an intensive, highly selective exploration of *Combretum imberbe* (Leadwood), *Millettia sthulmannii* (Jambire) and *Swartzia madagascariensis* (Ironwood), all first-quality species, and *Dalbergia melanoxylon* (Blackwood) and *Berchemia zeyheri* (Rosewood), both precious species as well. Without the benefit of community protection or that of forest rangers, these woodlands are subject to much short-term degradation (Figures 4 and 30). Intensive firewood exploration, as well as exploration for stakes and boards for building artisanal fishing vessels, occurs both in the Angoche mangroves and in the Rio Larde area.

Uncontrolled, frequent and intensive burnings (Figure 5) is yet another factor contributing to woodland degradation. These fires are commonly set by farmers to clear land for their plots, but also by timber prospectors clearing land for their own purposes. In Potome, these burnings trouble local residents and fishermen alike, for to them the forest is a place for conducting ceremonial rituals and, especially for the circa 160 medicine men residing in the district, a source for medicinal plants. Angoche fishermen, for example, carry out annual traditional ceremonies to supplicate a favorable harvest. The local people believe that their ancestors dwell in the forest. When the forest is destroyed these spirits disappear and must then "take up residence" in family homes, where they foment conflict among the members.

Knowledge of the resource points to the existence of considerable biodiversity, distributed into two distinct categories of vegetation: the mangroves and the dry coastal forest (Graph 6). The coastal forest is itself composed of a mosaic of different vegetation types, such as the predominately leguminous category where *Icuria-Hymenaea* formations prevail along with *Brachystegia*, both favoring the sandy soils of the coastal dunes. There are, in addition, mixed woodlands composed of various species associations along with those that flourish in riparian forests, especially *Kayak anthotheca* and *Parkia filicoidea*. These formations are influenced essentially by edaphic, anthropogenic and site-specific factors arising from disturbances that deplete, degrade and alter species composition.

Other plant formations were observed in the area, such as the coastal arbustive (bramble) forest that characterizes the swath of coastal woodland created by anthropogenic disturbances, and the plains composed of sandy, hydromorphic soils in areas subject to periodic flooding and seasonal watercourses.

A total of 206 vascular species were recorded. Of these, only 137 were collected as they presented botanical characteristics (blooms and/or fruits) that permitted subsequent identification in the herbarium. Thus far, 129 species, or 63% of those recorded, have been identified. These are grouped into 54 families, 31 of which are represented by a single species (Table 3 and Appendix II).

Of the identified species, three are endemic (*Icuria dunensis and Memecylon sessilicarpum*) and one, the 'Ekoda' (*Euphorbia bougheyi*) considered rare, with a single specimen of Euphorbiaceae having been found in an *Icuria* forest of Thopuitho (Figure 9). The only existing specimen in the herbarium was collected in 1963 at the beach in Beira. Six vulnerable species were also recorded (*Afzelia quanzensis*, *Craibia brevicaudata*, *Kayak anthotheca* and *Sterculia appendiculata*), which does not include two species not registered in this floral study, one that is endangered (*Craibia zimmermannii*), and three that face a low degree of risk (*Dalbergia melanoxylon*, *Millettia sthulmannii* and *Pterocarpus angolensis*).

Some species, such as the recently-classified *Icuria dunensis*, an endemic species observed in the dunes in Angoche e Thopuitho, are of both local as well as regional in importance. These

occur among mixed populations of *Hymenaea verrucosa*, *Afzelia quanzensis* and *Garcinia livingstonei*, among others. This species is endangered on account of the frequency with which it is tapped for firewood, lumber and bark, for these purposes supplanting the cashew trees in the area of Angoche.

It should be noted that of the six species found in the Angoche and Rio Larde mangrove forest, only three are common to the other mangrove forests surveyed. These are the 'Mutxo' - *Avicennia marina*, 'Inkatala' – *Ceriops tagal*, and 'Ntulo' – *Rhizophora mucronata*. Two species were fond on the inner banks of the Larde River, on the mangrove forest's leeward side. One of these identified was the *Sideroxylon inerme* – 'Ekhavá'. Fishermen have mentioned a mangrove species bearing the common name 'Mácui'. Neither identified nor observed by the team, this plant may be a rare species.

Of the species cited in this study, 63% are used for various purposes by the local communities and loggers. (Graph 2). It has been estimated that 30% of the species are employed medicinally, thus the importance of the Potome forest to the local community. Lumber exploration, as was further revealed, focuses on few species, only1.9% of those utilized. It should be pointed out that the six mangrove species are utilized for different ends, especially firewood, for which the species of choice are *Ceriops tagal* and *Rhizophora mucronata* (Table 5).

The greatest threat to these resources has come from the clearing of agricultural plots and the tapping of woodland resources for purposes of both lumber extraction (in Potome) and other ends (*Icuria* and mangroves). Agricultural activity has, furthermore, isolated these formations and caused considerable fragmentation into small, woodland-like areas such as the *Icuria* and *Brachystegia* forests.

Conservation and/or intervention priorities were assessed based on the total value of criteria related to conservation and landscape and those related to resource sustainability and threats to resource quality. The following areas were identified as being important to the conservation effort: (i) for its biological value, the stretch of *Icuria dunensis-Hymenaea verrucosa* coastal forest in the Thopuitho region and the riparian tracts of Potone; (ii) for their importance to the landscape, the mangroves of the islands of Angoche and the Larde River; (iii) for its cultural value, the swathe of

coastal *Brachystegia* forest of the Micolene region, as well as Potone's coastal mixed forest in the area known as Malaika.

These areas, though they may face grave threats (low degree of conservation, disparate land use and unmanaged employment of resources), can benefit from conservation and have their sustainability ensured through the implementation of measures that mitigate these harmful effects. The mixed forest of Potone (Angoche) and Nanthuco (Thopuitho) provide us an example. In these areas, where one finds first-quality timber resources, some threatened and vulnerable, programs that can benefit the local communities are recommended.

Though benefiting little from conservation because of the various pressures (cashew-tree planting, urbanization and fire-wood extraction) it bears, the *Icuria dunensis* tract near the city of Angoche appears to be biologically important as this forest contains a number of rare and endemic species. It is suggested, then, that urgent studies be implemented to assess the genetic make-up of the resources, which information can be stored in genetic data-banks (*ex-situ* or *in-situ*).

Action and programs that provide for sustainable resource management are urgently needed. The plans should, on one hand, take into account the biodiversity potential and beauty of the landscape and, on the other, encourage the development of a tourism industry and encourage implementation of for-profit agricultural practices for the benefit of the local population.

We should highlight the habitats of interest and their potential: (i) the mangroves that could possibly be open to tourism, benefiting the local communities directly (through a percentage of tourism receipts) and indirectly (protection of the mangrove forest and resulting guarantee of maintaining the quality of the refuge for faunal species); (ii) the Petome forest in the area of 'Malaika', as a local sanctuary and for purposes of cultural tourism; (iii) the *Icuria* and *Brachystegia* forests for the protection of these particular coastal forest species; (iv) the riparian forests of the leafy and dramatic *Kayak anthotheca* trees; e, (v) forests for community use in Nanthuco and portions of Potone.

We propose more detailed studies: (i) for the Larde River mangrove forest; (ii) in the Potone forest, for the establishment of a land-utilization strategy; (iii) in the Nanthuco forest, to evaluate the feasibility of resource exploration, particularly that of the *Olax dissiflora*

('M'siro') species; (iv) in the *Icuria* forest of Muebasse, to determine its dimension and conservation status; (v) of the group of islands that make up this archipelago, we suggest a study of the vegetation of the islands of Fogo, Casuarina, Epidendron and Caldeira in view of marine currents' influence on its flora, species of which are believed to have their origins in Australia, India and the Pacific Islands; (vi) studies to promote improvements to and rehabilitation of the *Icuria* forests in Potone (containing medicinal species), as well as Potone's riparian forest and that of Nanthuco; and, (vii) the rehabilitation degraded by mineral exploration.

We should want to stress the importance of recovery/planting efforts of the Inguri village mangrove forest in the city of Angoche, which was carried out by the Angoche Fishermen's Association. This initiative must be encouraged and granted supplemental assistance, both technical and financial, to conduct studies of the processes of the mangrove forest's expansion.

BACKGROUND

The area initially proposed for carrying out this study is of interest to the WWF as a site for implementing conservation programs. The WWF's interest stems from the extraordinary quality of the landscape and the wealth of biodiversity found in the patches of coastal forest and mangroves, together with the area's many marine species and corals. Of equal importance is the cultural diversity of the communities that inhabit the region. It should be noted that the WWF's interest in the region was prompted by the Angoche Fishermen's Association, concerned about the unchecked exploration of the region's vegetation (mangroves as well as coastal forests), the impact sustained by fisheries, and the degradation of the Potone forest, important for its medicinal resources and as a venue for traditional ceremonies. The Archipelago of the Primeiras and Segundas Islands was also selected as an important conservation area (IPAs) of high priority for conducting studies to help establish its status (Smith, 2005).

This coastal zone has a high population density which taxes its resources, placing these under serious risk of degradation if not adequately controlled, managed and protected. The existence of salt beds in the mangrove, agricultural expansion, uncontrolled burnings and the exploration of forest resources (for wood, lumber and firewood) represent the chief threats to the resource. A new activity, heavy-sands mining in the Moma region, is now underway. The mining industry has attracted migrations of those seeking better employment opportunities and relocated a number of communities that now inhabit areas granted the concessionaire, contributing to a need for new farms, fuel sources and lumber for building.

All of these activities are being carried out in an accelerated fashion, feebly monitored without adherence to adequate planning and management. This situation is further aggravated by the limited understating of the region's resources, environmental conditions and requirements for harmonious development.

The area in question encompasses patches of coastal forest, island vegetation, a mangrove complex and, in the deltas of the permanent waterways, areas that often become flooded. These various ecosystems are ecologically interrelated and provide food for the local population, together with a mating habitat and refuge for numerous species. A new forest species, *Icuria dunensis*, was identified in the local forest, where it occurs in dense growths in some areas.

According to expedition reports prepared by Gomes and Sousa in 1953 and 1965, the vegetation of the archipelago's islands is fascinating for being composed of species transported by sea currents from their origins in Australia, India and the Pacific Islands. The Ilha do Fogo (or Malibono), for example, presents species that are typical to East Africa (e.g., *Terminalia catapa* and *Caesalpinia crista*), with its vegetation being composed primarily of *Mimusops* sp., *Diospyros mespiliformis*, the latter being a variation of the species that occurs on the continent. The Ilha das Casuarinas (or 'Tanibi', 'Ilha das Árvores or dos Franceses'), besides the *Casuarina equisetifolia*, contains a dense arboreal population composed exclusively of *Diospyros mespiliformis* and shrub species that typically result from marine currents, such as the *Cassia fistula*. The Ilha de Epidendron (or 'Maloa', 'Rasa', 'Palmeiras') possesses vegetation whose composition is identical though more leafy (height 15 m / diameter 60 cm) than that of the other islands, thereby presenting a humid forest system in the more sheltered areas. We should mention the presence on this island of an epiphyte orchid of the *Vanilla* genus that grows along the branches and trunk of the *Diospyros* Lastly, the Ilha Caldeira is covered by a dense, shrubby heath of *Vangueria*, *Strychnos*, *Garcinia* and numerous lichen that do not occur on the other islands.

According to the referenced author, the islands' terrestrial fauna is scant, though he mentions a rat infestation on Ilha do Fogo and an abundant rabbit population of Ilha de Epidendron. At this time the author suggested establishing an ornithological preserve on Ilha Puga-Puga because of the abundance of the marine bird *Sterna fuscata*.

OBJECTIVES

To propose and design conservation / development programs for the Archipelago of the Primeiras and Segundas Islands, the ecosystem as a whole must be understood and the recovery / regeneration potential of its species must be determined by identifying the factors that impede their development.

SPECIFIC OBJECTIVES

In particular, this preliminary study on the basis of existing flora seeks information that would:

- Identify and describe vegetation types (forest and mangrove) that exist along the coast between Angoche and Moma ;
- List the species of the coastal forests and mangroves of this region;
- Identify the primary threats (forest-products extraction, agriculture and demographic pressures) facing this resource);
- Provide a preliminary list of the region's rare and endemic species; and,
- Recommend potential conservation areas and propose relevant activities that can be integrated with the management plans.

LOCATION AND GENERAL CHARACTERISTICS OF THE SURVEYED AREA

LOCATION

The area initially proposed for study is situated along the Primeiras and Segundas Islands archipelago, between the districts of Pebane and Angoche, in a 10 to 30 km

coastal strip encompassing mangroves, spots of coastal forest, dunes and island vegetation. However, because of time constraints and available funds, visiting the islands proved untenable. The study encompassed only the districts of Angoche and Moma, covering an area extending from the north of Angoche (Lat. 16º 13 742 S; Long. 39º 57 104 E) to the north of Moma (Lat. 16º 32 030 S; Long. 39º 33 341 E), respectively (Figure 1).

The areas surrounding the city of Angoche encompasses Petome forest (25 Km south of the city), the Angoche dunes (on the way to Praia Nova, 7 km from the city), and the Angoche mangrove forest, including the Island of Angoche, specifically the "islands" of Nhankuba, Mupacotó, Nadjeque, Buzo and dos Passarinhos. In the district of Moma, in the Thopuitho area of Tipane, the study encompassed the zones surrounding Kenmare, which are, respectively: the *Icuria* forest; the coastal area between Kenmare and the Larde River, including its mangrove forest; and, Nanthuco forest in the village of Nathaca.

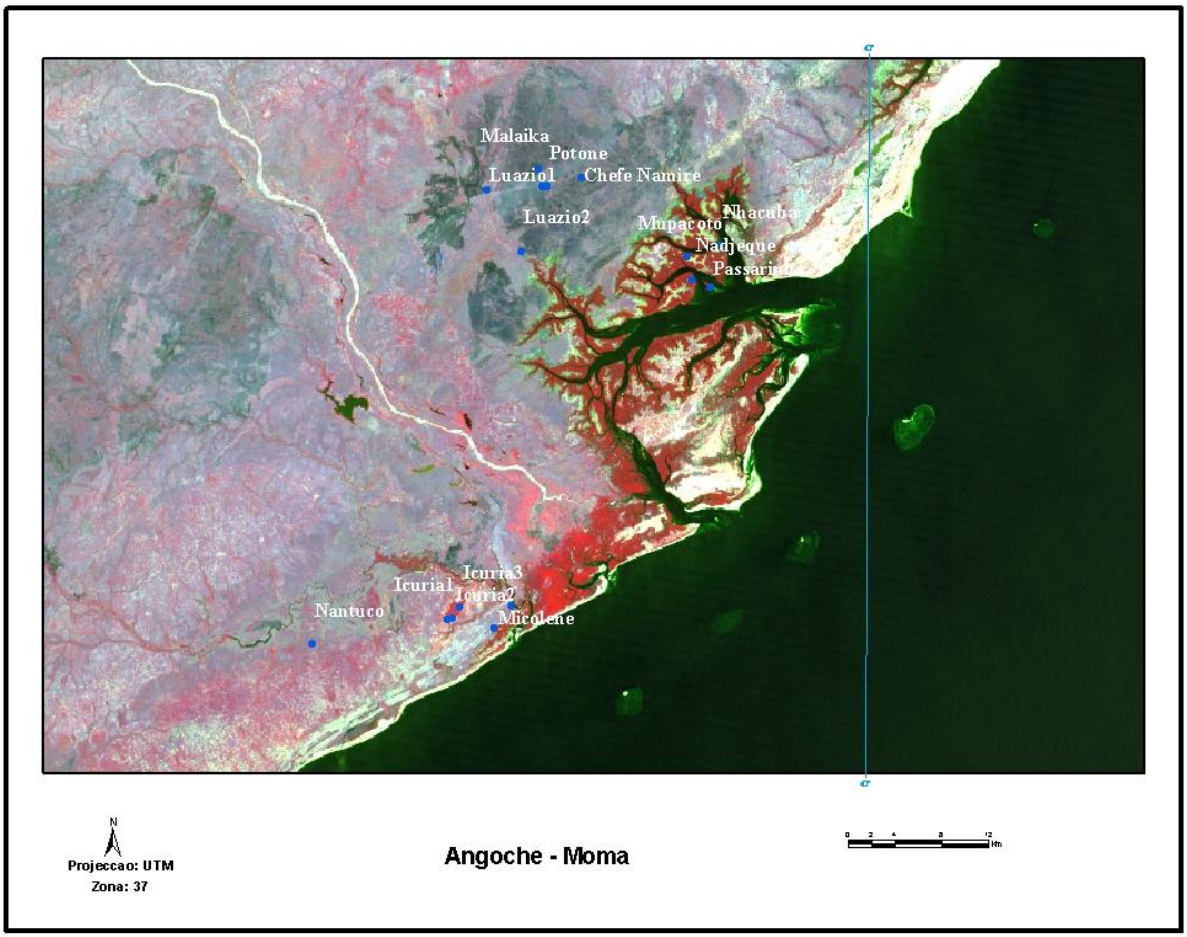

Figure 1: Satellite image identifying the three areas surveyed: Potone, Angoche and Thopuitho.

BIOPHYSICAL CHARACTERISTICS

The area in question is generally flat, excluding some undulating dunes in the Thopuitho (Kenmare) region. The soils are deep and mostly sandy, with the exception of the muddy, alluvial ones of the mangrove forests and the sandy soils resulting from alluvial deposits, presenting higher levels of lime (5-10%).

Two seasons characterize the region's tropical climate: a dry one from May to November, and a rainy season from December to April. The average annual precipitation of 1,000 to 1,400 mm is influenced by cyclones, which are very common to the Mozambique Channel. Average annual temperature is 25.6 ºC, with a maximum of 30.4 ºC and a minimum of 20.8 ºC.

A concentration of drainage paths and rivulets merge into the important rivers of the region and the Angoche coast: to the north, the Chitalane e Maldene rivers and, to the south, the Meculi River; in the Tipane region of Moma, the Larde and Thopuitho rivers. These rivers break up into a series of canals, forming extensive island areas in the deltas where mangrove forests, occurring along the entire coast from Angoche to Moma, predominate. Some of these islands (Quilua Island in Angoche, for example) are inhabited and others are occasionally settled by fishermen along the sand banks.

Two important lakes are worthy of mention: Malatane Lake in the Namitarari region of Angoche provides Angoche city its fresh water. In Thopuitho, in the area of Mavele, the Mavele Lake supplies water to the heavy sands factory in Kenmare.

CURRENT LAND USE PATTERNS

The communities' land occupation patterns may reflect wartime conditions in which affected populations, seeking greater security, tended to concentrate along the coast and near urban centers. In addition, one can point to an historic and cultural process of land occupation along the coast evidenced by the presence of extensive cashew tree plantations of adult trees, together with salt beds established in the mangrove forests of the city of Angoche. It should be pointed out that a cashew-nut processing plant existed in Angoche. We have recently witnessed the migration of families seeking to establish farms along the roads. In this case, the population of Angoche city is clearing plots in the Potone forest area and settling along the road from Boila to the Luázi River, in the direction of Moma. Some of the mangrove islands are inhabited and others only occasionally so by fishermen.

Subsistence agriculture is the predominant means of land utilization, especially for corn and manioc cultivation. The families are also in the habit of planting cashew trees and coconut palms as a source of income. The planting of cashew trees may have been responsible for the devastation of the forest over the dunes along the coast for, in both Angoche e Thopuitho, the cashew groves occupy areas that were previously *Icuria* and *Brachystegia* forest.

Fishing, involving approximately 80,000 fishermen, is an important activity for the coastal communities. Although practiced primarily along the coast in Angoche, where groups of fishermen occupy islands such as Quilua Island, these same fishermen maintain strong ties to inland agriculture and the Potone forest. Noteworthy is the fact that it has been the Angoche Fishermen's Association that has endeavored to recruit sympathizers for conservation of the Petone forest. The team surmised that this interest owes itself to the fact that the fishermen have families and ancestral ties in Potone, where every year they perform ritual ceremonies beseeching a fruitful fishing season, authorizing marriages and practice traditional medicine.

As regards Thopuitho, where the Kenmare Moma heavy sands extraction project is underway, communities that surround this project are ever building new villages and, besides providing Kenmare its labor supply, engage in trade and agriculture. Some older villages were visited in the mangrove areas, however, where the people rely primarily upon small-species fishing for local consumption, gathering *Cerithidea decollata* - 'Atacha' - in the mangrove forest (Figure 2), and small, sandy agricultural plots of corn, cashew trees and coconut palms.

Figure 2: *Cerithidea decollata* 'Atacha' in a Avicennia marina trunk in the Micolene mangrove.

The potential for tourism appears promising but little developed. Angoche, for example, is a clean city but with many public buildings and roads in need of repair. Seven kilometers from the city of Angoche is Praia Nova, with extensive white sands and the mangrove forest of the Meculi River, both offering a potential for organized boat tours (Figure 3).

Figure 3: Boat ride along the canals of the Angoche islands.

Neither Angoche nor Thopuitho possesses significant forest resources; nonetheless, intensive timber exploration has recently been witnessed in both areas. In Potone forest, for example, Leadwood (*Combretum imberbe*) and the Kiaat tree (*Pterocarpus angolensis)* are being extracted. Despite an increase in the lumber business for buyers from Nacala, the inhabitants reap no benefit from this business and are unable to raise the funds necessary for their yearly pilgrimages. The Forestry Law, particularly as it pertains to the percentage of the exploration fees channeled to the local communities and their control over the resource, is unknown. A cargo truck was observed loading Leadwood (Figure 4) for Chinese clients. The entire cargo of logs had to be inspected to determine whether it included some combination, such as African Blackwood (*Dalbergia melanoxylon*, Pau Preto), and not just Leadwood. The regular license indicated extraction of 10 m^3 of Leadwood e 5 m^3 of Jambire (*Millettia sthulmannii*), without any control as to the quantity of timber removed on the basis of this license. There lacked, in other words, a bill of lading confirming the amount previously removed , though this had been the fourth transport made by this particular truck.

Figure 4: Loading *Combretum imberbe* in Potone.

Potone's timber exploration, reinitiated two years ago (the area had been explored by MADEMO in the 1980's), is becoming unsettling as conflicts arise with the Rei Tumahaia communities. The aforementioned species, including Jambire (*Millettia sthulmannii*), Ironwood (*Swartzia madagascariensis*) and Rosewood (*Berchemia zeyheri*) are also employed in traditional popular medicine. It should be noted that 160 medicine men (Mr. Namire being their chief) serve the 440 families of Potone, a figure which indicates the importance of this forest as a source for traditional medicine. Furthermore, the forest bears enormous cultural significance in the minds of the people. In a meeting with 75 community members, the community protested that, thanks to deforestation and the burnings caused by prospectors (Figure 5) – especially in the area known as "Malaika", a sanctuary of the Tivirivi and Potone Rivers – the spirits of their dead are going about aimlessly for lack of the "shadows of the forests." These wayward spirits, they claimed, would then dwell in their living relatives' homes, there fomenting conflict among the members.

Figure 5: Area burned by prospectors in search of timber in Potone.

The mangrove forest is being exploited intensively, especially for firewood and building material for the people of the cities of Angoche and João Maia, in Thopuitho. Angoche's mangrove areas are being cleared for salt beds (Figure 6). The quality of the mangrove (as regards its component species e vegetation structure) is higher in Rio Larde than in Angoche. Both the mangroves on the way to Praia Nova (Angoche city) and those in the villages of Micolene and João Maia, in Rio Larde, have been extensively damaged and overrun with the Grey Mangrove (*Avicennia marina*) species, characteristically shrubby on account of over exploration (Figure 7). A riverboat visit sponsored by the Fisheries Association, however, confirmed that the Angoche islands mangrove forests posses splendid opportunities for recovery as they still contain a fairly dense concentration of the five principal mangrove species.

Figure 6: Salt beds in the Angoche city mangrove, in the direction of Praia Nova.

Figure 7: Arbustive structure of the over-exploited mangrove forest in the Micolene region.

METHODOLOGY

The team that was organized to carry out the field work was composed of the following individuals:

Dra. Tereza Alves (Team leader e chief scientist)
Eng. Camila de Sousa (expedition organizer e ecologist)
Eng. Ivete Maloleque (Forestry, Northeast Zonal Center, IIAM)
Mr. Jossias Zeamela (Collector e herbalist, LMA, IIAM)
Mr. Abílio Samate (Driver, Northeast Zonal Center, IIAM)

In Angoche, two Fisheries Association inspectors, Messrs. Chara and Azevedo joined the team along with, in Moma, Messrs. Félix Amade and Manuel Carlos, Kenmare employees. The team was also assisted by local guides who led it to areas of interest and identified species and their traditional uses.

AREAS SELECTED FOR MEASUREMENT/OBSERVATION

The area initially proposed for study encompassed the entire northern zone of Angoche to Moma, including the Ilha do Fogo. The initial stratification of the vegetation identified in the forest, topographic and field maps taken from 2004 satellite imagery served as a basis for establishing the range of biodiversity to be considered in the field work. Given the extent of the area and the impossibility of collecting, in the course of 12 days, all floral information, areas were chosen for observation among those proposed on the basis of real field situations (accessibility, visual quality of resources and sufficient time for measuring samples).

After surveying the condition of the terrain, the proposed methodology was altered so as to ensure the gathering of information and identification of species that inhabit the selected locations. This alteration arose from two situations/conditions observed in the terrain: 1) the area had been recently burned; 2) the deciduous nature of the species and the season in which initial observations were carried out allowed for a limited number of trees exhibiting botanical characteristics (with fruits or blooms, for example) that would permit species identification; and, 3) difficulties in ascertaining

fluctuations in tide levels so as to conduct prolonged measurements in the mangrove areas.

The following areas of vegetation were in this way encompassed in the study (Table 1):

- the Potone and Luázi River Forest;
- two strips of *Icuria dunensis* forest: in Angoche, near Praia Nova; and in Thopuitho, at the Kenmare concessionaire;
- two strips of mangrove forest, situated near the city of Angoche: along the road to Praia Nova and on the islands of the Mucapate River delta (ilha Quiluba/ilha Nhankuba);
- three mangrove areas of the Larde River: the villages of Micolene, Mulimoni and João Maia were visited, but measurements were only conducted in the village of Micolene; and
- measurements were carried out as well in two strips of coastal forest previously identified in satellite imagery of the Thopuitho zone, in the villages of Nanthuco and Micolene, respectively.

Table 1: Itinerary/Areas chosen for vegetation surveys and species-gathering, from October 15 to 28, 2006.

Dates	Collection/measurement location	General description of vegetation type
17-18	Potone Forest: in the Potone and Tivirivi Rivers (Malaika zone) & surrounding areas	Coastal dry forest, deciduous, Average crown height 15 m, riparian vegetation and spots of vegetation over termitaries. High grass (mostly entirely burned). Occurrence of *Sterculia appendiculata*, *Diplorhynchus condylocarpon*, *Strychnos* sp. and *Hyphaene coriacea*.
19	Road to Cultural center/ Luázi River and Luázi River/Namacuta Forest.	Dr coastal deciduous forest, 10 to 12 m high, 6-9 m^2 basal area, containing *Combretum* sp., *Afzelia quanzensis*, *Pterocarpus angolensis* and *Entada abyssinica*; Riparian forest 15 m in height, containing *Khaya anthotheca*, *Parkia filicoidea* and *Ficus sycomorus*.
20	*Icuria* forest & surroundings of Praia Nova	Vegetation of white-sands dunes, containing *Hymenaea verrucosa*, *Afzelia quanzensis* and *Garcinia livingstonei*.
20	Angoche island mangrove forest	Dense mangrove, of an average height of 5-7 meters. Variation of predominant species: *Avicennia marina* e *Rhizophora mucronata*, and predominance of *Sonneratia alba*
21	Praia Nova: Angoche city mangrove forest	Very degraded mangrove forest cmoposed exclusively of *Avicennia marina*;
23,25	*Icuria* forest: Mulimone, Mokuba, and Nakwasica zones	Coastal dry forest over white sandy dunes; closed forest with crown up to 30 meters high, containing Mostly *Icuria dunensis, Memecylon sessilicarpum* and *Hymenaea verrucosa*
24	Nanthuco forest:	Dry, mixed coastal forest, deciduous with 12 meter crowns and 3 m^2 basal area, cmoposed of *Combretum imberbe*, *Anona senegalensis*,

Dates	Collection/measurement location	General description of vegetation type
		Brachystegia sp. and *Millettia sthulmannii*; In a lower section of the area, with occasional floods from the Larde River, presence of *Acacia* sp. ('Inthuco'), *Phoenix reclinata* and *Hyphaene coriacea*
26	Floresta de *Brachystegia* de Micolene	Forest with 10 m crown heights, atop white sand dunes adjacent to the mangrove forest, predominantly of *Brachystegia spiciformis*, *B. boehmii*, *B. allenii*. Forest that was a cemetery during colonial times and therefore still revered, and surrounded by agricultural plots.
26-27	Larde River mangrove forest in the village of Micolene	Mangroves with 2 m^2 basal area, forming a crown under 6 meters in height, under exploration (cutting for lumber), containing *Avicennia marina*, *Rhizophora mucronata*, *Ceriops tagal* and the transitional species *Sideroxylon inerme*. Area also used to gather the *Cerithidea decollata* ('Atacha') snail and the 'Matorro' crab.

SELECTION OF PARCELS FOR INFORMATION GATHERING

For reasons cited above, the initially-proposed methodology was adopted involving the collection of plants (botanical material) in locations which, for the Most part, appeared representative of this particular vegetation. The Line Transect system was employed, on the basis of random selection, these being guided along the principal gradient found at the site and/or perpendicular to a line (a road, the coast or riverbank).

Measurement parcels of 50 m x 10 m were established whenever it was ascertained that sufficient information would be gathered regarding the various conditions facing the population. Otherwise, a route would be taken in various directions whereby general information about the location would be gathered – information concerning species and gathering of botanical information whenever it was possible to obtain identification characteristics (blooms and fruits). The objective was to always gather the maximum biological and species information as to the different types of naturally-occurring vegetation, thereby enabling differentiation of species diversity in the context of the different sites (areas) measured.

Whenever possible (i.e., when the parcel provides sufficient information) 50 m x 10 m parcels were established for dendrometric measurement of all samples with diameters greater than 10 cm DAP. *Nested quadrates* measuring 5m x 5m were used to gather information on young specimens (diameters of 4-10 cm DAP.). To asses the development potential of the species, 1 m x 1m parcels were also established to enable counting of the natural regeneration of ligneous plants less than 1 m in height.

In addition, a 10-minute search was conducted in the areas adjacent to the parcel to record all other vascular plants, herbs, embryos and grasses not observed in the measured parcels. This method increased the chances of finding endemic/rare species.
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FIELD CARDS AND VARIABLE MEASUREMENTS

A field manual was put together to assist in the gathering of both trasects, such as those of the transferred parcels, asses the status of the species and measured samples and to describe the measured parcels in terms of site quality characteristics. The data gathered in the field were recorded in five field cards designed to: 1) determine general site characteristics and the status of the parcel; 2) obtain soil information; 3) register plants according to various classes (trees, juveniles and regeneration); e, 4) recording of species collected for the herbarium and their uses.

Three soil samples (removed at 10 cm depth) were collected and mixed from each measured parcel for subsequent analysis at the IIAM laboratory, to determine physical and textural properties (% clay, % lime and % se) and conduct chemical analysis (pH, organic matter, NPK, CE, Ca, Mg, Na, sum of bases and CaCO3).

Table 2 presents a summary of the records entered for the transects/parcels measured.

Table 2: Summary of records e variables measured in the established parcels.

Variables measured	Important data
Site description/description of area being studied:	Measurement data; team make-up; transect number; parcel number;
	Position; GPS reading to determine: latitude and longitude coordinates in degrees, minutes; aspect; altitude (a.s.l.);
	Permanent natural landmarks: rivers/streams; valley; dunes; roads;
Terrain topography:	% incline; topographic position; terrain type
Types of vegetation:	Percentage of coverage by predominant species comprising upper and herbaceous stratum (soil cover); presence of grass plots
	Number of layers; average crown height; basal area;
Level of disturbance/damage/signs of degradation:	Presence of gaps; fires (recent, old); clearing of plots; timber extraction;
	Risk level for species; presence of toiças; bark and *ring bark* removal, sanitary status;
Possible points of interest for conservation:	Evidence of fauna; sanctuaries protected by local communities; landscape;
Soil characteristics:	General characteristics; soil depth; humidity;

Variables measured	Important data
	Texture, pH, M.O; NPK; salinity (CE) and other laboratory analyses;
Species information:	Species names, average heights; diameter measured from canopy, condition of measured tree, bifurcation; *life form*, phenology; and potential uses;
	Regeneration potential: number of individuals of each species;

SPECIES IDENTIFICATION

The gathering of botanical information for species identification focused on the principal trees, shrubs and vines. Some grasses and sappy plants were also gathered.

These materials were pressed in the field and subject to a process of sun-drying. The sun-drying process was continued, as was the assembly of the species in the National Herbarium (LMA). Whenever possible (time availability once back from the field) a preliminary identification of the scientific name would follow. The final identification proceeded in the LMA, using a bibliography and available taxonomic keys, and verified in the herbarium's existing references. This endeavor is still underway.

It should be stressed that the season for gathering botanical material was not the most appropriate in view of the fact that a majority of the species had not developed identifying characteristics. We suggest that more detailed surveying work be conducted to identify plants, and that these be focused in areas of interest in either April/May or October/November to allow gathering of the necessary botanical elements for taxonomic identification.

It is important to mention that during the gathering of specimens in Angoche and Petone, inspectors from the Fishermen's Association received on the job training in specimen-gathering and pressing the material (Figure 8).

Figure 8: Training of Angoche Fishermen's Association inspectors , Messrs Chara and Azevedo, in the technique of preparing species for the herbarium.

DATA ANALYSIS

A list of 206 species was completed that included scientific and common names, family, vulnerability status and uses (Appendix I).

The data collected in the field were applied to spreadsheets in a Species x Parcels and Environmental factors x Parcels matrix. The values for each indicate species presence/absence.

On the basis of species presence/absence data, the vegetation is then described qualitatively (floral description, species abundance and distribution throughout the area) and quantitatively through classification (TWINSPAN) and order (CCA) methods to analyze habitat similarities and respective changes in floral composition, while assessing as well environmental factors (anthropogenic, site and edaphic) that influence species distribution.

A multiway regression analysis via the technique of Canonical Correspondences Analysis (CCA) of field data, using 'PISCES' (Pisces Conservation Ltd., 2002) software, allowed implementation of the 'Monte Carlo' and ANOVA statistical tests, and to at once identify potential significant relationships between species and environmental factors. The variables related to soil characteristics were transformed to Log (X+1) , thereby reducing errors derived from the unit of measurement of the same.

To improve order arrangement, stabilize canonical coefficients, reduce co linearity values between variables ($R^2 > 0.8$), and separate the independent effects of the different variables in the distribution of species, some of the species and dependent variables had to be eliminated from the analysis. In the case of edaphic variables, a total of 51 arboreal and arbustive species were used and five soil variables (electrical connectivity -EC, pH, % organic matter -MO, % nitrogen - N e % se), observed in nine established parcels. For variables indicative of site-specific conditions, a total of 72 species and five variables (burnings, exploration, height of upper strata - AIE, % herbaceous strata cover - % cobh, and basal area - BA) were used, and observed in the 14 established parcels. In the final analysis of the selected variables, edaphic values presented, then, values of $R^2 < 0.7$ e $R^2 < 0.6$ for factors of site-specific conditions.

The results of the analyses are presented in the species-abundance graphs and those of species/parcel sample similarity and factors affecting the composition of identified formations.

In order to establish conservation/development priorities, the methodology developed by Bell and Martin (1984) and Primack (1998) was adopted to define criteria that would permit classification of potential conservation areas and establish a matrix for listing according to priority, perhaps less subjectively, areas of importance and identify immediate action for their conservation/development. Attention was given to the different locations visited and to the types of vegetation found so as to identify landscape and conservation units for use in the matrix. In general, the established criteria took into account the following factors:

- Biological values: Vegetation diversity and types (number of species, ecosystem importance), their uniqueness with respect to other populations and the occurrence of rare/endemic species ;
- Landscape value: botanical attraction, i.e., the presence of flora that is representative of the vegetation-type (coastal, mangrove, etc.); picturesque landscape, recreational attractions, accessibility;
- Socio-economic value: diverse forms of land usage, uses/utilization of resources (medicinal, firewood, food, fauna, other products);
- Cultural/historic/traditional value: cultural/sanctuary use and importance to local communities;
- State of conservation: legal statute, conservation awareness, threats (agriculture, logging), uncontrolled burnings, urbanization.

A scale of values was established for conservation/threat, ranging from 1 (low) to 5 (high), to be attributed to each criterion when filling in the chart. Conservation and/or intervention priorities were assessed on the basis of the total sum of the referenced criteria and arranged according to conservation or threat values.

RESULTS AND DISCUSSION

Though the number of completed samples has been greatly reduced for the aforementioned reasons, the information gathered and methodology chosen for data analysis of the presence of species reflects the actual situation in the field and, in general, allowed us to emphasize tendencies involving the association of species in the various botanical formations that were observed. Better results, however, can be obtained with abundance values (number of specimens recorded for each species found) in a greater number of parcels to be established for different types of vegetation.

FLORA

Vascular species

A total of 206 species was recorded, with 137 collected for herborization and identification (the list of all species is presented in Appendix I). However, this number may rise should the sample area expand. One hundred and twenty-nine species have been identified to date, representing 63% of the total recorded. Seventy-six remain unidentified.

The species that have been identified are grouped according to 54 families, mostly representing the 10 families presented in Table 3. Thirty-one families are represented by a single species (Appendix II). The number of families, however, may increase with the 76 species that remain to be identified.

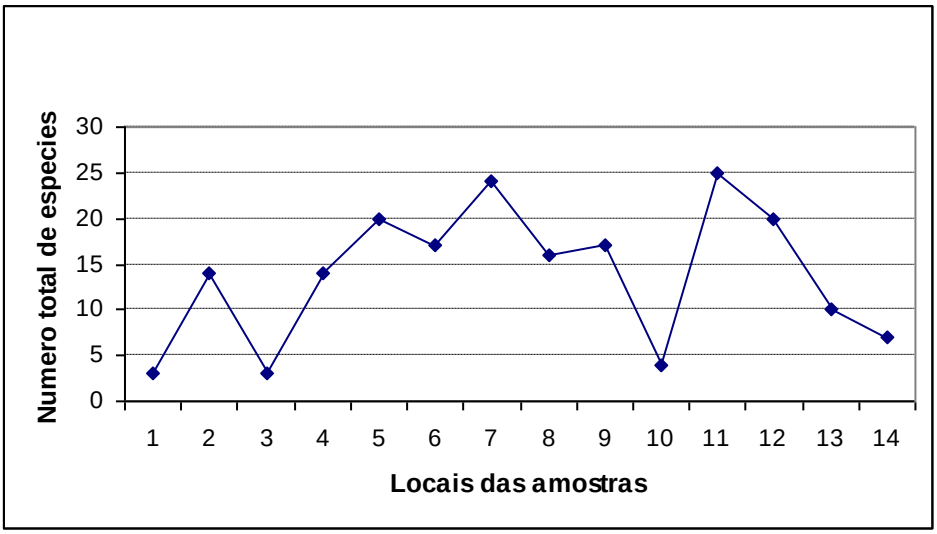
Table 2: Principle families, number of genera and species, and respective order according to number of species per family**.**

Family	N.º of genera	N.º of species	Family position in order
Fabaceae	23	30	1
Euphorbiaceae	6	7	2
Apocynaceae	5	5	3
Poaceae	5	5	4
Combretaceae	3	5	5
Anacardiaceae	3	5	6
Rhizophoraceae	3	3	7
Areaceae	3	3	8
Cyperaceae	2	3	9
Rubiaceae	2	2	10

Abundance of species in the measured parcels

Taking into account the presence of arboreal e arbustive species recorded in the measurement parcels, one notes in Graph 1 that the total number of species found in the various measured areas is variable, indicating an unequal distribution of species throughout the area of research.

Graph 1: Species abundance: number of species (trees and shrubs) found in each of the 14 samples measured in the Angoche and Moma region.



This variability of species abundance throughout the various plant formations is confirmed not only by a natural variation related to species association (for example, parcels 1,3 and 10 which represent the mangrove), but results also from manifold disturbances to which these formations are subject, whether from natural causes (gaps and natural mortality) or anthropogenic (burnings, logging and extraction of resources other than timber, for example), as is the case with parcels 13 and 14 of the Potone forest.

Rare, Endemic and Threatened Species

Of the species identified to date, three (*Icuria dunensis* and *Memecylon sessilicarpum*) are endemic and one rare: the 'Ekoda' – *Euphorbia bougheyi*, a Euphorbiaceae only found in the forest of Thopuitho's inland dunes (Figure 9). The herbarium contains but one specimen of this species, collected on the beach at Beira in 1963. The region also contains six vulnerable species: *Afzelia quanzensis*, *Craibia brevicaudata*, *Khaya anthotheca* and *Sterculia appendiculata* (all recorded in this survey) and *Deinbollia borbonica* and *Schlechterina mitostemmatoides* (recorded in previous surveys). One endangered species (*Craibia zimmermannii*) and three in the low-risk category (*Dalbergia melanoxylon*, *Millettia sthulmannii* and *Pterocarpus angolensis*) were recorded as well (Table 4).

Of the mangrove species, only the 'Macui' can be considered rare, at least locally, as this species, albeit not recorded by the team, is often mentioned by the fishermen.

Other species exist that have not been recorded in our survey. These have, though, been mentioned in previous surveys as species requiring special consideration to determine their level of vulnerability, as they are absent from all of the lists of endangered or threatened plants that were consulted. Fourie and Lubke (2000), for instance, make reference to the *Hirtella zanzebarica* (Chrysoblanaceae) and *Suregada zanzibariensis* (Euphorbiaceous), also recorded in Mombassa, as potentially rare species, as well as *Spermacoce kirkii*, a species endemic to Mozambique that is not included in the preliminary list of *The Vascular Plants of Mozambique* (Da Silva *et al*., 2004).

Figure 9: *Euphorbia bougheyi* found in the *Icuria* forest in Thopuitho.

Table 3: Species classified as threatened, vulnerable and endemic found in the surveyed area, in the coastal strip of Angoche and Moma and along the archipelago of the 1[as] and 2[as] Islands.

Species	Notes (and codes for species status according to IUCN categories)	Source†
Icuria dunensis	Endemic endangered (ENA2c). Under threat by the extraction of its wood and bark, which is stripped from the trunk; clearing of farm plots/cashew-tree plantations. Confused with *Hymenaea verrucosa*, occurring in Nampula and Zambézia.	2,3
Khaya anthotheca	Vulnerable (VUAlcd)/LR-lc). A tree threatened in areas where it is sought as a timber resource.	1,2
Sterculia appendiculata	Vulnerable (VUAlad, BlBc). Tree species under threat from utilization in parts of Mozambique. Difficult regrowth, occurring in coastal and riparian forests.	2
Dalbergia melanoxylon	LR-nt. Threatened by demand for its wood	1
Millettia sthulmannii	LR-nt. Threatened by demand for its wood	2
Pterocarpus angolensis	LR-nt. Threatened by demand for its wood	1
Deinbollia borbonica[1]	Recently recorded as common to the Moma mining concession areas. Status classified as VU A2cB1B2bcD2	2
Afzelia quanzensis	Vulnerable (VUD2)/LR-nt. Threatened by demand for its wood	2
Craibia brevicaudata	Vulnerable (VUD2)/VUBl+2b	1
Craibia zimmermannii	Endangered (EN)	5
Euphorbia bougheyi	Endemic (Rare)	4,5
Memecylon sessilicarpon	Endemic (DD). Common the forests of Moma, and regarded as endemic to the coastal forests.	2,3
Schlechterina mitostemmatoides[2]	Vulnerable (VUD2) Not found in Nampula; can be considered newly-recorded as it has been recorded in the Kenmare survey.	5

†Source: (**1**) World List of Threatened Trees (Oldfield, Lusty & MacKinven 1998); (**2**) Mozambique, in Southern African Plant Red Data Lists (Golding 2002).; (**3**) Mozambique endemics – list of KEW compiled by J. Timberlake.(**4**) 1997- IUCN Red List of Threatened Plants; (**5**) A preliminary Checklist of the Vascular plants of Mozambique

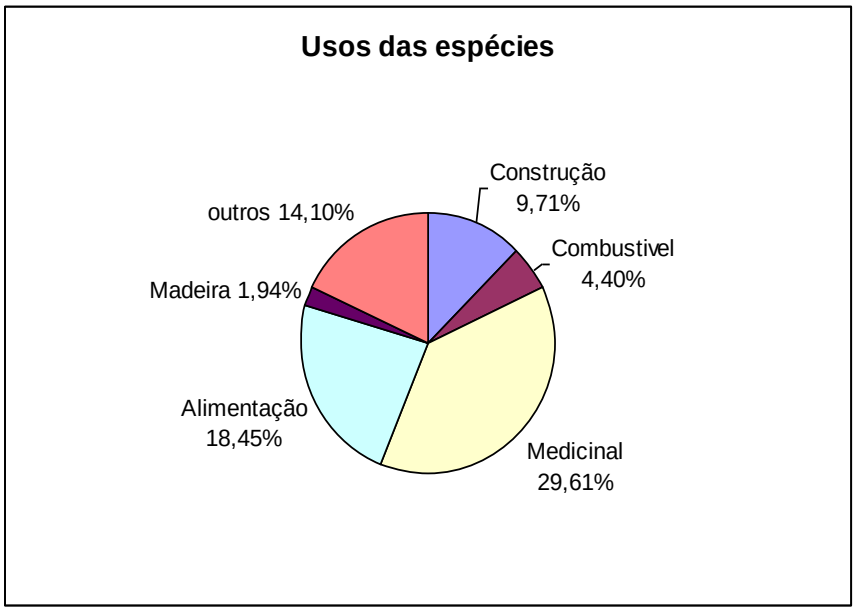
[1] Not identified in our survey, but included in the Red Data List for Mozambique among threatened and extinct species, and was recorded by the survey conducted in Kenmare.
[2] Not identified in our survey, but included in the checklist of Mozambican vascular plants (Da Silva et al, 2004)[2] as vulnerable, and was recorded by the survey conducted in Kenmare.

Species uses

Of the species registered in this survey, only 63% bear any importance (in terms of utility) and are utilized by the local community and loggers. Graph 2 demonstrates that the majority of species are employed medicinally, which reflects the importance of the Potone forest to traditional medicine practices. It was not possible to identify either the medicinal species preferred by the community or those that are increasingly rare.

Note that 26 of the species are employed for more than one purpose. Note also that timber exploration focuses on a relatively small number of species (1.9% of all species utilized).

Graph 2: Pattern of vascular plant utilization in the Angoche and Moma regions



It is also important to note that six mangrove species (chiefly *Ceriops tagal* and *Rhizophora mucronata*) are employed for a variety of ends, but above all as firewood (Table 5).

Table 4: Mangrove species uses and preferences in the surveyed area

Species	Uses				
	Firewood	**Lumber**	**Medicinal**	**Food**	**Handicrafts**
Avicennia marina	٧				
Bruguieria gymnorrhiza	٧				
Ceriops tagal	٧٧٧	٧			
Sonneratia alba	٧			٧٧٧	
Rhizophora mucronata	٧٧٧	٧			
'Macui'	٧		٧٧		٧

Types of Vegetation

Definitions

For purposes of this study, a forest is an area greater than 0.5 ha composed of trees exceeding a height of five meters and a crown cover of More than 10% (FAO, 2004). According to Clarke (2000), coastal forests are the undifferentiated forests occurring in the Zamzibar-Inhambane regional mosaic extending in a 50 km strip along the Indian Ocean. Dry forest is the predominant vegetation of this ecoregion (Clarke *et al.*, 2000), subdivided into coastal forests dominated by leguminous species, *Brachystegia*, and mixed and riparian coastal forests.

The dry, coastal, predominantly leguminous forest is composed of trees of the luguminous family where but one or two species account for 50-95% of all specimens measuring DAP>10cm.

The coastal *Brachystegia* forest consists of a type of formation that has been unaffected by burnings, having a closed crown covering consisting primarily of a combination of *Brachystegia spiciformis* and *Hymenae verrucosa*. One can say that this type of formation is a variant of those that are predominantly leguminous, as both the *Brachystegia* e *Hymenaea* are thus characterized.

The dry, coastal mixed forest presents a variety of species associations which are usually unique to a particular forest, thus rendering any sort of general description difficult. For this type of forest, studies have demonstrated the occurrence of 152 dominant arboreal species e 94 species classified as common or frequent (Clarke *et al.*, 2000).

The riparian forest grows along seasonal and permanent watercourses, and marked by large trees, such as *Parka filicoidea*, *Ficus sycomorus* and *Khaya anthotheca*, that are also found along the banks of watercourses outside of the stretch of coastal forest.

Mangrove forests are areas of salt-tolerant trees and shrubs that grow in tidal basins, estuaries and bays (www.aims.gov.au). One finds a pattern of species distribution reflecting the reaction of plants to such factors as variations in salinity, availability of nutrients and the level of oxygen in the soil.

Description of Vegetation

In general, the vegetation of the surveyed region is formed primarily of a mosaic composed of cashew e coconut plantations, small agricultural plots and diverse varieties of natural vegetation. In the areas that have suffered the greatest from human disturbance, this vegetation forms a crown covering of approximately 10%, as compared to 60% in the more pristine areas. The average height of these crowns varies from four to 20 meters, as the vegetation is of the short to moderately short, open to moderately open, deciduous or semi-deciduous variety. The herbaceous layer of this vegetation is primarily gramineous, normally of the Poaceae and Cyperaceae families. In areas unaffected by burnings, these gramineous varieties are so profuse as to form tufts. It is possible, though, to find denser patches of forest where the crowns cover approximately 80% and reach heights of 20 meters, with practically no

herbaceous layer. In the areas along the watercourses one finds such species as *Khaya anthotheca* and *Parkia filicoidea* forming an incipient layer, for these reach heights in excess of 20 meters and tower above the average neighboring vegetation.

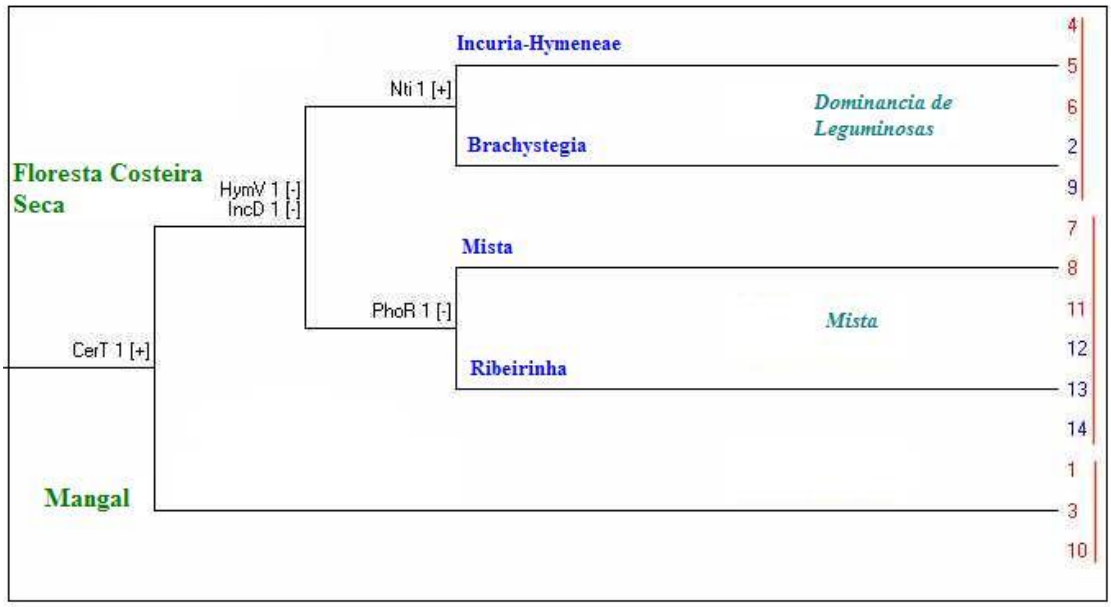
Similarity Analysis:

Analysis of the species occurring at the various surveyed locations permitted an ecological stratification of two distinct varieties of vegetation (Graph 3): dry coastal and mangrove forest. The dry coastal forest, however, can be further divided into two subgroups, one predominately leguminous and the other mixed.

Looking at these two subgroups, one finds, on one hand, a *Brachystegia* variety in dry coastal forests that are predominantly leguminous and, on the other, an association of *Icuria dunensis-Hymenaea verrucosa* species. It should be noted that both formations occur in the white, sandy soils of the coastal dunes.

The dry coastal forest habitats presents a group of various species associations, including *Phoenix reclinata* and another that includes riparian forest species, such as *Khaya anthotheca* and *Parkia filicoidea*.

Graph 3: Twinspan dendogram showing classification of vegetation by floral similarity between locations within the surveyed area.



Analysis of Vegetal Formations:

On the basis of the aforementioned ecological stratification and current familiarity with the situation in the field, the following vegetal formations were identified:

(i) Dry coastal forest containing predominantly leguminous species

The dry, coastal, predominately leguminous forest is found in areas of well-drained soil and presents a simple structure composed of an arboreal layer in which the *Icuria dunensis-Hymenaea verrucosa* species predominate, with a crown height averaging 15 to 30 meters and a basal area of 7 m^2. Shrubs can be found throughout, especially that of the *Strychnos henningsii* species, but the predominance of specimens represent those of the arboreal layer. An herbaceous layer is all but absent, but for the presence of lianas. The *Icuria dunensis* presented a noteworthy regenerative capacity.

This variety of vegetation can be found in Angoche, where it occurs in strips on the white sands of the dunes that lie perpendicular to the coast, and in small patches surrounding the city (Figures 10 and 11). These forest patches face serious risk from

intense demographic pressures: Indeed, they not only do they provide firewood but are being transformed into cashew plantations, coconut groves and, in future, will be subject to the fate of urbanization in general.

Figure 10: Remaining *Icuria* forest in the city of Angoche.

Figure 11: A degraded area of *Icuria dunensis* in Angoche.

Towards the South, in the area of the Kenmare concession, a patch of this vegetation was found with crowns reaching heights of 30 meters, cover areas of 60 to 80%, and a basal area of 6 m^2 (Figures 12 and 13). The arboreal layer, although predominately composed of *Icuria dunensis* and *Hymenaea verrucosa*, commonly presented specimens of *Craibia brevicaudata*, *Craibia zimmermannii*, and *Memecylon sessilicarpum* as well. The arbustive layer is dominated by species of the upper stratum, with the frequent occurrence of the *Euphorbia bougheyi*. The herbaceous layer is practically non-existent.

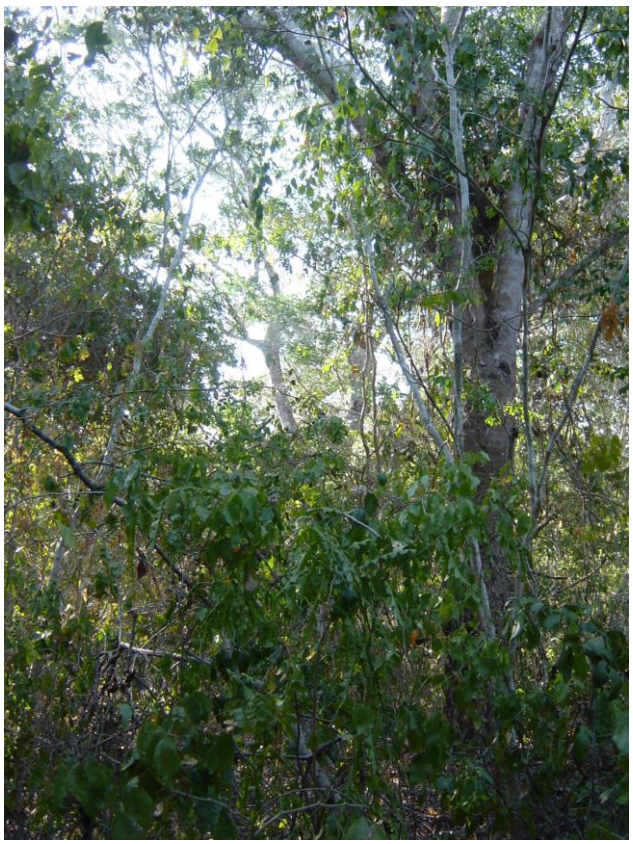


Figure 12: *Icuria dunensis* and *Hymenaea verrucosa* forest in the Thopuitho zone

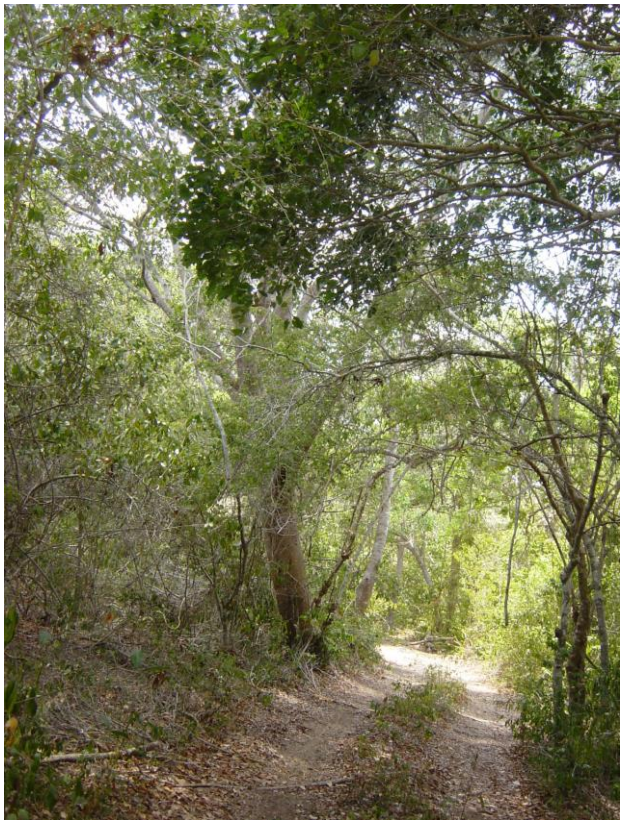


Figure 13: View of the interior of the *Icuria dunensis* and *Hymenaea verrucosa* forest in Thopuitho.

(ii) Dry coastal *Brachystegia* forest

The dry coastal *Brachystegia* forest is generally present in well-drained, nutrient-poor or extremely lixiviated soils, where *Brachystegia spiciformis* and *Hymenaea verrucosa* predominate. They can be distinguished from the formations of the coastal forests by their surface physiognomy.

A small patch of this type of vegetation is found bordering the mangrove forest along the coast of the Micolene zone. This habitat, entirely surrounded by small agricultural plots, has been protected since colonial times for being the burial ground of the Nanvuka family, founders of the village of Micolene. The formation presents a dense, superimposed crown cover of 15 meters, predominately of *Brachystegia spiciformis*, *Brachystegia allenii*, *Brachystegia boehmii*, and with occasional specimens of *Hymenaea verrucosa* and *Mimusops obtusifolia*. The arbustive layer can be unusual,

with occasional *Diospyros mespiliformis* and *Hyphaene coriacea*, together with species of the arboreal layer, such as *Hymenaea verrucosa* (Figure 14). Although scarce, the herbaceous layer is predominately of the *Sansevieria hyacinthoides* and some species of lianas (Figure 15).

Figure 14: Patch *Brachystegia* dry coastal forest in the area of Micolene.

Figure 15: Herbaceous layer of the *Brachystegia* coastal forest, with a predominance of *Sansevieria hyacinthoides.*

(iii) Mixed dry coastal forest

The mixed dry coastal forest is characterized by numerous species associations. This variety of vegetation is found in Potone and Angoche, as well as in Thopuitho's Nanthuco and Mulimone zones, and presents species of short to medium height (crowns attaining 8 to 15 meters) that are predominantly deciduous and varying from one location to the other. The herbaceous layer is well-developed, attaining heights of 1.5 meters and composed predominantly of the *Heteropogon melanocarpus* grass which, being highly vulnerable to fires, places the entire forest at risk. Moreover, timber exploration is rampant in this type of forest.

Three varieties of species association occur in the Potone zone, chiefly a function of the level off humidity. In the driest area, the particular species association is that of *Entada abyssinica, Ficus sp., Hyphaene coriacea,* and *Kigelia africana* (Figure 16). In more humid areas, one finds associations comprising *Diplorhynchus condylocarpon*, *Diospyros mespiliformis*, *Pteleopsis myrtifolia*, *Sclerocarya birrea*

and *Sterculia appendiculata*, especially in the 'Malaika' zone, where the Potone and Tivirivi Rivers converge, and often atop termitaries (Figure 17). Another association occurs with the *Afzelia quanzensis*, *Albizia* sp., *Brachystegia* sp., *Combretum imberbe*, *Dalbergia melanoxylon*, and *Millettia sthulmannii* species in the area near the Luázi River (Figure 18).

Figure 16: Herbaceous layer developed in the mixed coastal forest in Potone, in the area of 'Malaika'.

Figure 17: Forest in the Potone zone atop termitaries

Figure 18: Mixed coastal forest near the Luázi River, Potone

In the Kenmare concession zone, this type of vegetation, characterized by associations of *Acacia* sp., *Annona senegalensis*, *Combretum imberbe*, *Piliostigma thonningii*, *Phoenix reclinata*, and *Strychnos innocua*, is found in Nanthuco in the more humid zones neighboring areas subject to seasonal floods (Figure 19). In the drier areas, such species as *Combretum adenogonium*, *Diplorhynchus condylocarpon*, *Euclea natalensis*, *Ficus* sp., *Millettia sthulmannii*, *Olax dissitiflora*, and *Vitex mombassae* are common.

In Mulimone's white, sandy soils the *Afzelia quanzensis* species predominates, where it is found in association with *Millettia sthulmannii*, *Rourea orientalis*, *Strychnos* sp., and, less frequently, the *Parinari curatellifolia* (Figure 20). This is one of the areas that Kenmare has set aside for the extraction of heavy sands during the next five years.

Figure 19: Nanthuco forest, where *Acacia* sp. Predominates in humid areas

Figure 20: Mulimone dry zone, where *Afzelia quanzensis* predominates

(iv) Riparian forest

This type of formation is found along riverbanks, and is marked by the predominance of grande porte species with dense crowns (80% cover) and reaching heights of 30 meters, as in the case of *Khaya anthotheca* and *Parkia filicoidea*. In the surveyed area, this vegetation occurs along the banks of the Luázi River in Potone (Figures 21 and 22). The vegetation is seriously threatened as, besides timber exploration of *Dalbergia melanoxylon* and *Combretum imberbe*, small agricultural plots are being cleared along these banks.

It should be noted that the Luázi, though a perennial river, has in recent years been known to dry up entirely, resulting in the inflow of sea water at low tide adjacent to Namacula I, in the area known as 'Lagoa Culini' (16º 13 433' S; 39º 43 311' E).

Figure 21: Riparian forest of the Luázi with permanent flow and, downstream, stones along the bank showing the limit of sea water intrusion, Lagoa Culini area (16º 13 433' S; 39º 43 3114 E)

Figure 22: Riparian forest of the Luázi River forest of the Luázi River

(v) Mangrove forest

Towards the coast and deltas of the chief rivers, where soils become alluvial and miry (marine sedimentary and estuary soils), the vegetation is predominantly mangrove. These formations, however, have been harmed by the demand for firewood and lumber, especially near the city of Angoche and along the banks of the Rio Larde near the Larde township.

Angoche's mangrove forest, situated near Praia Nova and the Maldane River, is now in a seriously degraded state (Figure 23). The mangroves are short, never more than three meters tall with 0.5 m^2 basal areas. A single species predominates, *Avicennia marina* ('Mutxo'), possibly because the choice species have already been extracted (Table 5), or because of the Mutxo's regenerative capacity. The mangrove forest along the banks of the Larde River in the town of Mulimone, where only the *Avicennia marina* species exists, presents more developed trees (Figure 24).

Figure 23: Degraded mangrove forest in the city of Angoche, with the Praia Nova Casuarinas crowns in the background.

Figure 24: Larde River mangrove forest, in the town of Mulimone.

The mangrove forest of the Angoche Islands, though suffering from the influence of demographic pressures, is nevertheless in a robust condition, and one can find trees reaching heights of seven meters representing a number of mangrove species, including *Avicennia marina*, *Rhizophora mucronata*, *Ceriops tagal*, and *Sonneratia alba* (Figure 25). The abundance of these species varies from one location to the next on account of the species' tolerance to a number of factors.

According to local fishermen, the Koti Island mangrove forest is disappearing because of intensive firewood extraction. Besides fishing, this resource is the principal source of livelihood for the Island's people. Passarinho Island, on the other hand, is disappearing altogether on account of the rise in sea level.

Figure 25: Mangrove forest on one of the islands of Angoche.

The mangrove forest adjacent to the town of Micolene, sustained by the Thopuitho River, presents, despite intensive exploration (Figure 7) specimens averaging six meters in height with a basal area of 2.2 m^2. Besides the aforementioned species, with the exception of the *Sonneratia alba*, one encounters the *Sideroxylon inerme* ('Ekhava'). Note furthermore the two varieties of crab 'Ekala' and 'Matorro' were observed in the area, along with the *Cerithidea decollata* ('Atacha') snail, which is very much appreciated by the local people (Figure 26).

Figure 26: *Cerithidea decollata* 'Atacha' in the Micolene mangrove forest, in the trunk of a *Avicennia marina*.

Other Formations in the Surveyed Area

Though not as yet studied (that is, measurement parcels were not established as these were not included in the study), other vegetal formations were encountered that are worthy of mention:

(i) Coastal arbustive forest

This type of vegetation is a common characteristic of the stretch of coastal forest called brenha (Clarke *et al.*, 2000). One finds this formation in the Kenmare concession area, chiefly in the area surrounding the *Icuria dunensis* forest, where it emerged from past anthropogenic disturbances (planting and burnings for sisal and

cotton plots). The state of this forest can be best described as post-damage, as it is now undergoing a phase of regrowth with the presence of saplings (Figure 27).

This formation generally evinces a low, dense crown cover averaging a height of four to five meters with almost 100% cover, and is primarily composed of *Euclea natalensis, Strychnos* sp. and *Tarenna littoralis*. Though greatly dispersed, the *Afzelia quanzensis* grande porte tree is also found here.

Figure 27: Arbustive coastal forest in Thopuitho.

(ii) Grassland

This variety occurs in sandy, hydromorphic soils, in strips that run parallel to the periodically-inundated coastline and adjacent to seasonal watercourses. These grasslands are composed primarily of *Cyperus* sp., *Miscanthus* sp. and *Eragrostis* sp., forming a 80 to 100 % cover, and *Hyphaene coriacea,* found dispersed and in tufts (Figure 28). Patches of this sort are found in areas of Angoche's Lipariri and in Thopuitho, in the Tipane and Mavele zones, as well as in the Nanthuco basin.

One finds in Angoche and in Tipane, besides the aforementioned species, the *Garcinia livingstonei*, *Xylotheca tettensis* and the creeper *Cassytha filiformis*. In the area of Mevale, one encounters grasses of the Poaceae family, namely the *Typha*

capensis and *Imperata cylindrica* (Figure 29). In the Nanthuco basin, towards the Larde River, the predominant species are the *Heteropogon melanocarpus* and *Imperata cylindrica*, along with the commonly-found *Acacia* sp. and *Phoenix reclinata*, and, occasionally, the *Annona senegalensis*, *Ficus* sp. and *Strychnos* sp.

Figure 28: Grassland with *Hyphaene coriacea* in Thopuitho.

Figure 29: Mavele grassland in Thopuitho.

FACTORS INFLUENCING SPECIES DISTRIBUTION

The greatly reduced number of measured parcels was insufficient for a determination as to whether the range of environmental factors (site conditions and those attributed to the soil) influenced in any significant way the variety found in the composition and distribution of species, as determined by the percentage cumulative variance in *eigenvalues* of the four axes. It was found that possible anthropogenic factors and site conditions account for only 36% of this variation, while edaphic phenomena explain 61%. The Monte Carlo statistical test, conducted for each group of dependent variables (site and edaphic conditions), indicates in fact that the set of edaphic variables evaluated have a significant influence, at 5%, on species distribution (p= 0.05 and p= 0.02, respectively, in axes 1 and 2). The same was not verified in the case of variables representing site conditions (p= 0.4 and p= 0.08, respectively, in axes 1 and 2). These values could become significant with a greater number of samples or had absolute values for species abundance been employed in the analysis.

As such, these formations appear to have been influenced by edaphic factors, whereby the species adapted over time according to local ecological conditions, and any disturbance, whether human or natural in origin, can accelerate the degradation of these habitats and alter their species composition. These conclusions reflect the actual condition of the vegetation of the surveyed area, represented by the three principal varieties of formation identified above by the Twinspan (Graph 3).

The Distribution of Species as Influenced by Soil/Edaphic Attributes

In general, one can observe in Graph 4 that the species of these vegetal formations are affected, on one hand, by the capacity of soils, particularly the arenaceous ones, to retain water (measured by the percentage increase of sand in the texture), represented by the group of predominantly leguminous forest species found at the bottom of graph 4, and by the increase in organic materials present in the ensemble of species

found in the mixed forest, as shown at the top of Graph 4. The mangrove forest species are greatly affected by increases in electrical connectivity (EC), that is, by salinity levels, as demonstrated to the right of Graph 4.

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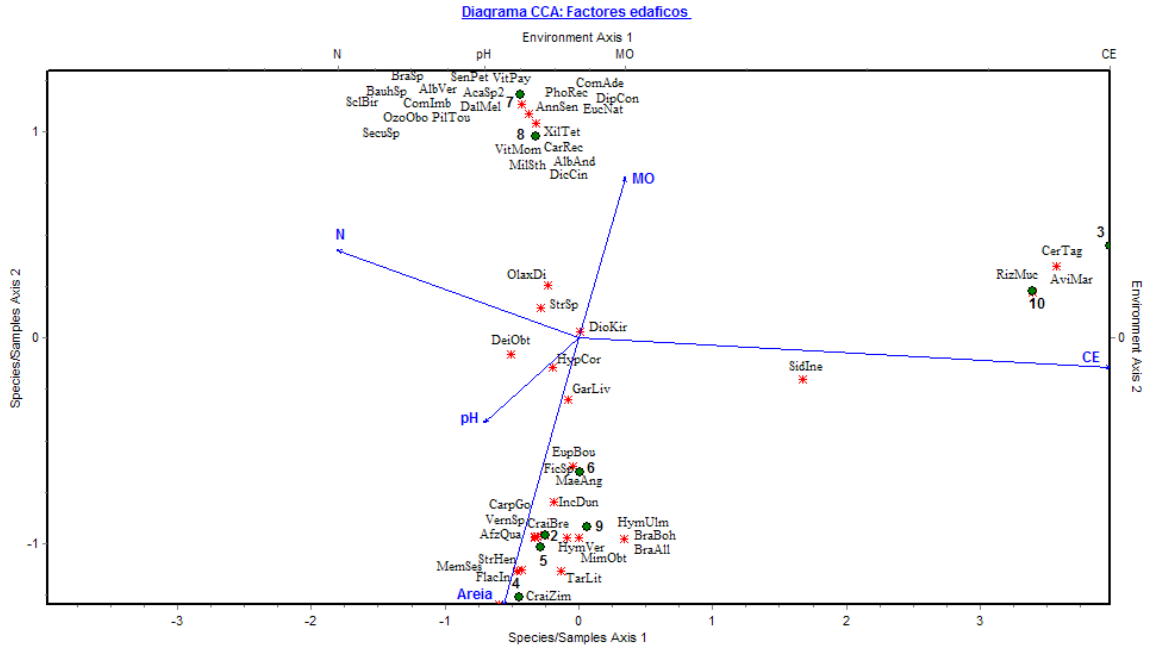


The multiple linear regression of the attributes of soil demonstrates that, indeed, the *Ceriops tagal* and *Avicennia marina* mangrove species are positive and significantly influenced at 0.1% by the set of variables analyzed (ANOVA of the regression with Adjusted R^2= 0.95; *p*= 0.007), where the EC is the determining factor, in other words, there is greater chance of finding these species in soils possessing higher levels of salinity (*p*= 0.001). Both species occur in soils with lower OM and sand levels, though their presence is not a significant one. In turn, the *Rhizophora mucronata*, which is positively influenced by 5% by the set of variables analyzed (ANOVA of the regression with Adjusted R^2= 0.88; *p*= 0.02), is so influenced not only by the higher level of salinity (*p*= 0.01) but also by a higher level of MO and greater

percentage of sand in the soil (p= 0.09 and 0.03, respectively), though negatively and significantly limited is soils presenting greater levels of pH (p= 0.009).

It is interesting to observe the "transition" of the *Sideroxylon inerme* species towards the middle of Graph 4, which demonstrates that, besides the five factors assessed, there may be others that have an even greater influence on its distribution. This fact is confirmed by the insignificant results of the ANOVA (p= 0.8). It should be stressed that the species was observed at the *leeward side* of the mangrove forest, indicating that, although it is affected by tides, the species tends towards the mangrove forest's migration to the dry coastal forest.

The species at the top of Graph 4 that are primarily of the mixed forest occur, in general, in soils containing higher levels of argil and OM. The ANOVA results emphasize the significant influence by 0.1% of the set of five soil variables evaluated for the species *Annona senegalensis*, *Combretum adenogonium*, *Euclea natalensis* and *Phoenix reclinata* (Adjusted R^2= 0.97; p= 0.003). Note that all of these are negatively influenced by 0.01% by the increase in the level of salinity in the soils (p= 0.0008) and percentage of sand (p= 0.0003). In association with these species one also finds *Dichrostachys cinerea*, *Albizia adianthifolia*, *A. versicolor*, *Millettia sthulmannii*, *Vitex Mombassae*, *V. payos*, *Senna petersiana*, *Acacia* sp., *Dalbergia melanoxylon*, *Combretum imberbe*, *Bauhinia* sp., *Sclerocarya birrea*, etc.

The predominantly leguminous representative forest species demonstrate, as they position themselves at the bottom of Graph 4, their preference for very arenaceous soils. However, it was not possible to highlight this tendency in the ANOVA, where generally the probability (*p)* calculated was greater than 0.4, and therefore not significant at 5%. But one finds in these types of soils besides *Icuria dunensis*, *Hymenaea verrucosa*, *Maerua angolensis*, *Memecylon sessilicarpum*, *Brachystegia boehmii*, *B. allenii*, *Hymenocardia ulmoides*, *Tarenna littoralis*, *Craibia brevicaudata*, *C. zimmermannii*, the *Afzelia quanzensis*, *Carpolobia goetzei*, *Vernonia* sp., *Strychnos henningsii* species as well, among others.

The group of species found in the middle of Graph 4 are those demonstrating a weaker preference for a specific type of soil, and can thus be found in diverse

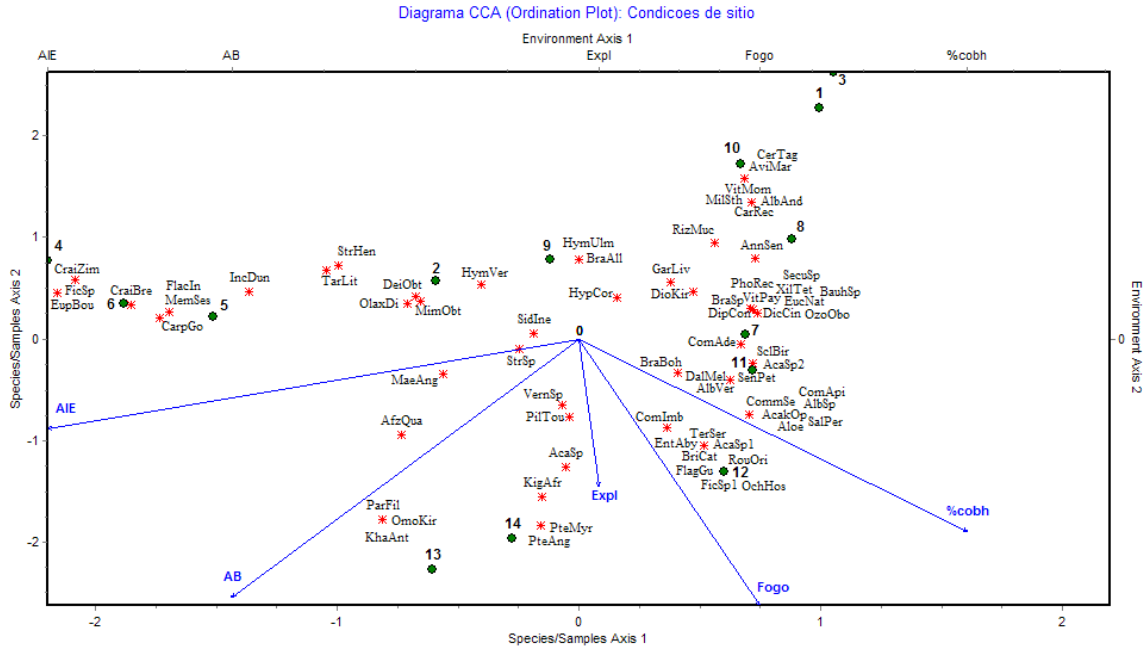
locations. These species are the *Olax dissitiflora*, *Strychnos* sp, *Diospyros mespiliformis* and *Deinbollia oblongifolia*. Among these species, however, one finds that the *Garcinia livingstonei* is the most common to arenaceous soils, whereas the *Hyphaene coriacea* dwells in soils that are slightly acidic.

Species Distribution as Determined by Site Conditions

Although the Monte Carlo statistical test has not figured prominently in the analysis of site-condition variables, a group of species can be found in these formations that appear to be affected by the actions of humans; where, indeed, one finds evidence of various forms of disturbance, including cutting and exploration, together with frequent burnings. These disturbances place such species as *Pterocarpus angolensis*, *Pteleopsis myrtifolia*, *Kigelia africana*, *Acacia* sp., *Combretum imberbe*, *Terminalia sericea*, *Entada abyssinica*, *Bridelia cathartica* and *Flagellaria guineensis* at the bottom center of Graph 5. Species common to areas having a greater herbaceous cover (though the presence of herbaceous species can be the result of ecological factors as well), such as *Salvadora persica*, *Acokanthera oppositifolia*, *Combretum apiculatum* and *Cmomiphora serrata*, are found at the bottom right-hand corner of Graph 5..

Nevertheless, factors more closely related to the development of each species, determined on one hand by average crown height and on the other by the basal area of the measured parcels, form the association of another species group, placing these - *Craibia zimmermannii*, *C. Brevicaudata*, *Ficus* sp., *Memecylon sessilicarpum* e *Icuria dunensis*, e a *Khaya anthotheca*, *Ormocarpum kirkii* and *Parka filicoidea* at the left-hand bottom corner of Graph 5.

Graph 3: CCA diagram showing the influence in distribution of the species of the five dependent varietals representing site-specific attributes (burnings, exploration, upper-strata height - USH, percentage covered by herbaceous strata e base area - AB) evaluated on the basis of 51 species found in the nine locations measured.



The ANOVA results of the multiple linear regression analyses demonstrate that, in general, the set of variables representing site conditions contribute significantly (5%) only in the distribution of the *Brachystegia allenii* (Adjusted R^2= 0.59; *p*= 0.02), *Hymenocardia ulmoides* (Adjusted R^2= 0.659; *p*= 0.02), *Icuria dunensis* (Adjusted R^2= 0.54; *p*= 0.03), e *Mimusops obtusifolia* (Adjusted R^2= 0.57; *p*= 0.03) species, and again significantly (in 0.1%) to the *Craibia brevicaudata* (Adjusted R^2= 0.83; *p*= 0.0008) species. Note that site factors in the distribution of the *Kigelia africana* (Adjusted R^2= 0.46; *p*= 0.06) species is almost significant (to 5%).

The presence of *Brachystegia allenii* and *Hymenocardia ulomides* is explained by the site condition variables (Adjusted R^2= 0.59; *p*= 0.02) but are found in significant quantities in the less-explored locales (*p*= 0.003). The same was observed as *Mimusops obtusifolia* (*p*= 0.006).

Icuria dunensis is prevalent in areas where there is a less dense herbaceous cover (p= 0.02). This observation indicates that this species forms closed habitats when both mature and during its young phase as well. Site conditions contribute in turn to the prevalence of *Craibia brevicaudata*, examined and found to be most common in habitats with greater basal areas (p= 0.009) and crown heights (p= 0.02). This species is nonetheless extremely vulnerable to burnings (p= 0.002).

There are species which, though in this study they show no significant relationship to the set of site factors are, for the aforementioned reasons, nonetheless influenced by specific factors that can be analyzed individually (*Student t test*). Burnings, for example, can benefit and contribute to the presence of the *Brachystegia boehmii* (p= 0.04), though this species suffers the negative impact of exploration (p= 0.03). The *Diospyros mespiliformis* is likewise negatively affected by exploration (p= 0.05). Among the mangrove species, we would highlight the *Rhizophora mucronata*, which occurs less frequently in habitats of greater crown heights (p= 0.03), this perhaps being the result of the exploration to which this species is subject.

POTENTIAL BIODIVERSITY CONSERVATION AREAS

With the objective of calling the attention of specific communities to future conservation and development plans on the basis of vegetal diversity, species composition, the presence of endemic, rare and threatened species, their use, and on a subjective assessment of observations conducted during initial field surveys with respect to existing pressures on resources, important/interesting data were gathered and priorities established both in the way of biodiversity conservation as well as activities designed to assuage the negative consequences of threats to which the resource is subject. Table 6 presents the results of this assessment in terms of the various conservation and landscape areas, as well as threats to the quality and sustainability of the resource.

One notes that, in general, these areas are subject to harmful pressures and threats to their conservation and sustainable resources. The areas of greatest importance to conservation, such as the *Brachystegia* coastal forest em Micolene, the mangrove forest of the Angoche Islands, the *Icuria* coastal forest of Thopuitho and Potone's riparian forest, should be receive priority consideration for conservation measures, not only on account of their great biological importance, but also for the beauty of their landscapes and, in the case of Micolene and Potone, for their culture significance to the communities. On the other hand, priority forest-management intervention should focus on the mixed coastal forests of Potone and Nanthuco, because of the great number of threats to which they are subject, their frail sate of conservation and pressures from economic interests.

Table 5: Values matrix and priority of areas of importance and immediate conservation/development measures for the different units..

CRITERIA	Icuria Forest		Brachystegia Forest	Mixed Forest		Riparian Forest	Mangrove Forest			Total
	Angoche	Thopuitho	Micolene	Potone	Nanthuco	Potone	Cidade Angoche	Ilha Ang	Rio Larde	
Conservation values										
Biological	13	19	16	10	11	14	4	13	12	
Landscape	8	11	13	11	10	14	9	20	16	
Cultural	1	1	5	5	1	3	1	1	1	
Sub total	**22**	**31**	**34**	**26**	**22**	**31**	**14**	**34**	**29**	**243**
Threats										
Economic	6	5	2	10	10	4	10	7	6	
State of Conservation	26	22	14	37	33	28	24	17	13	
Sub total	**32**	**27**	**16**	**47**	**43**	**32**	**34**	**24**	**19**	**274**

Priority 1 conservation	above 30
Priority 2 conservation	25-29
Priority 3 conservation	< 24
Priority 1 intervention	above 40
Priority 2 intervention	30-39
Priority 3 intervention	< 29

AREAS THAT ARE OF IMPORTANCE TO CONSERVATION

For their Biological Value

Four areas have been identified in this study as being of considerable importance because of their biological value, thereby justifying measures to ensure their conservation, not only to preserve the important biodiversity found there (plant diversity and critical ecosystem) but also for their being unique to the region and for the presence of rare and endemic species:

(i) The patch of coastal, predominantly leguminous forest with formations of *Icuria dunensis-Hymeneae verrucosa* found in the Thopuitho region is unique and contains many rare and endemic species. This forest is currently threatened as it has been singled out for mineral exploration. It also is a source of lumber for resettlement communities within the Kenmare concession area. Nevertheless, there is a proposal for collaboration between the WWF and the KMAD (Kenmare Moma Development Association) for the mining plans to be altered in order to protect this swath of *Icuria dunensis* forest, requiring, perhaps, the formal establishment of a forest reserve.

Further in-depth studies of this area then become critical as regards its regenerative capacity potential for rehabilitation. At the same time, this patch should be compared with the forest in Muebasse or other areas so as to clearly identify which are to be demarcated as IPA's (Important Protection Area) and/or for species conservation.

(ii) The patches of riparian forest in Potone, along the banks of the Luázi River and in the area where the Potone and Tivirivi (Potone River tributary) rivers converge are in grave threat from intensive logging and burnings, resulting in the abatement of flows from the Luázi and Potone rivers, with the latter becoming a seasonal watercourse.

Despite the considerable biological importance of this area stemming from species diversity and its typical riparian formations, only the forest area known as ´Malaika´,

near the Tivirivi River and of great importance to Potone's cultural heritage, is in need of special attention to protect its vegetation.

As Potone is a dry area facing a number of water-related problems, urgent measures to protect these formations within a 20-meter strip along the banks of the Luázi, Potone and Tivirivi rivers becomes crucial. This measure, extremely important for the conservation of the resource and to supply water for the Potone community, is provided for in the Land Law under partially protected areas (Article 8), but has not been followed, calling for rigorous efforts to ensure its compliance.

It must also be kept in mind that the potential importance that the landscape of the riparian forest beside the Luázi River may come to represent in the context of a sustainable plan for tourism development. The locale is an attractive one, where the waters of the sea and the river meet in an area called 'Culine' that in addition holds historical and cultural value for the local community.

For the Importance of the Landscape

(i) Though important from the biological standpoint, the areas that form the mangrove forest, such as those of Angoche Islands and the Larde River, enjoy conservation priority because of the landscapes they offer. These two areas, especially the more accessible of the Angoche Islands, present tourism opportunities, particularly in the sense of offering a singular access to the natural attractions of the area should sightseeing experiences be offered by boats guided by members of the local community. Such boat tours indeed represent excellent opportunities to explore the various canals among the mangroves and to take in the picturesque landscape of dramatically-exposed mangrove roots (Figure 3).

For Cultural Interest

(i) The small path of coastal *Brachystegia* forest found in Micolene is of great cultural interest for being the old burial site of the first inhabitant and founder of the

town of Micolene. Moreover, this forest is important from the biological standpoint for being the only known coastal *Brachystegia* forest patch presenting, in structure and composition, species that are peculiar to this formation, rendering this forest important and a worthy object of conservation.

Although this area to date does not benefit from the protection of a legal statute, it has been safeguarded by the local community. As it is found close to the Kenmare zone, it would be advisable for this area to be considered one of high value for conservation and even included in the protocol of understanding between the WWF and the KMAD. Ideally, however, studies should be undertaken to identify similar areas along the coast that contain this variety of coastal forest.

(ii) The Potone mixed coastal forest, chiefly the portion that lies between the Potone River and the Tivirivi's tributary, is of great cultural value for therein one finds the "Malaika", a traditional area where cults are performed. Indeed, here traditional ceremonies are conducted to venerate the spirits of the dead and to entreat them to provide for abundant fishing and planting, and for protection from evil spirits.

The remaining area is of extraordinary importance as a source for medicinal resources, and considered a "garden" of medicinal species. Here one finds 160 medicine men, all of whom collect the plants of this area to concoct their remedies. The area is unique in the sense of uniting the mystical element of the spirits and their sanctuary, in the so-called "Malaika", with the curative ingredient of the plants.

Although of great interest to the community, the area has to date not been protected from timber exploration by individuals from without the community. This situation is further aggravated by the burnings employed to find ever more dispersed tree species.

AREAS OF INTEREST FOR DEVELOPMENT

Vast areas unaffected by human activity, or those lacking in agricultural potential, have in general remained unidentified, despite their faunal and tourism potential, and can be immediately set aside as wilderness areas to be protected or developed for

ecotourism. Possible exceptions here would be some of the Islands (not visited by the team) forming the Archipelagos. The greatest threat to the remaining biodiversity and the critical mangrove forest may be demographic pressures stemming from the need to establish small plots (machambas) concentrated along the Potone road, expanding cashew plantations (one of the area's chief sources of income) and the encroachment on fisheries by illegal fishing vessels.

Included in this category are areas which, despite facing serious threats (poor state of conservation, multiple and disorderly land and resource-usage), remain good candidates for conservation and ensured sustainability through implementation of usage regulations that would transform the aforementioned threats into favorable conditions through the enrichment and proper utilization of the existing resource.

According to the assessment, the areas facing the greatest degree of threat are the mixed forests of Potone, in Angoche, and Nanthuco, in Thopuitho. These areas offer, in addition, the potential for implementing community development projects that could generate income. Moreover, one finds in these areas species of greater commercial value as wood resources which, in turn, are those included in the categories of threatened and vulnerable species.

For their Economic Interest

(i) The Potone region has been increasingly populated by families from the city of Angoche seeking to clear agricultural subsistence plots which, because of the clearing methods employed, threaten the local vegetation. The frequency and destructive force of uncontrolled burnings resulting from plot clearing have, along with unchecked timber exploration, intensified over the past two years.

The prospectors set fire to the forest to more easily find the species, ever more dispersed, that they are after. Extraction of gramineous varieties is very common in this type of vegetation which, being very dry, makes for intense and devastating fires that damage the herbaceous and arbustive layers (Figure 5), and can eliminate many

saplings. In effect, the natural regeneration of the forest is compromised by the diminution of the number of adult plants in the habitats, thus leading to a perpetual cycle of degradation.

Over the course of time this process will alter the forest's structure, leaving it more open and with a floral composition of predominantly fire-resistant species. Thus such species as *Khaya anthotheca* (Umbaua) and *Parkia filicoidea* become less frequent and begin to concentrate along the rivers that still contain perennial flows.

Evidence of intensive timber exploration was found, especially in the areas of Namitoria and Nampete (Figure 30). After having finished our field work, we observed in the Potone/Nampete forest a truck carrying a cargo of logs very precariously, its heavy load being hauled onto the vehicle by men using boards and ropes (Figure 4). The species being cut are frequently Blackwood, Ironwood, Mondzo and Jambire. The administrative oversight of this enterprise appears, however, deficient: bills of lading for the cargo bore no signature, neither that of the revenue officer nor the forest inspector, despite the fact that the referenced truck had been observed making a number of hauls in the area. And judging by the number of trunks in the log-yard, the Mondzo (*Combretum imberbe*) cutting limit of 10 m^3 and that of the Jambire (*Millettia sthulmannii*) 5 m^3 had likely been exceeded.

These problems are of great concern to the area's inhabitants, especially those who collect medicinal plants, now dwindling and under threat. Moreover, the loggers' activities, besides depleting the area's resources, provide the local population little benefit from this exploration

To complete this account of activities that put these forest formations in jeopardy, we must mention firewood, lumber and non-timeb materials extraction, such as bark. Again, this situation calls for the implementation of a community-based program for forest resources development.

Figure 30: Exploration area for *Combretum imberbe* in Potone.

(ii) As regards the Nanthuco region, its forest evinced signs of having undergone timber exploration by means of a highly selective and intensive process. Exploration was primarily for the *Combretum imberbe* (Mondzo) species, used especially for railway ties. In the past, many cotton plantations existed in the area.

The sparse herbaceous vegetation of this area is more a consequence of burnings than of cattle grazing, which is practically non-existent. According to the local people, the fauna are disappearing because of intensive, unchecked hunting. Prominent among the endangered species is the Nanthuco, a variety of antelope, which gives the region its name.

This is yet another area that offers some potential for community-based forest exploration projects. To this end, adequate administration of the area so that it can serve the community as a sustainable source of timber resources (chiefly firewood and lumber) becomes crucial. In the process, the coastal *Icuria* e *Brachystegia* must be protected and in no way compromised.

For their Inadequate Degree of Conservation

(i) Although the patch of *Icuria dunensis* forest adjacent to the city of Angoche is of moderately significant biological importance for the presence of endemic and/or rare species, its primary importance lies in great variety of threats to which it is subject: On one hand, the elimination of the mangrove forest to establish salt beds increases the demand for forest resources in this patch adjacent to Angoche city's mangrove forest; and, on the other, the conversion of the *Icuria* forest to cashew-tree plantations along the areneous strips. It should be pointed out that a small patch of forest containing *Icuria* is found in the city of Angoche, in a swath of dune in the mangrove forest in the direction of Praia Nova. This patch is protected as it contains a cemetery.

Though the area is very much degraded and not viable in terms of interventions for purposes of conservation, the *Icuria* species may yet offer some promise in the way of genetic material. To this end, studies designed to assess genetic material and the gathering and storage of this material as part of an ex-situ conservation effort are proposed.

(ii) The Angoche city mangrove forest is the most threatened of all because of the demand for firewood and building lumber, a situation further aggravated by the dearth of these resources in adjoining areas. Furthermore, the mangroves are being cut to allow for salt beds and to extract lumber for housing and the building of fishing boats (Figure 31). Although the fishermen mentioned six mangrove species, only one, the Mutxo (*Avicennia marina*), occurs in Angoche city.

Figure 31: The Almadia, a traditional fishing boat used in Angoche.

RECOMMENDATIONS

With a view to a harmonious development of the Archipelago, certain proposals present themselves, whether for conservation or use of resources, to be implemented as detailed management plans come to the fore ensuring the sustainable utilization and conservation of ecosystems. In given situations, these options for utilization of the landscape and/or vegetation of these areas would counter threats against their valuable resources.

The promotion of appropriate forms of tourism, especially ecotourism, would contribute to the maintenance of the biodiversity and wilderness resources of the surveyed areas. Tourism would furthermore yield income opportunities for communities which enter into partnerships as economic agents.

FOR THE POTONE AREA

(i) The migration of people from the city and environs of Angoche to the Potone forest, where they seek to clear agricultural plots, must be discouraged so as to lessen subsistence activities that contribute to deforestation. Moreover, these agricultural plots yield very little because of the sandy soil on which they are established. We propose the institution of appropriate zoning regulations to govern and limit the number of agricultural plots, chiefly along the eastern border, or the area adjacent to Boila. Agricultural extension programs designed to enhance productivity are also recommended for this area.

(ii) Designate the Potone forest as an area for conservation and community use, and employ legislation so as to benefit from the Forestry Law and the 20% of exploration taxes this law requires be retained within the communities. The training of forest inspectors should emphasize aspects of the forestry and lands law pertaining to the benefits that are destined to the communities, as well as the means by which these benefits are delivered.

The area lacks adequate zoning and forestry inventory rules for the utilization of medicinal plants. Such regulations would allow local communities, especially Potone, to employ receipts to conduct their traditional ceremonies and fund their annual pilgrimage.

At the same time, we would suggest reforesting areas within the Boila Commercial Zone to help satisfy the needs of these communities for firewood and construction materials. Such programs should employ silvicultural systems, such as the combination of rapid-growth exotic species with native ones. A forest revitalization program should also be initiated using native species of commercial value, such as the *Khaya anthotheca, Millettia sthulmannii Combretum imberbe*, etc., together with species that are of cultural and medicinal importance.

(iii) It is furthermore crucial that the sacred Malaika area of the forest of Potone be maintained as a cultural sanctuary, and that a detailed ethnobotanical study be conducted in conjunction with medicine men of its medicinal species. This research would allow for identification of the species utilized, a determination of the state of the habitats of the preferred species and the definition of plans for the sustainable extraction of these plants. Areas should also be set aside as "medicinal gardens," with species selected by the medicine men. To this end, it is important that we investigate methods of propagation of the such crucial species as the Mwawala, Mukuratepo, Reperepe, etc.

AREAS NEIGHBORING ANGOCHE

(i) The touristic use of the mangrove forest, with boats to guide visitors wishing to appreciate the beauty of this vegetation, can be yet another income-generating development alternative to benefit the area's fishermen. Other income sources would thereby be created for periods of fishing prohibition and to allow vital aquatic species to reproduce.

(ii) The work of the Angoche Fishermen's Association must be promoted, developed and supported for the recovery of the mangrove forest. This assistance can be achieved through a program of enrichment and replanting of degraded mangrove patches with the species most sought after by the population, such as the *Ceriops tagal* in the more areneous saline soils containing less organic matter, and the *Rhizophora mucronata* in saline soils containing a greater proportion of organic matter.

Adequate research into how to propagate the various mangrove species is called for as well, especially in the case of those species that cannot easily regenerate by natural means. To initiate this effort, the IIAM Forestry Unit of the Northeast Zonal Center, based in the Namialo station in Nampulo, must be involved. Furthermore, a team from the Association must have the opportunity visit key locations within Mozambique – especially Sofala – and abroad – Tanzania, Kenya, etc. – where mangrove forest recovery projects are underway.

IN THE THOPUITHO AREA

(i) For a five-year period, Kenmare will operate in the Mtes Pehle (Pilivi forest) area and Namaloco. The company will later explore the Mulimone zone, although it has committed to excluding from its exploration plans all areas where the *Icuria dunensis* species is present. It is crucial, therefore, that species to be utilized in rehabilitation programs in the explorations zones are identified. Although these areas bear the scars of much degradation, a considerable variety of economically-important species remains. The situation, then, calls for the gathering of seeds and the implementation of a program for their conservation in gene banks, thus ensuring rehabilitation of the species.

(ii) The transfer of the population of the areas open for exploration to the village of Mutiticoma, in Tipane, must occur along with the introduction and development of agricultural practices that are appropriate for extraordinarily areneous soils. We must also keep in mind that the construction of the new village is now at a well-advanced phase.

(iii) Zoning of the Nanthuco mixed forest is likewise suggested. Such should occur along with a plan for the management of timber and other resources to enable a

sustainable and orderly exploration of existing resources so as to benefit the local population. For example, exploration of the *Millettia sthulmannii*, a tree species common to the area that has an elevated regenerative capacity, can be thus managed. At the same time, programs for properly exploiting utilizing *Olax dissitiflora* for the production of face creams ('M'siro') can be conducted, especially given the fact that efforts are underway to market this product in the city of Nampula.

(iv) Lastly, we suggest that both the *Icuria dunensis* forest areas as well as the *Brachystegia* patch in Thopuitho be classified in the (IPA) category of high conservation priority in the context of the protocol established between Kenmare and the WWF, as these areas lie within the concession zone and will be affected by Kenmare's operations.

As such, within the realm of the protocol of understatnding/ comitment with Kenmare, these areas should be managed for purposes of conservation and therefore excluded from the areas intended for mining. In the case of the *Icuria* zone, once it is in a degraded state its rehabilitation will have to be considered, along with a halt to lumber exploration for construction.

OTHER STUDIES TO BE CONDUCTED

In view of the fact that this study constitutes a rapid evaluation, we propose more detailed studies of the region, including of those areas which the team has already surveyed, including: (i) the mangrove forest of the Larde River; (ii) the Potone forest, to foster a land-utilization plan; (iii) the Nanthuco forest, to assess the potential for forest-products exploration, particularly utilization of the *Olax dissiflora* ('M'siro') species to produce cosmetic cream in conjunction with the Nampula DPA community project to market the product; (iv) in the Muebasse *Icuria* forest, to determine its extension and status. (v) The Archipelago team furthermore recommends research into the extant vegetation of Ilhas do Fogo, Casuarina, Epidendron and Caldeira in view of reports that the floral composition of these areas is affected by maritime currents, with the origins of some species being traced to Australia, India and the Pacific Islands. These botanical surveys must be conducted in the months of April and May and October and November to ensure gathering optimal numbers of fertile specimens, with blooms and/or fruit. (vi) Revitalization and rehabilitation studies for the

Icuria forest of Potone (with medicinal species), the riparian forest and that of Nanthuco. (vii) Lastly, we encourage the development of programs to rehabilitate and revitalize areas which mining operations have degraded.

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APPENDICES

Appendix 1: List of all species found in Angoche and Moma regions

Scientific Name	Common Name	Family	Status	Use	Observations
Abrus precatorius	Muphinimini	Fabaceae		Medicinal	
Acacia sp	Nékweya	Fabaceae		Medicinal	
Acacia sp	Nthúko	Fabaceae		Firewood	
Acacia sp	Nakawia	Fabaceae			
Acacia sp	Uriyakhope	Fabaceae			
Acacia sp.	Nékweya	Fabaceae			
Acokanthera oppositifolia	Mufula	Apocynaceae		Medicinal	
Adansonia digitata	Inlápa	Bmobacaceae		Food	
Afzelia quanzensis	Mukokofi	Fabaceae	Vulnerable LR-nt(VUD2)	Wood	In the red data list in the low-risk species group
Ageratum conyzoides		Asteraceae			
Albizia adianthifolia	Nráka/Muraka	Fabaceae		Wood	
Albizia versicolor	Nkurathepo	Fabaceae		Medicinal	
Aloe sp.	Eláwa	Aloaceae		Medicinal	
Anacardium occidentale	cajueiro	Anacardiaceae		Food	
Eropogon sp.		Poaceae			
Annona senegalensis	Mihépe	Annonaceae		Food	
Asparagus sp	Nxileyamuáli/Nsileyamwali	Asparagaceae			

Scientific Name	Common Name	Family	Status	Use	Observations
Asparagus sp	Namoro	Asparagaceae			
Avicenia marina	Muxo	Avicenniaceae		Firewood, Pylons, Stakes	
Bauhinia sp	Txitxipe	Fabaceae		Medicinal	
Boscia sp.	Nlavilávi/lavilavi	Capparaceae		Medicinal	
Brachystegia speciformis	Murotho	Fabaceae		Rope	
Brachystegia allenii	Munté	Fabaceae			
Brachystegia boehmii	Kapóti ; Capote	Fabaceae			
Bridelia Cathartica	Nampuputo	Euphorbiaceae		Medicinal ; Food	
Bruguieria gymnorrhiza	Muthumáxi	Rizophoraceae			
Bulbostylis burchelli	Ereru ya búri	Cyperaceae			
Carissa macrocarpa	Sevatha	Apocynaceae			
Carpolobia goetzei	Tequerreque/Tekereke	Polygalaceae		Soap	
Cassytha filiformis	Lúthathaka/Ntavitavi	Lauraceae			
Ceriops tagal	Nkhátala	Rhizophoraceae		Stakes, Firewood	Propagates with ease
Cissus cornifolia	Sopátari	Vitaceae		Medicinal; Food	
Cissus quadrangularis		Vitaceae			
Cissus rodundifolia	Lapéla	Vitaceae			
Cocos nucifera	Coqueiro	Areaceae		Food	
Cmobretum adenogonium	Náma	Cmobretaceae		Medicinal	
Cmobretum apiculatum		Cmobretaceae			
Cmobretum imberbe	Mokoda/Mucosa	Cmobretaceae			
Cmomelina africana		Cmomelinaceae			
Cmomiphora serrata	Nikwáku	Burseraceae			
Craibia brevicaudata	Saikúri	Fabaceae	Vulnerable (VUD2)/VUBl+2b	Stakes	
Craibia zimmermannii	Ecori	Fabaceae	Endangered (EN)		

Scientific Name	Common Name	Family	Status	Use	Observations
Cynodon dactylon	Nossáca	Poaceae			
Cyperus sp	Thúkulo	Cyperaceae			Grass
Cyrtorchis arcuata	Ethátua	Orchidaceae			Icuria parasite
Dalbergia melanoxylon	Mpívi	Fabaceae	LR-nt	Wood	
Datura sp.	Piritxale	Solanaceae		Medicinal	
Deinbollia oblongifolia	Ukhulábwa; Okhulábwa; Narima Moda	Sapindaceae		Food	
Deinbollia sp.	Namalopa	Sapindaceae			
Dicerocaryum zanguebarium	Ekhúwa	Pedaliaceae		Shampoo	
Dichrostachys cinerea	Thélela/Thalala	Fabaceae			
Diospyros mespiliformis	Muribariba	Ebenaceae		Food	
Diplorhynchus condylocarpon	Rókosi;Ndzori	Apocynaceae		Cola	
Entada abyssinica		Fabaceae			
Eragrostis sp.		Poaceae			
Euclea natalensis	Mulala	Ebenaceae		Toothbrush	
Euphorbia bougheyi	Ekodá	Euphorbiaceae	Endemic (Rare)		
Euphorbia mauritania		Euphorbiaceae		Medicinal	
Ficus sp	Nthápu	Moraceae		Medicinal	
Ficus sp.	Erwí	Moraceae		Cola	
Ficus sycoMorus	Mahúrua/Maurrua	Moraceae		Medicinal	
Flacourtia indica	Tocmoa/Thocmoa	Flacourtiaceae			
Flagellaria guineensis	Ntále	Flagellariaceae			
Garcinia livingstonei	Nvétho/Nkhumili	Clusiaceae		Food; household utensils	
Gloriosa superba		Colchicaceae			
Grewia transzambesica	Khúntea	Tiliaceae		Food, Stakes	
Heteropogon melanocarpus	Pelehi	Poaceae		Roofing/fencing	

Scientific Name	Common Name	Family	Status	Use	Observations
Hibiscus sp	Samarire	Malvaceae		Food	
Hymenaea verrucosa	Nkháta	Fabaceae		Medicinal; food; boat building	
Hymenocardia ulomides	Nassipálala/Nachipalala	Euphorbiaceae		Stakes	
Hyphaene coriacea	Nkhúta	Areaceae		Food	Fruit called Okwarákua
Icuria dunensis	Ikuri, Nkúri	Fabaceae	Endemic (ENA2c)	Rope; boatbuilding	In the red data list of extinct and endangered species
Imperata cylindrica	Nrére	Poaceae		Roofing	
Ipoomea sp.	Muakánula/Macanula	Convolvulaceae		Medicinal	
Khaya anthotheca	Mbáwa	Meliaceae	(LR-Lc)/ Vulnerable (VUAlcd)	Medicinal	In red data list of low-risk species
Kigelia africana	Murukuruku	Bignoniaceae		Medicinal; Pesticides	
Lagenaria sphaerica	Desconhecida	Cucurbitaceae			
Leolphia petersiana	Nthíele	Apocynaceae		Food, cola	
Lonchocarpus bussei	Mwákha	Fabaceae		Medicinal	
Macuna coriacea		Fabaceae			
Maerua angolensis	Khiriwiri ; Nlúkaom	Capparaceae		Medicinal	
Maprounea africana	Muntakítxawe	Euphorbiaceae		Medicinal	
Memecylon sessilicarpum	Khaturréia/Catorreia	Melastmoaceae	Endemic (DD)	Firewood; stakes	In red data list for group having insufficient data
Millettia sthulmannii	Nampire	Fabaceae	LR-nt	Wood	In red data list of low-risk species
Mimusops obtusifolia	Thunázi; Thénari; Nkúmazi	Sapotaceae		Food	

Scientific Name	Common Name	Family	Status	Use	Observations
Omomrdica balsamina	incacana	Cucurbitaceae		Food	
Nymphaea nouchali	Nkókowa	Nymphaceae		Medicinal; Food	Kulini Lake acquatic plant
Ochna hostilis	Mulucaom				
Olax dissitiflora	Nsilo/Nsiro	Olacaceae		Face cream; Stakes	
Oromcarpum kirkii	Mkúthu/Nkutha/Incutu	Fabaceae		Medicinal	Found only along the banks of the Luázi River
Ozoroa obovata	Nakwápe	Anacardiaceae		Medicinal	
Ozoroa sp	Nakwápi	Anacardiaceae		Bed building	
Parinari curatellifolia	Nthúpi	Chrysobalanaceae		Firewood; food	
Parkia filicoidea	Mpovéra	Fabaceae		Medicinal	
Phoenix reclinata	Marita	Areaceae		Food, fish traps, basketry	Sithu fruit
Phyllanthus reticulatus	Namádzuco	Euphorbiaceae		Medicinal	
Piliostigma thonningii	Sitipe	Fabaceae			
Psidium guajava	goiabeira	Myrtaceae		Food	
Pteleopsis myrtifolia	Mpíti; Mpuiri; Mpuiti; Muleva	Cmobretaceae		Medicinal	
Pterocarpus angolensis		Fabaceae	LR-nt		
Rhipsalis baccifera	Desconhecida	cactaceae			
Rhizophora mucronata	Nthúlo	Rizophoraceae		Firewood; stakes	
Rhodognaphalon schumannianum	Nthíli	Bmobacaceae			
Ricinus cmomunis	Nkúra	Euphorbiaceae			
Rothmannia sp.		Rubiaceae			
Rourea orientalis	Muphúrunho/Mupurunho	Connaraceae		Medicinal	
Salvadora persica	Erákhi	Salvadoraceae		Medicinal	
Sansevieria hyacinthoides	Elawa	Dracaenaceae		Ornamental	

Scientific Name	Common Name	Family	Status	Use	Observations
Sclerocarya birrea	Nthulo	Anacardiaceae		Medicinal	
Securidaca longipedunculata	Nakehe	Polygalaceae		Medicinal , soap, brooms, firewood	
Senna petersiana	Nreperepe	Fabaceae		Medicinal	
Sideroxylon inerme	Mutxotxoca; Ekhava	Sapotaceae		Food	
Sonneratia alba	Nkwáta	Sonneratiaceae		Food, boatbuilding; stakes; honey production	Thindiri Fruit
Sterculia appendiculata		Sterculiaceae	Vulnerable (VUA1ad, B1Bc)		In the red data list of extinct and endangered species
Strychnos henningsii	Yolowa	Loganiaceae		Fencing yards	
Strychnos innocua	Nkuluko	Loganiaceae		Medicinal	
Strychnos panganensis	Etulihiamphíli	Loganiaceae			
Strychnos spinosa	Nthóka; Mukuluko	Loganiaceae		Food	
Tabernaeomntana elegans	Racaraca	Apocynaceae		Harpoons	
Tamarindus indica		Fabaceae			
Tarenna littoralis	Ntá/M'thá	Rubiaceae		Firewood	
Tephrosia sp		Fabaceae			
Terminalia sericea	Hai hai	Cmobretaceae		Medicinal	
Typha capensis	Nipuku	Typhaceae		Roofing	
Vernonia sp	Lifusso	Asteraceae		Medicinal	
Viscum junodii	Ethátua	Viscaceae			Parasitic plant from Nkwáta
Vitex Ommbassae	Mpúru/Mphuro	Verbenaceae		Medicinal; Food	
Xylotheca tettensis	Nkákhau;Linsawa	Flacourtiaceae		Medicinal; Food	

Scientific Name	Common Name	Family	Status	Use	Observations
Not identified	Khirikiri				
Not identified	Mwanarimu			Medicinal; Food	
Not identified	Moleva			Medicinal	
Not identified	Wáwala			Medicinal	
Not identified	Enhénhe				
Not identified	Ethátua			Medicinal	
Not identified	Maitho ochéra			Medicinal	
Not identified	Hurúrio/Uririó			Medicinal	
Not identified	Desconhecida				
Not identified	Mobe			Medicinal	
Not identified	Nanrácimwè			Seeds	
Not identified	Ihán ha				
Not identified	Desconhecida				
Not identified	Xiriyéla				
Not identified	Ntabetabe			Medicinal	
Not identified	Desconhecida				
Not identified	Ndálawa			Food	
Not identified	Desconhecida				
Not identified	Ndí			Edible fruit	
Not identified	Desconhecida				
Not identified	Desconhecida				Sap causes itching
Not identified	Mathápa sirissiri			Food	
Not identified	Nfússi			Firewood	
Not identified	Sosso			Food	
Not identified	Mpámela			Medicinal	
Not identified	Desconhecida				

Scientific Name	Common Name	Family	Status	Use	Observations
Not identified	Desconhecida				
Not identified	Nthicakókohe				
Not identified	Desconhecida				
Not identified	Ethátua /Thatúa				
Not identified	Nkákharra			Food	
Not identified	Desconhecida				
Not identified	Liwépa			Medicinal	
Not identified	Muvutha mwana			Medicinal	
Not identified	Ntátakwi			Medicinal	
Not identified	Tútuli				
Not identified	Murrúmpana			Medicinal	
Not identified	Nayako			Cage construction	
Not identified	Musátawa			Pesticide	
Not identified	Mwákho				
Not identified	Mafúa			Medicinal	
Not identified	Namanéne				
Not identified	Namuno			Medicinal	
Not identified	Nvévera				
Not identified	Nakuzupa				Poisonous
Not identified	Eritricha			Food	
Not identified	Mpúxi			Food	
Not identified	Ntátawa			Food	
Not identified	Nthukiri			Food	
Not identified	Nkálanja			Cables	
Not identified	Nánthata			Syrup	
Not identified	Matxini			Medicinal	
Not identified	Sepeúme/Sumaúma			Mattresses	
Not identified	Nakhuco			Medicinal	

Scientific Name	Common Name	Family	Status	Use	Observations
Not identified	Ndzále				
Not identified	Nsátawa			Insecticide	
Not identified	Ethíkina			Roofing ; fencing	
Not identified	Muthótxe			Food	
Not identified	Nayako				
Not identified	Namahaca			Medicinal	
Not identified	Ntálala			Medicinal	
Not identified	Rótwe				
Not identified	Mucahavara			Medicinal	
Not identified	Erupakuluhe			Roofing; fencing	
Not identified	Ntátakwi				
Not identified	Nanthiti				
Not identified	Mpára			Food; stakes	
Not identified	Nacuna			Food	
Not identified	Nipúko			Roofing; fencing	
Not identified	Mpwápu				
Not identified	Vánha			Medicinal	
Not identified	Thátxe			Roofing; fencing	
Not identified	Ncócopa				
Not identified	Ntéla			Home building	
Not identified	Muravarava			Medicinal	
Not identified	Mutiquiri				
Not identified	Lunha				

Appendix 2: Order of families according to number of species

Family	Nº of genera	Nº of species	Position in order of species per family*
Fabaceae	23	30	1
Euphorbiaceae	6	7	2
Apocynaceae	5	5	3
Poaceae	5	5	4
Cmobretaceae	3	5	5
Anacardiaceae	3	5	6
Rhizophoraceae	3	3	7
Areaceae	3	3	8
Cyperaceae	2	3	9
Rubiaceae	2	2	10
Sapotaceae	2	2	11
Bmobacaceae	2	2	12
Asparagaceae	2	2	13
Capparaceae	2	2	14
Cucurbitaceae	2	2	15
Ebenaceae	2	2	16
Flacourtiaceae	2	2	17
Polygalaceae	2	2	18
Loganiaceae	1	4	19
Moraceae	1	3	20
Vitaceae	1	3	21
Sapindaceae	1	2	22
Asteraceae	1	2	23
Viscaceae	1	1	24
Verbenaceae	1	1	25
Typhaceae	1	1	26
Tiliaceae	1	1	27
Sterculiaceae	1	1	28
Sonneratiaceae	1	1	29
Solanaceae	1	1	30
Salvadoraceae	1	1	31
Pedaliaceae	1	1	32
Orchidaceae	1	1	33
Olacaceae	1	1	34
Ochnaceae	1	1	35
Nymphaceae	1	1	36
Meliaceae	1	1	37
Melastmoaceae	1	1	38
Malvaceae	1	1	39
Lauraceae	1	1	40
Flagellariaceae	1	1	41
Dracaenaceae	1	1	42
Convolvulaceae	1	1	43
Connaraceae	1	1	44

Family	Nº of genera	Nº of species	Position in order of species per family*
Comelinaceae	1	1	45
Colchicaceae	1	1	46
Clusiaceae	1	1	47
Chrysobalanaceae	1	1	48
Cactaceae	1	1	49
Burseraceae	1	1	50
Bignoniaceae	1	1	51
Avicenniaceae	1	1	52
Annonaceae	1	1	53
Aloaceae	1	1	54

* In order of number of species per family