Management Plan and Development Strategy for the Inhaca Archipelago (2010 - 2014)

1 Introduction

1.1 Geographical Situation

The Inhaca Archipelago, consisting of two Islands, inhaca island, the largest and named after the Archipelago, and the Portuguese Island, northwest of Inhaca, lies in the quadrant of parallels 25°57'49"S and 26°05'00"S and meridians 32°53' 00"E and 33°00'00"E, opposite Maputo City, municipality to which it belongs (Figure 1.1). It is a discontinuity of the Machangulo Peninsula, from which inhaca island separates to the south, through the Santa Maria Canal. According to Moreira (2005) the Canal was opened possibly during the holocénica transgression phase. In this way, the Inhaca Archipelago is the product of the marine regression of the Holocene period.

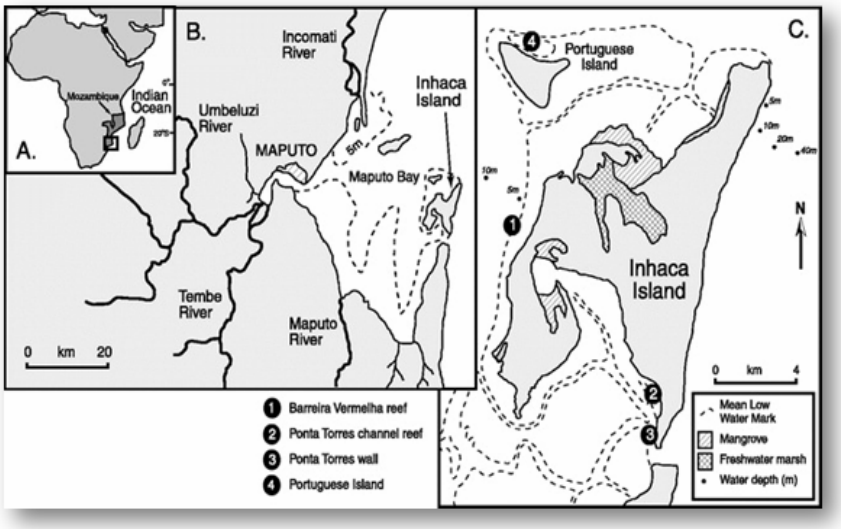

Figure 1.1: Location of the Inhaca Archipelago in Africa, Mozambique and in relation to Maputo Bay (Source: Perry, 2003)

According to Sénvano et al. (1997), the islands of the Inhaca Archipelago are separated from each other by the very narrow channel of the Golada de Santa Maria, in an extension of 2.3 km, from Portinho to Ponta Cigalo. Inhaca Island has a total area of about 42 km^2. The most distant places on Inhaca Island, Ponta Torres and Ponta Mazonduè, are separated by a distance of 13 km. The maximum width is 6.5 km long and was measured from the

Red to the east coast. The Portuguese Island has only 1.6 km^2 of surface, a maximum length of 2 km, from Ponta dos Elefantes to Ponta Samendene, and an extreme width of 1.3 km, from Ponta Cigalo to the north coast of the island.

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The Inhaca Archipelago is part of maputo city, which, in mozambique's administrative division, has province status. It is one of the urban districts of this City-Province. This political and administrative position of the Inhaca Archipelago within the administrative division of the country dates back to 2005, the year in which, by decision of the Municipal Council, the Archipelago moved to Municipal District Number 7 of the Municipality of Maputo, forming from three neighborhoods, namely the Inguane District, the Ribzene District and the Nhaquene District. However, in the administrative division of 1986, the Archipelago constituted a Locality of the Marracuene District, as a result of the administrative reclassification that year took place.

1.2 History of the Inhaca Archipelago

Product of the marine regression of the Holocene period, the Archipelago holds the natural conditions of habitability common in tropical island landscapes. According to Impacto (2001), in the collective memory of the current inhaca islets the references about when the Island came to be inhabited and when it was "discovered" are almost lost. However, some myths and legends passed down from generation to generation remind us of remote times.

The arrival of the first inhabitants to Inhaca Island took place through the Machangulo Peninsula, the end of the nearest continent to the Island. They are Africans from the same group of peoples who inhabited Machangulo. Later, people from other latitudes climbed the Archipelago. From this, according to Craveirinha (2001), it was Luíz Fernandez and his men, Portuguese navigators lost from vasco da Gama's armada on the second sea voyage to India, the first from overseas to have direct contacts with the inhabitants of Inhaca Island in 1502.

The history of the Inhaca Archipelago is deeply linked to its inhabitants, to the ivory trade that lasted until the beginning of the 18th century – with a trading post established by the Portuguese on the small Island of the Portuguese – to leprosaria, to slave traffic, but above all to research and conservation of nature, of which today inhaca Marine Biology Station (EBMI) and forest reserves are some historical landmarks (Impact , 2001). In fact, EBMI, whose facilities were built in 1951, is born from scientific interest in a field favorable to the investigation of the natural composure of the Archipelago, especially the marine. The Station is located near a cove, on the west bank of Inhaca Island and is separated from the beach by a small strip of indigenous vegetation, only open in two places for access to the sea.
It is difficult to accurately affirm when scientific research began in the Inhaca Archipelago, but it is known that European newspapers of 1909 reported the existence of two paradisiacal islands in the Indian Ocean, referring to the islands of Inhaca and the Portuguese due to their biodiversity. However, it has not been until the beginning of the 1920s that teachers and students have been attending the Archipelago, with academic objectives. The EBMI Museum of Natural History, with the herbarium functioning as a reference collection of terrestrial, marine and amphibian plants and animals, has reflected research activity in the Archipelago since that date.

The Forest and Marine Reserves of the islands of Inhaca and the Portuguese were established in 1965 and are the main indicators of the association of the Archipelago with the conservation of this island territory. These reserves existed without physically established limits on the ground until 1976, therefore, after the proclamation of national independence, when they were demarcated by the then National Directorate of Geography and Registers (DINAGECA). In 1989, casuarinas were planted in Ponta Torres and Ngomela in the eastern zone, an action aimed at coastal protection throughout the strip they cover.

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The current situation of the Inhaca Archipelago is characterized by the strong concern about the phenomena, especially of natural soil erosion accelerated by certain management practices, progressive degradation of biodiversity, increasing population density and relatively high poverty rate of the islets. The situation described above should be associated with the fact that the Archipelago is already a Special Reserve, which ensures opportunities for new approaches to face the challenges posed by the situation.

1.3 Status of the Inhaca Archipelago

The social and ecological importance of the Inhaca Archipelago can also be recognized through the legislative history about itself, highlighting that the scientific community will have played a fundamental role in achieving such privileged legislative consideration. Indeed, already in the 1920s, the Inhaca Archipelago had become an important research station, although few studies are available dating back to that time. The periodical "Mozambique Quarterly Documentary" contains records from the 1930s.

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Historically, in the research activity on the Inhaca Archipelago, the Overseas Scientific Research Board is evidenced whose research work of the 1940s led or contributed to the creation of the EBMI in 1948. In the construction of the first EBMI facilities, inaugurated on February 3, 1951, the collaboration of the University of South Africa's Witswatersrand, following finally the government's consent Portuguese at that time.

The following years had as main challenge to obtain a legal definition that favored the position of the EBMI and its research activities in the context of that time. The first legislative pronouncements took place almost in the mid-1960s, through Legislative Diploma No. 2375 of May 4, 1963, I Série, which framed the EBMI at the Scientific Research Institute of Mozambique (Table 1.1).

Tab. 1.1: Legislative chronology, Inhaca Archipelago

LEGAL INTRUSION	Effects
Legislative Decree No. 2375 of 4 May 1963, I Series	He is part of inhaca's Marine Biology Station at the Scientific Research Institute of Mozambique
Ordinance No. 18736, of 5 June 1965, I Series	Determines the delimitation of the land of the Inhaca Islands and the Portuguese and assigns its management to the Scientific Research Institute of Mozambique Portugueses
Legislative Diploma No. 2620 of 24 July 1965, I Series	Creates the Partial Reserve of Inhaca Island, among the areas whose management was entrusted to the Scientific Research Institute of Mozambique
Decree No. 30/75 of 23 October of the Council of Ministers	He is part of the Scientific Research Institute of Mozambique in the administrative structure of the University of Lourenço Marques
Decree No. 12/1995 of 25 April of the Council of Ministers	Changes the designation of the University of Lourenço Marques to Eduardo Mondlane University; Approves the Statutes of Eduardo Mondlane University
XIV Meeting of the Council of Ministers held on 14 July 2009	Approves the creation of the Ponta do Ouro Partial Marine Reserve, covering the Inhaca Archipelago

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Legislative Decree No. 2620, of 24 July 1965, I series	It creates the partial reserve of Inhaca Island, among the areas whose management was entrusted to the Institute of Scientific Research of Mozambique
Decree No. 30/75 of 23 October of the Council of Ministers	Integrates the Institute of Scientific Research of Mozambique in the administrative structure of the University of Lourenço Marques
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Subsequent legal instruments updated and extended this position. The most evident deliberation in the sense of extension was taken at the XIV Session of the Council of Ministers of the Government of Mozambique, held on July 14, 2009, which approves the creation of the Ponta do Ouro Partial Marine Reserve, with a geographical dimension that covers the entire Archipelago, also encompassing, and without discontinuity, a vast area that enters the continent into the country.

Thus, the Inhaca Archipelago, constituting and circumscribing a Special Reserve area, enjoys and is subject to provisions contained in Law 20/97 of 1 October – the Environmental Law. This provision states, in Article 14(1), that "It is forbidden to implement housing infrastructure or for another purpose that, by their size, nature or location, cause a significant negative impact on the environment, the same applies to the disposal of waste or materials used". In the subsequent paragraph of Article 14 it states that "The prohibition inserted in the preceding paragraph applies in particular to coastal areas, areas threatened with erosion or desertification, wetlands, environmental protection areas and ecologically sensitive areas" (Article 14, Environmental Law, 20/97 of 1 October). This time, the Inhaca Archipelago, with its political-administrative position as a Municipal District, has at the same time a specific status as a geographical space of protected area.

1.4 Framework of the Plan

The sustainable use of natural resources and the conservation of biodiversity are now recognized as pillars of the process of economic and social development of nations. Indeed, the lack of well-designed strategies to bring sustainable long-term management of the territory's natural resources (including special reserves) has produced significant failures over the last few decades which have prevented the expected results in many places.

Since the proclamation of National Independence, the Archipelago has benefited from a Strategic Plan, designed between 1982-83 by Eduardo Mondlane University, and a Development Plan prepared by the

National Plan Commission and the National Institute of Physical Planning dated 1990. Each of these instruments corresponded to the requirements and needs of national development in a specific context.

This Management Plan of the Inhaca Archipelago arises in a new context, determined primarily by the existence of a Plan of the Urban Structure of the Municipality of Maputo of which the Archipelago is part and by the position of the Archipelago as part of the Ponta do Ouro Partial Marine Reserve. Moreover, the framework of laws, policies and regulations relating to the planning and management of the territory and its resources is wider than it was before (Table 1.2).

Table 1.2: Some legal provisions on land management and its resources

LEGAL DEVICE	MATTER CONCERNING
Law No. 20/97 of October 1	Environmental Law
Law No. 19/2007 of July 18	Spatial Planning Law
Law No. 4/96 of January 4, 1996	Law of the Sea
Law No. 16/91 of August 3, 1991	Water Law
Ministerial Diploma No. 180/2004 of 15 September 2004	Regulation on Water Quality for Human Consumption
Ordinance No. 177/78 of May 16	Hunting modalities to be practiced in the People's Republic of Mozambique
Law No. 10/99 of July 12	Law of Forests and Wildlife
Ministerial Diploma No. 55/2003 of 28 May	Common mechanisms in the licensing of forestry and faunistic activity
Ministerial Diploma No. 93/2005 of 4 May	Mechanisms for channelling and using the twenty percent of the value of the fees, assigned to local communities, charged under forest and faunistic legislation.
Law No. 19/97 of October 1	Land Law
Ministerial Diploma No. 29-A/2000 of 17 March	Technical Annex to the Land Law Regulation
Decree No. 66/98 of 8 December	Land Law Regulation
Decree No. 1/2003 of February 18	Amends Articles 20 and 39 of the Land Law Regulation, approved by Decree No. 66 of 1998 of 8 December.

Law No. 3/90 of September 26	Fisheries Law
Decree No. 51/99 of August 31	Regulation of Recreational and Sport Fishing and its annexes
Decree No. 43/2003 of December 10	General Regulation on Maritime Fisheries (REPMAR)
Law No. 4/2004 of June 17	Tourism Law
Ministerial Diploma No. 17/2001 of 7 February	Establishes the mechanisms of the transition process of conservation areas for tourism purposes to the Ministry of Tourism, pursuant to Article 4(1) and 2 of Presidential Decree No. 9/2000 of May 23
Resolution No. 8/97 of 1 April	Policy and Strategy for Forest Development and Wildlife
Resolution No. 5/95 of 6 December	National Environment Policy
Resolution No 10/95 of 17 October	National Land Policy and its Implementation Strategies
Resolution No. 18/2007 of 30 May 2007	Spatial Planning Policy
Action Plan for the Prevention and Control of Uncontrolled Burning	Approved at the 32nd Ordinary Session of the Council of Ministers of December 4, 2007
Action Plan for Climate Change Adaptation	Approved at the 32nd Ordinary Session of the Council of Ministers of December 4, 2007
Action Plan for the Prevention and Control of Soil Erosion 2008-2018	Approved at the 32nd Ordinary Session of the Council of Ministers of December 4, 2007
Environmental Strategy for Sustainable Development	Adopted at the 9th Session of the Council of Ministers on 24 July 2007

According to Article 10 No.1 on territorial planning instruments of the Spatial Planning Law, "Territorial planning, according to its level of intervention, is carried out using the instruments necessary to achieve the objectives of spatial planning, in accordance with its regulations and is based on the principle that lower-level territorial planning instruments should not contradict decisions and directives emanating from the higher level". Thus, the Management Plan and Development Strategies of the Inhaca Archipelago is submitted and does not contradict the Urban Structure Plan of the Municipality of Maputo.

Article 9 of the same Law, on the characterization of territorial planning, defines that "At the local level, programs, plans, development projects and the regime of urban land use are established in accordance with the laws in force".

Inhaca Municipal District lacks an updated development plan as an instrument for application at the management level; it comprises action strategies in achieving sustainable social and economic development and, given its status as a Special Reserve (Law No. 10/99 of 12 July, Forest and Wildlife Law). The importance of the Archipelago attributes great responsibility to the use and management of the territory and its resources. This Plan aims to support general efforts to improve the quality of life of local communities, conserve biodiversity and control and reduce the degradation of natural resources.

1.4.1 Vision and Objectives

1.4.1.1 General

The Inhaca Arpélado is rich in marine and terrestrial biodiversity and, therefore, the Forest and Marine Reserves are important:

- for scientific research, especially for having some unique ecosystems south of Ecuador and in the world. This richness is what determined the construction of inhaca Maritime Biology Station that for convenience was awarded the management of reserves to protect the ecosystems of study;

- because the Inhaca Archipelago constitutes a natural barrier against the direct impact of ocean tides on the shoreline of the continent, in particular the cities of Maputo and Matola and the village of Catembe. Therefore, inhaca's environmental degradation may affect the areas mentioned here in including the salinity level of the Incomáti, Infulene, Matola, Umbeluzi, Tembe and Maputo rivers that flow into Maputo Bay. The salinity of these rivers can rise up to considerable upstream distances. If this happens there will be negative impacts on many species including agricultural fields in the valleys of the rivers referred to. Therefore, there may be economic and environmental damage;

- because Inhaca is one of the main and preferred tourist destinations in Mozambique, its tourist resources are the potential survival base of local communities.

The identification of the purposes, objectives and importance of the Reserves of the Inhaca Archipelago inevitably passes through the support of the legislation in force in Mozambique, particularly the Law of Forests and Wildlife Bravia, DecreeNo. 10/99. This decree sets out the general objective for the conservation and protection of biodiversity in Mozambique and indicates the objectives that must be followed.

The Law of Forests and Fauna Bravia 10/99 aims to "... Promote the sustainable use of floristic and faunistic resources with initiatives that ensure the protection and conservation of these resources for the well-being of current and future communities."

Article 4 of this law establishes that the objective to be followed is to protect, conserve, develop and rationally and sustainably use floristic and faunistic resources for the economic, social and ecological benefit of present and future generations of Mozambicans.

1.4.1.2 Vision

Promote the conservation, development, sustainable use of natural resources and environmental protection of the Inhaca Archipelago, Maputo Bay, the mainland coastline and the capital of Mozambique.

1.4.2 Objectives

- Conserving biodiversity and its ecosystems
- Protect and rehabilitate coastal and mangrove forests
- Protect and rehabilitate corals and associated fauna
- Promoting Community participation in the management of natural resources
- Promoting and preserving cultural and historical values

- Encouraging the development of sustainable tourism.

2 Description of Natural Resources

Natural Resource: Forest resources, marine resources, soils, groundwater and others can be found in Inhaca. In addition to these can be used solar and wind energy.

Forest Resources: Forest resources can be terrestrial or marine. The terrestrial flora performs several functions among which: breaking of winds, soil protectors against erosion, shelter of animals and people, food source (fruits, tubers, vegetables and honey), medicines (leaves, tubers, roots and stems), construction of dwellings (firewood, cuttings, lacquer, wood, reed and grass) and pasture. The marine flora (algae and seagrass) is a feeding base of several marine species among which the dugongo.

Faunistic Resources: Faunistic resources can be terrestrial (birds, insects and reptiles) or marine (fish, molluscs, shellfish, marine mammals, turtles, corals "fish nest and others"). They are an important basis of the ecological and feeding balance of the communities of the Inhaca Archipelago.

Corals: The corals of the Inhaca Archipelago are associated with sandstones. It is in coral reefs where diverse types of marine fauna (fish, molluscs and shellfish) are reproduced and developed. They are not only a human food source, they are also a strong tourist attraction.

Mineral Resources: In Inhaca can be distinguished sandstone rocks and markedly sandy soils. The communities in Inhaca take advantage of the rocky material and sand for housing construction, especially the manufacture of blocks for construction.

Soils: The soils of the Inhaca Archipelago are generally very sandy, white and very poor for the practice of agriculture. The Red Barrier area has red soils, the Ponta Ponduíne yellowish soils due to the presence of some amount of clay. Interestingly it is on these highly sandy soils that grows the beautiful vegetation of this Archipelago. Inhaca soils are composed mainly of sand and a small amount of remarkable organic material in wetlands, ponds and/or swamps.

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Groundwater: The Inhaca Archipelago contains little groundwater. Thus, it is not advisable to use the excessive use of little drinking water that the Archipelago **has.**

Solar and wind power: Winds and sunlight can be a strong source of alternative energy. Most of Inhaca's population lives without access to electricity despite Cahora Bassa's energy being consumed locally since 2003.

2.1 Biophysical Environment

2.1.1 Physiographic characteristics

The geological and geomorphological characteristics of the Inhaca Archipelago are shown in table 3.1. It is a compilation made using the Explanatory News of the Geological Letter of Inhaca Island, on a scale of 1:25.000, of the National Directorate of Geology, dated 1997.

FISIOGRAPHIC UNITS	OVERVIEW
THE AREA OF THE ANCIENT DUNES (PLEISTOCÉNICAS) Area of the ancient, unstable dunes of the Middle Pleistocene Superior;	GEOLOGICAL FORMATIONS OF THE MIDDLE-UPPER PLEISTOCÉNICO: Composed basically formations, namely the Formation of the Red Barrier and the Formation of Changana. **Formation of the Red Barrier** – the oldest in terms of geological age; consisting of dunes related to sea levels lower than the current one, associated with the regressive phase that occurred in the Middle-Upper Pleistocene; eoleanite formed by a carbonated cement sandstone; calcareous sands with medium granulometry and rich in calcium carbonate and disaggregated reddish sands granulometry, which ranges from fine to medium. **Changana formation** – also related to the regressive phase that occurred between the Middle and Upper Pleistocene; two lithological members in this formation: the lower limb consisting of an eoleanito and the upper limb consisting of orange and sometimes reddish sand dunes. GEOLOGICAL FORMATIONS OF THE UPPER PLEISTOCÉNICO: Formation of The Ponduíne Tip Pleistocene Superior, characterized by sandstones with cross-stratification and fine lamination of small scale; Formation of Cabo da Inhaca: consisting of eoleanites and is covered by dunes. Newer holocénicas that give rise to a dune crest existing on the eastern side of the Island. It *comprises Dunes of The Tips* which are semi-stabilized, and the Inner *Dunes* that are semi-stabilized
THE AREA OF THE RECENT DUNES (HOLOCÉNICAS) Eastern High Dunes; Central Dunes	HOLOCÉNICA FormationS: Dunes on Inhaca Island: of various types, correspond to age: Holocene; The Island of the Portuguese: type of holocénica age dunes; Another type of dunes is characteristic of the central part of Inhaca Island are dunes of soft reliefs. This type of dunes is called by Central Dunes; High dunes *(Dunas Altas do Oriente),* which were deposited on the Formation of Cabo da Inhaca; Supratidal zones and mangrove plains occur northwest of Cabo da Inhaca and Ponta Rasa and south and north of Saco da Inhaca. It covers *Recent High Dunes* which are prominent dunes at altitude and distinct by age (Eastern High Dunes) and *Recent Low Dunes* that form a wave of low-altitude open dunes with gentle slopes
DEPRESSIONS	It comprises alluvial interdunar depressions (and depressions?): they are formed from deposits of interdunar depressions in the central part of Inhaca Island, characterized by enrichment in organic matter.
THE PLAINS Tidais Paleoplains, Inland plains,	Recent formations: the tidal paleoplains and paleobars of sand observed around the Island, specifically the ânguas in the airport area in Ponta Rasa, the northern end of Saco da Inhaca, sector of the coast between Ponta Ponduíne and boca do Saco; High plains, corals and beaches accompanied by recent dunes are newer formations that are located in almost the entire periphery of the Island except mangrove areas and areas where erosion is felt with greater intensity. It understands the inner plains (interdunares), the coastal plains (tidais and corals, covered with mangroves; relief

FISIOGRAPHIC UNITS	OVERVIEW
Coastal plains	very open wave of low dunes, bulging by wind erosion; In the areas of mangrove or other poorly developed (secondary) vegetation cover, erosion is felt with great intensity; *beaches* occur on almost the entire periphery of the islands, with quick dunes.

Table 3.1: Physiographic characteristics (Source: based on Sénvano et al., 1997)

The coastal geomorphological characteristics of the islands of the Inhaca Archipelago are remarkably distinct. The eastern coast of Inhaca Island is formed by a single beach, almost straight, extending close to 12.5 km long, from Ponta Mazónduè to the proximity of Ponta Torres, from which rise the High Dunes of the East. The coast is in retreat, at the latitude of Monte Inhaca, estimating Moreira (2005) at 0.11 m/year and the high beach has lost 22 m, at an erosion rate of 0.81 m/year, between 1973 and 1999. The coast on the Portuguese Island is distinguished by the flat topography, affected by erosion caused by bursting waves and tides. The southern portion of the coast of Inhaca Island, at the latitude of Ponta Torres comprises forbidden plains and beaches, from where dunes that locally exceed 40 m of altitude, with a forest cover.

From this geological constitution and its external geomorphological manifestations were born and developed different types of soils and vegetation. The dominant soils are dune, sandy in texture, white in color and poor in fertility. Its spatial variation is mainly due to the topography and internal drainage conditions. Therefore, Engelen and Kauffman (1977) distinguished three types: dune soils, hydromorphic lagoon soils with fresh water and salty hydromorphic soils.

The dune soils: occur in areas of varied slope, depending on the relief of the dunes. They are deep and very permeable soils, they are white in color, synonymous with low organic matter content. They constitute the surface of the dunes from those with moderate slopes to the strongly inclined. They occupy an area of more than 3,000 hectares. These are characterized by being white sandy soils with great depth and high permeability and poor in organic matter or humus.

Dune soils occur in areas of varied slope, according to the relief of the dunes. They are deep and very permeable soils, they are white in color, synonymous with low organic matter content. Hydromorphic soils of laguna with fresh water, on the contrary, abound in places where the water table is not deep, prone to flooding or at least flooding. Its color varies between white and gray, the latter common on the shoulders of the lagoons. On these soils of the wetlands develops a predominantly herbaceous hygrophilic vegetation, dense where human intervention remains significant, favored by the abundance of moisture and the relatively high content of decomposed organic matter. The occurrence of salty hydromorphic soils, however, coincides with the flatter areas of the Archipelago. They are soils of places that receive at least from time to time some influence of the sea. The possibility of exchanging fresh water with sea water is higher mainly at living tides, for this reason, its fresh water table suffers mobility due to the influence of sea waters (Muacanhia, Achimo & Deniasse, 2008).

In Inhaca there is no freshwater course (CNP-INPF, 1990:27). Wetlands have an internal drainage, lose moisture by evapotranspiration and gain it from precipitation. This circulation of water largely defines the geo-hydrological aspects of the archipelago.

One of the island's biggest problems is coastal erosion. On the east coast erosion is caused by winds (wind erosion) and waves and on the west coast it is caused by rainwater. Erosion is also a problem for coral reefs that are covered in sand. The bay is also subject to topographical changes. Aerial photographs indicate that the area covered by sandbanks has increased by about 10% between 1967 and 1989 (de Boer et al., 2000) and this trend continues to evolve in recent years.

2.1.2 The Problem of Erosion

Erosion can be attributed on the one hand to natural factors such as the sea, wind and rainfall that lead to marine, wind and rain erosion. On the other hand, erosion is caused by the action of man, anthropogenic factor, namely local communities through deforestation, grazing of goats in the dunes (Ngomela), practice

of agriculture in the Forest Reserves (Nhaquene) and wetlands (Lake Tivanine), implantation of camps and holiday homes in the dunes and mangrove (Saco da Inhaca, agriculture in the Forest Reserves) (Muacanhia, Achimo & Deniasse , 2008).

According to Muacanhia (2004) wind and marine erosion increases in the rainy season (October to March) because this is the season of strong winds and giant waves responsible for erosion in much of Inhaca (Muacanhia, 1988; Muacanhia & Deniasse, 2007).

Analyzing the data of Engelin and Kauffman (1977), on average, up to 1 m deep inhaca soils have 94% sand and 6% clay and organic matter. It must be recognised that this proportion must have changed due to the increase in the percentage of sand caused by deforestation and exposure of soils to erosion.

Clay is primarily responsible for cementing sediments. The reduced percentage of clay in inhaca soils justifies by itself the vulnerability of soils to external agents causing erosion.

Most of the sites in the Inhaca archipelago suffer from a combination of erosion (wind-marine-rain erosion). Wind-marine erosion occurs simultaneously almost throughout the year. The sites most affected by this type of erosion are the Red Barrier, Malengana, Machúnguè, Ngomela, Ponta Mazónduè, Ponta Ponduíne, Ponta Rasa and Ilha dos Portuguese.

The combination of the three types of erosion (marine-wind-rain) is accentuated in the Red Barrier due to the sharp slope which favors the action of the force of gravity which also plays an important role in this combination of erosion factors. The erosion process in the area endangers red barrier reefs and can therefore reduce interest as one of the main destinations of scientists and tourists.

Erosion in Inhaca occurs easily not only due to external agents but also due to the fragility of sandstones in the face of erosion agents. According to Engelin & Kauffman (1977), the rocks are characterized by poor compaction and cementing suffering easy physical disintegration. In some places the chemical-mineralogical composition (Ca++, Mg++, K+, Na+) make them vulnerable to chemical-physical degradation processes. The authors highlight in their study the dangers that Inhaca can run in the face of erosion and recommend that there be mitigation measures such as reforestation, especially focusing on the planting of fruit trees that have a dual function (ecological and food) (Muacanhia, Achimo & Deniasse, 2008).

In meteorological terms, the climate in southern Mozambique, including Inhaca Island, is essentially subtropical, while from the point of view of oceanographic characteristics it is more tropical. This region is located in the transition between the temperate climate and the tropical climate and is characterized by a cold and dry season from April to September and a hot and rainy season that runs from October to March.

Meteorological observations (Mavume 2000) indicate that the predominant average wind direction is southwest, but from October to January prevails the northeast direction. The Island is subject to strong winds from the ocean and has a greater impact on the coast and dunes in the eastern part than on the west and north coasts that are protected. Severe occasional storms, lasting a few hours in the afternoon, cause the penetration of water along the coast causing sea between the Portuguese Island to become dangerous and impassable for small boats (Kalk, 1995).

January and February are the warmest and wettest months with temperatures between 26.3°C and 26.2°C, respectively, including precipitation values between 135.9 and 143.9 mm. The lowest monthly rainfall is 23.7 mm and is recorded during the month August while the lowest temperature is 19.6°C and occurs in July. On the other hand, the highest relative humidity reaches 82.1% while evaporation shows moderate

variations with an average of 100 mm/month.

2.1.3 Bathymetry

Bathymetry is one of the techniques used to perform analysis of nautical charts from a given zone. Figure 3.1 shows the behavior of the background around the Inhaca Archipelago.

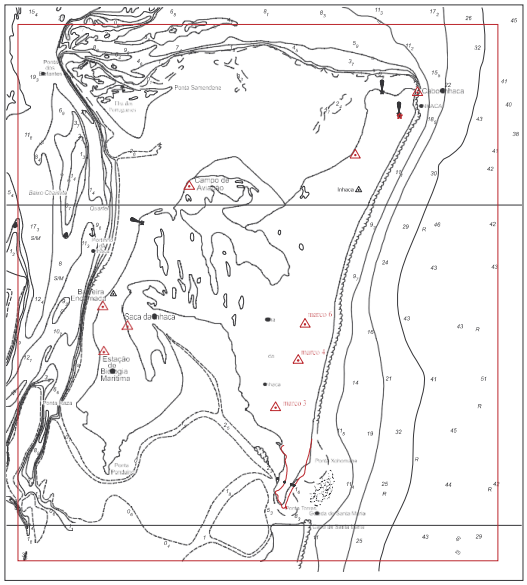

Figure 3.1: Bathymetry of the Inhaca Archipelago - overlapping the shorelines in the Ponta Torres area (1959 and 2009).

The minimum width of the Ponta Torres area, varied by approximately 200 meters in the last 50 years old. There is a displacement of the line to the East direction, which shows an instability of the sediments in this zone at short time scales (half a century) as a result of several factors that can be summarized as follows:

- There is evidence of erosion in the southern zone of the Inhaca Archipelago, mainly in the Ponta Torres area;
- Erosion is more pronounced on the west side of Ponta Torres than on the east side;
- The satellite image of the southern area of Inhaca Island shows that the Ponta Torres area is the area with the lowest vegetation cover. This finding may be contributing to the exacerbation of erosion in this area;
- The analysis of the topographic chart (Figure 3.1) shows that the Eastern zone of the South of the Inhaca Archipelago, where Ponta Torres is located, has lower topographic altitudes.

Uapessuane Bay (Figure 3.2) is a body of shallow waters. It opens towards Maputo Bay (in the Ponduíne section) and connects the Indian Ocean through the Ponta Torres Strait. The surface area is about 25 km2 during the living tide. Measurements obtained by Mavume (2000) indicate that the average depth in relation to the average sea level is approximately 1 m. Further north, the bay closes in the form of a bag and is therefore called Saco da Inhaca. The extension of the Torres Strait from the Indian Ocean to the Uapessuane Bay is 0.9 km (~1 km) and its width is about 200 m. The average depth of the strait is about 10 m in relation to the average sea level. Two main tidal channels cross Uapessuane Bay connecting Maputo Bay to the Indian Ocean. The depths and widths of these channels vary (Figure 3.2), but the effective width during live tide is about 100 m and the depth is less than 1 m.

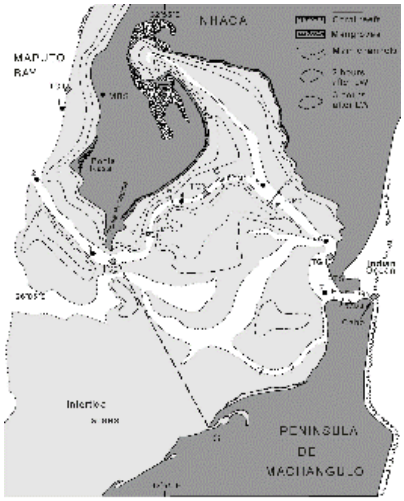

Figure 3.2: Uapessuane Bay showing the tidal zone exposed at the live tide stage during a measurement campaign conducted between 1998-1999

2.1.4 Currents and tides

According to Kalk (1995) there is a tendency of the sea to be warmer than the mainland at the latitude where the Inhaca Archipelago is located as a result of the flow of equatorial waters directed southward into the Mozambique current that propagates parallel to the east coast of Inhaca Island along the edge of the continental shelf, about 8 km from the coast to the open sea (Fig. 1.4). This current derives from the Southern Equatorial Current (SEC; Schott and McCreary, 2001). The current flows west across the Indian Ocean towards the coast of Africa between latitudes 5°S and 15°S.

In the Mozambique Channel the currents have been classically conceived as being dominated by a strong current flowing along the coast, the Mozambique current (Lutjeharms, 2006). Circulation schemes used in the past showed different flow patterns (Harris, 1972; Sætre and Jorge da Silva, 1984). This interpretation, largely based on non-synoptic river observations and diversion of vessel routes (Sætre, 1985; Lutjeharms *et al*., 2000), has been considered quite simplistic. From the data collected from a hydrographic cruise carried out in the year 2000 "The Agulhas Current Sources Experiment (ACSEX-I; From Ruijter *et al*., 2002)" and the

altimetry data showed that the traditional continuous current of Mozambique is currently a set of vortexes (cyclonic and anti-cyclonic), moving slowly southward through the channel (Lutjeharms, 2006, by Ruijter *et al*., 2002).

The behavior of vortexes in the Mozambique Channel has two distinct characteristics. The first characteristic is that the anticyclonic (hot) vortexes are much larger than cyclonic (cold) vortexes and therefore dominate the flow. The second characteristic is that these vortexes give indications that they are affected by the topography of the seabed (Schouten et al., 2003). The mentioned vortexes are formed in the narrowest region of the Mozambique Channel and spread southward strides through the continental shelf of Africa (Ridderinkhof and de Ruijter, 2003; Schouten *et al*., 2003; Fig. 3.3).

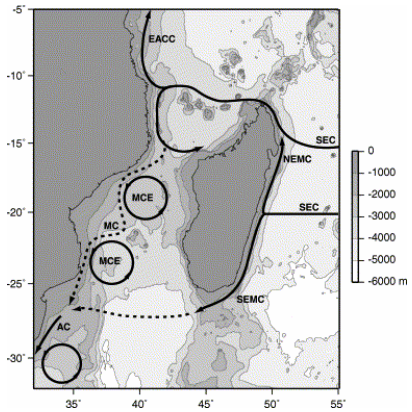

Figure 3.3: Formation and advection of the vortexes of the Mozambique Channel (Schouten et al., 2003).

Schouten et al. (2003) analyzed the characteristics of these vortexes using a combination of locally observed data and altimetry data obtained from satellites. Its results showed that these anticyclonic vortexes have cross-sectional areas of about 350 km with a strong barathepica component, extending to the bottom of the sea and have maximum surface velocities of 2 ms^{-1}. On the other hand, a combined analysis of altimetry data from the TOPEX/Poseidon and ERS-1/2 satellites showed that about 4 are formed per year with a net transport per year of about 15-18 Sv in the upper layer of the 1500 m (Schouten et al., 2002b; 2003; de Ruijter et al., 2002; Ridderinkhof and de Ruijter, 2003; Penven et al., 2006).

In the Ponta Torres strait, the currents are strong and highly variable, sometimes affected by tides, winds and the positive over-elevation of the average sea level induced by ocean waves along the coast. The coral reef is discontinuous and known as Hell's Gate, but skilled people aboard high-speed boats are able to navigate there despite the danger posed by the enormous force of the waves. The description of the tides of the Inhaca Archipelago has been made by Kalk (1995), Hoguane (1996), Hoguane et al (1999). Kalk (1995) classified the tides as semidiurnas.

Commented [JK5]: ?

Based on the Tidetables of the Port of Maputo and The Portuguese Island, Kalk concluded that the phases and tidal amplitudes on the west coast of Inhaca are similar to those of Maputo, with the exception of the high tide that takes place a few minutes before and with a few centimeters less because the position of Inhaca Island is close to the mouth of Maputo Bay.

Andersson and Green (1999) obtained a live tide amplitude of 2(M2 + S2)of 3.12 m on the west side of the Island near inhaca Maritime Biology Station and a amplitude of 0.6m for dead tide. The high tide occurs 5-20 minutes before the Port of Maputo. De Boer et al. (2000) used a series of shorter tide observations and for the Uapessuane Bay agreed with the classification but amplitude that observed in the area of the Ponta Torres Strait during the living tide was 2.2m, just inside the strait and during the dead tide an amplitude of 0.7m. The over-elevation of the average sea level induced by ocean waves and pointed out as the main reason for this difference in amplitudes.

The Ponta Torres Esteiro is an example of narrow, having a variation of flow influenced by tides in particular the difference in sea level between the Ocean and the Uapessuane Bay. The action of occasional tides and strong winds plays an important role in coral zones, community structure and sediment distribution patterns in the area (de Boer et al., 2000). The waters enter the South Bay from the Ocean as well as maputo bay. This process affects the dynamics of nutrients and many biochemical processes in the ecosystem of Uapessuane Bay.

2.2 Biological environment

2.2.1 Terrestrial vegetation

The vegetation of the Inhaca Archipelago is associated with local environmental-climatic conditions. According to these conditions, there are five very striking types of vegetation: coastal forests, coastal brenha, forests, prairies (dambos) and pioneer vegetation. However, there is no detailed map illustrating the different types of vegetation.

Pioneer vegetation: The pioneer vegetation comprises the carpet of juicy herbaceous species that occurs just above the high tide line on loose sand particles. This area has harsh ecological conditions such as low organic matter, water *stress,* high saline concentration and strong winds, which gives it a dynamic character (Kalk, 1995). The particles of sand deposited on the beaches by the waves of the sea are, after droughts, raised by the wind and deposited on the dunes. In fact, the concentration of sands and subsequent formation of these dunes is facilitated by the presence of pioneer vegetation.

The distribution of the species that make up the pioneer vegetation in the Inhaca Archipelago obeys a gradient of tolerance to local ecological conditions giving rise to a natural zone. Along the coastal gradient – inland, the most tolerant (less demanding) species are gradually replaced by the less tolerant (more demanding) as conditions become more favorable in a process of natural succession. *Scaevola plumieri* and *Ipomea pes-caprea* are some pioneer species present in the coastal area and associated with dune formation. The S. *Plumieri,* for example, is a juicy pioneer species of underground rhizome and leaves with a thick cuticle. The fine sands carried by the wind are accumulated on this species, propelling the formation of the dunes (Fig. 3.4).

Figure 3.4: Aspect of S. plumieri (fleshy leaves) and Ipomea pes-caprae (pink flowers) growing on dune forming in the coastal part

According to Kalk (1995), the accumulation of sand on this plant stimulates its growth. That is, these plants are important for their ability to emerge after periods of burial. Immediately after, generally fabaceae species such as *Canavalia rosea*, *Sophora inhambanensis*, *Tephrosia* spp. (Fig. 3.5) colonize the site.

Figure 3.5**:** Portion occupied by S. *inhambanensis* (silver leaves), C. *rosea* (creeper) covered by hemiparasite *Cassytha filiformis* (yellow creep).

These species contribute to the improvement of soil nutritional conditions in a natural fertilization process, given their nitrogen fixation capacity (Kalk 1995). Then, in more consolidated soils there are species of shrubs such as *Euclea* spp., *Diospyros* spp., *Mimusops caffra.* These species create a microclimate suitable for the occurrence of other shrubby and tree species or other types of vegetation further inland.

In the ponta Torres region, the pioneer vegetation constitutes a continuous and irregular strip (50 -150 meters wide) along the eastern part and occupies almost the entire southern zone. The eastern part is the result of the continuous deposition of sands and formation of primary dunes. Therefore, this area has a common pattern of natural zone (Fig. 3.6).

Figure 3.6: Extension of pioneer vegetation in the southern and eastern part of Ponta Torres showing a continuous range (ca. 800 m) of casuarinas in the southeast.

In the southern part of Ponta Torres, the pioneer vegetation is discontinuous due to the presence of a strip of casuarinas to the southeast and patches of coastal brenha to the Southwest. The band of casuarinas (ca. 800
m) was planted in 1985 to propel the recovery of vegetation from the western part, previously destroyed due to human interference in the early 1980s. During these years, Ponta Torres received people who due to the civil war on the continent, went to Inhaca (Ponta Torres) for security reasons. The patches of coastal brenha represent the remnant of this type of vegetation in that place.

Coastal brenha: This type of vegetation is associated with the steep parts of the dunes and comprises, in general, the transition zone between the pioneer vegetation (on the coast) and the forests (inland). Given its exposure to strong and saline winds from the sea, the coastal brenha has an almost uniform physiognomy along the entire East Coast of the Island (Fig. 3.7).

Figure 3.7. Fragments of coastal brenha (in the background) along the East Coast of Inhaca Island.

The coastal brenha consists of at least two strata the herbaceous/shrub and arboreal. The highest and most exposed parts of brenha are covered by a low and dense vegetation covered mainly by *Rhoicissus digitata*, *Rhus natalensis* and *Grewia* sp.. This vegetation serves to contain the movement of loose sands on the summit of the dunes. The fetus *Microsorium* sp. is one of the plants that fills the herbaceous stratum. *The Pseudopulchellus Croton, Azima tetracantha* and *Suregada zanzibarensis* are some of the most common shrubspecies in this stratum (Kalk, 1995). Here and there, there are species of Phoenix *reclinata, Euclea natalensis, Diospyros inhacaensis and Acacia karoo.* Trees, usually deciduous and densely compact canopy can reach up to about 8 m in height (Kalk, 1995). The main tree species include *Mimusops caffra*, *Olax dissitiflora* and *Sideroxylon inerme.*

Coastal forests: Forests occur over the dunes of the Eastern coast and next to the red barriers in the western part of the Island. The forest that goes from (almost) the extreme south of Ponta Towers towards the Lighthouse is one of the few spots of this ecosystem, in Inhaca, considered even less disturbed by human activities.

In terms of structure and composition, forests constitute the most advanced stage of the process of natural succession of the vegetation of the coastal zone. The lower stratum consists of succulent and annual or perennial plants. Succulent plants include *Sansevieira* spp, *Aloe parvibracteata*, *Kalanchoe paniculata, Scadox sp.* among others. The shrub by *Carissa bispinosa, Psydrax obovata, Clausena* sp., *Ochna* sp.. The upper stratum, which can reach more than 15 m in height, consists of trees such as *Mimusops caffra*, *Sideroxylon inerme*, *Apodytes dimidiata*, *Diospyros rotundifolia* and *Bridelia micrantha*. There is a remarkable presence of lianas (e.g. *Ancylobotrys petersiana*, *Landolphia kirkii, cissus quadrangularis, Cissus roduntifolia, African Cardiogyne and Secamone filiformis*) whichhinders penetration into these forests.

Forests are used by local communities as a source of various timber and non-timber products. According to some authors (e.g. Barbosa 1995) the populations of Inhaca Island remove firewood, berries, medicines, building materials, among other forest products. In addition, several forest areas are converted annually through cutting and burning for agriculture. Forests are one of the areas rich in nutrients for agricultural practice on the Island (Serra King, 1995).

Floodplains (dambos): Floodplains occupy about 17.5 % of the total surface of Inhaca Island (Kalk 1995; Barbosa, 1995).. Most of these areas are located near the lower areas of the Island, immediately behind the higher dunes (Fig. 3.8)..

Figure 3.8: Dambo behind the coastal brenhas with floating species of Nymphea sp..

These areas have a characteristic specific composition with the presence of reed community, almost always, and rarely with submerged flora (Kalk, 1995).

The emerging vegetation includes *Phragmites autralis, Typha latifolia,*and *Cyperus papyrus.* Other species such as *Sporobolus virginicus*, *Imperata cylindrica*, *Cyperus* spp. can be found (Kalk, 1995).

Phragmites australis (reed) and C. *papyros* are used by local communities for various purposes. The reed is used in the construction of houses, while the C. *papyros* is used in the manufacture of mats. The areas adjacent to the plains are used by local communities for agriculture. Crops such as sweet potatoes, vegetables and rice are produced on the floodplains. In addition to these uses, the dambos are authentic freshwater reservoirs in Inhaca.

Forests: The forests of Inhaca Island are fragments of vegetation that are intended for use by man. The forests are characterized by having scattered trees separated by extensive areas covered by graminal and/or species of small shrubs. In fact, the forest represents a stage of natural succession after agriculture, in the areas opposite the dunes, on inhaca island. Thus, most of these forests are fallow areas that lie in the middle of coastal forests, abandoned to recover their fertility (Fig. 3.9). Woody species include *Acacia karoo, Sideroxylon inerme, Hymenocardia* sp. among others.

Figure 3.9: Aspect of a forest dominated by the shrub by the shrub by the shrub by Helichryssum kraussii, in the middle of the Inguane forest.

In addition to these, other species, whose socio-economic and cultural value is recognized by local communities, such as fruit trees (e.g. *Syzygium cordatum, Mimusops caffra, Sclerocarya birrea* and *Trichilia emetica*) and shade trees(e.g. *Albizia adianthifolia*), are left duringcultivation. Local communities recognise the contribution of these species in their daily lives. In addition, the plants left in the machambas have an important ecological role in the recovery of old cultivation areas. These plants create a local microclimate that will propel secondary colonization by other more demanding species in terms, for example, of moisture, shade, nutrients, etc.

2.2.2 Terrestrial and marine fauna

Terrestrial fauna: The diversity of terrestrial fauna in the archipelago includes insects, birds and reptiles. In addition to these groups, there are small mammals, amphibians and molluscs in the archipelago. The

terrestrial fauna of Inhaca Island is confined to coastal dune forests, lakes and temporary reservoirs of brackish freshwater, where the species find the appropriate habitat for breeding, hiding and nesting.

The forest reserves that extend from the Ribzene area to Ponta Ponduíne and the Lighthouse to Ponta Torres, constitute the fundamental centers of survival and conservation of terrestrial fauna, mainly mammals and reptiles. Amphibians reproduce in swampy areas.

Mammals registered on Inhaca Island include the wild pig, fruit bats, insectivorous bats, moles, squirrels, lobes, shrews and various species of rats (Table 3.1, annex).

Inhaca Island has about 200 species of birds that are part of 57 families. Of these species, about 120 are residents, 65 migratory and 15 species are marine and use the coastal forest for nesting. Some of the species are shown in Table 3.2 (attached).

The great abundance and diversity of vegetation and plant habitats including freshwater marshes allow the breeding of amphibians. On the Island, 9 amphibian species were recorded, part of which are illustrated in Table 3.3 (attached). The marshes occur in the northern part of the island and some smaller ones are inland. Currently, 31 species of reptiles are known, including one of fresh water. Terrestrial reptile species are presented in tabs
3.4 (attached).

Inhaca Island is home to more than 500 species of insects that are distributed in over 65 taxonomic families. This diversity is determined by factors such as solar radiation, temperature, humidity, wind, salinity of waters and soils, food source, anthropogenic activities and others. Phytophagous insects, with emphasis on lepidopterans, coleopterans of the families Chrysomelidae and Curculionidae; dipterans, agrominizides and cecidomides, and, hymenoptethra cinipid, are distributed and diversified according to the types of vegetation they feed on. Pollinating insects facilitate the abundance and diversity of angiosperm plants. On inhaca island phytophagous insects lepidopterans, hexaeters, orthopterans, tisanopterans and fasmopteros are prominently main ly followed by coleoptera, dipterans and hymenoptera.

The most abundant species on Inhaca Island are *Crematogaster spp.* (Hymenoptera: Formicidae) and *Ceriagron glabrum* (Odonata: Cenagrionidae). In regenerating vegetation, particularly Ngomela are more abundant, *Bromophila caffra* (Diptera: Blatystomatidae) and *Elis maculata* (Hymenopetra: Vespidae). In the machambas of M'pande for example are more abundant, *Scaphidium spp*. (Diptera: Bombyliidae) and *Sarcophaga carnaria* (Diptera: Sarcophagidae), *Pantala flavescens* (Odonata: Libellulidae) and *Lycus acantholycus* (Coleoptera: Lycidae), while in Matlotoma insects more abundant are *Lestes virgatus* (Odonata: Lestidae), *Duronia chloronata* (Orthoptera: Acrididae) and *Auxiliary Auxuliar Catantops* (Orthoptera: Acrididae) and *Zonocerus elegans* (Orthoptera: Pyrgomorphidae).

The insects are distributed by coastal brenha, the coastal forest of the dunes, in cultivated areas of the interior and by the forests adjacent to the machambas with dispersed vegetation, by the associated pantanal vegetation and by the mangroves. The microclimatic areas are frequented by insects that feed on pollen and pollinators such as butterflies and moths, bees and flower beetles.

Much of the insects are phytophagous and feed on leaves, flowers, fruits and roots of plants. For example, crisomelide beetles, scarabeids, cerambicids, ants and the like, termites, larvae of various butterflies and moths.

In the vegetable mat, decaying organic matter and regenerating forest abound locusts, crickets, cicadas, soil beetles, sylods, dandelion ant and wasps abound. In the micro-climate of swamps and pantanal vegetation abound mosquitoes, dragonflies, aquatic beetles and their larvae. On the surface of the waters of the mangrove channels and mangrove species are gerinids, various types of wasps, flies and beetles. In the coastal zone between tides abound cincindelid beetles. Some of the insect species on Inhaca Island are presented in Tab. 1.5.2.6.

In addition to the species mentioned above, Inhaca Island has great biological diversity of insects. Termites belonging to the families *Rhinotermitidae* and *Hodotermitidae;*aphids of the family *Aphididae*, Dipterans of the families *Bombyliidae*,Syrphidae and *Tachinidae*were recorded.

Marine fauna : The diversity of marine habitats (such as coral reefs, mangroves and carpets of sea grass) that characterizes the Inhaca Archipelago makes it able to sustain a range of species of marine fauna that includes some species considered threatened/protected internationally, such as turtles, dugongs, dolphins, sharks. A list of marine fauna species is shown in Table 3.5 (attached) including 4 species of sea turtles.

2.2.2.1 Importance of terrestrial and coastal fauna

Inhaca's terrestrial and coastal fauna has economic, ecological, cultural and social importance.

Mammals, particularly wild pigs are the main source of hunting animal protein for the population. However, these animals cause damage to agricultural crops on the Island and emerge resource of potential human-animal conflict. Birds can rarely be used as a food source, but together with reptiles and amphibians are part of the food chain, where they contribute to the maintenance and stability of the Island's ecosystem. The molluscs, mainly marine, are a food and commercial source of inhaca's population. Shells of various species of molluscs are sold in informal and formal markets as souvenirs and adornment objects. This last utilitarian value includes echinoderms (e.g. stars, ofioros and sea urchins). Crustaceans of crab species such as mangal crab and santola, lobsters and shrimp are food source and financial revenue of the population.

Insects and the like are part of the food chain and are indicators of the conservation status of forests. Insects participate in the reproduction of various plant species through the pollination process. Some species are the subject of traditional myths and beliefs, including the cure of diseases.

2.2.2.2 Conservation and sustainable use of terrestrial and coastal fauna

On inhaca island, particularly in the Ponta Torres area, is located an area of breeding and development of marine coral reefs, habitats protected by conservation laws of the nature and are breeding and growing centres for fish, crustaceans and other marine animals of economic, commercial and food importance in Mozambique.

A Fig. 3.10 illustrates a fraction of the environment of fish diversity that grows on coral reefs there.

Figure 3.10: Microclimatic illustration of the diversity of fish that occur on coral reefs in Ponta Torres, Inhaca Island.

On the eastern coast of Inhaca Island, particularly up to 2500 m from the Ponta Torres channel, is a spawning, nesting and feeding area of sea turtles. On this coast, in the forest of the dunes, they nest migratory birds protected by nature conservation laws. Dolphins, dugongs and whales are protected marine animals and occur in Maputo Bay and on the Island's Eastern Coast.

The unregulated use of these habitats, through the development of less sustainable human activities, could not only destroy the habitats of protected species, but also reduce the reproductive potential and abundance of fish, crustaceans and other economically important marine animals in Maputo Bay in general and the eastern coastal area of Inhaca Island in particular. The species important from a conservation point of view are listed in Table 3.6.

Table 3.6: Protected species of Ponta Torres

Common/vulgar name	Scientific name
Dolphins	Sousa chinensis
	Plumbea Sousa
	Aduncus Tursiops
	Truncatus tursiops
Dugongs	Dugond
Whales	Novaeangliae Megaptera
Snakes/snakes	Phyton Sebae
	Naja
Lizards/geco	Albigularis albigularis
Sea turtles	Caretta

2.2.3 Mangroves

Mangroves occur under sandy and sludge substrate with greater emphasis on the following sites:

- Noge-Schwaned including Aerodrome-Delegation;
- Inhaca bag;
- Shallow Point;
- Tivanine (Lighthouse);
- Uapessuane Bay coastline (East and West);
- Western End of the Island of the Portuguese.

Mangroves represent about 12% of the total area of Inhaca Island (Kalk, 1995; Barbosa, 1995; Muacanhia & Albano, 2002), being the airport and Saco those that occupy greater extension. However, recent studies indicate a trend of increasing the area occupied by this ecosystem to about 500 ha (de Boer, 1999; Muacanhia & Albano, 2002; Muacanhia, 1999). Presumably, this increase is due to the regeneration and expansion of the mangrove to new areas such as Ponta Torres (Muacanhia & Albano, 2002). The mangal occupied about 10 ha in the Portuguese Island (Muacanhia, 2004), whose current extent is estimated at about 1 ha (Muacanhia, Comunicação Pessoal, 2009).

In the Inhaca Archipelago, five main tree species were recorded including *Avicennia marina, Rhizophora mucronata, Ceriops tagal, Lumnitzera racemosa and Bruguieira gymnorhiza*. In addition to these, there are three other species associated with the ecosystem.

Mangroves have ecological, socio-economic and cultural biological importance. They are a physical barrier against the penetration of saline winds from the sea to the machambas. They retain sediment stemming from the continent contributing to the protection of corals at sea. Some species of marine fauna such as crustaceans and fish use the mangrove as shelter and for nesting. The tree species of the mangal are used by local communities as firewood, building material for houses and boats.

2.2.4 "Intertidal" fauna and flora (between tides)

The coastal shores of the Inhaca Archipelago can be classified, according to their exposure to wave action, on exposed, sheltered and heavily sheltered sandy shores, exposed, sheltered and heavily sheltered rocky shores, and estuarine-influenced shores. In the intertidal area of these coasts, basically three zones are distinguished, namely the upper margin (extending from the base of the dunes to the midline of the tide), the flat intermediate margin (extending from the midline of the tide to the low line of the dead tide) and the lower margin (extending to the low line of the live tide) (Kalk, 1995). Being necessary different mechanisms of adaptation to these various habitats, the flora and fauna differs between them.

The sheltered sandy coasts, to the west and southwest of the island, facing Maputo Bay, contain, on its upper bank, species such as *Ocypode ceratophthalmus* (ghost crab) whose activity is especially nocturnal (Kalk, 1995) and *Donax faba* (a bivalve mollusc that can reach considerable densities in these areas) (Kalk, 1995). According to Kalk (1995), the deposition of sand led to the disappearance of plants such as *Scaevola*, *Canavallea* and *Ipomoea* typical in the upper margin.

According to the same author, the microflora, existing in the 2-3 cm of the upper surface of the substrate, is composed essentially of diatoms and dinoflagellates (single-celled algae). Diatoms of the genera

Cocconeis and *Navicula*arecommon, which have the particularity of being attached to the grains of sand, and also *Nitzschia,*who lives in the film of interstitial water between the grains of sand. Common dinoflagellates belong to the genera *Prorocentrum* and *Amphidinium*. Small groups of blue-green algae cells (Cyanophyta) of the species *Chroococcus minutus*, *Gomphosphaeria* sp and *Lyngbia confervoides*are alsocommon.

In the flat intermediate zone there is an association of excavator worms (which drill on the substrate) and flatworms*(Convoluta macnaei*, which leave greenish lines on the substrate, resulting from symbiosis with a single-celled green algae, *Tetraselmis convoluta);*excavator worms of *phyllochaetopterus elioti, Thelepus plagiostoma, Loimia medusa, Pista brevibranchia, Siphonosoma cumanensis, Glycera subaena* and *Ceratonereis erythraensis*arecommon. .

The lower margin is home to large quantities of ocypode crabs*(Dotilla fenestrata)*as well as "pipe-making" worms of the species *Owenia fusiformis, Mesochaetopterus minutus* and *Diopatra cuprea.* On the lower bank are distinguished large areas of sludge sand, which alternate with the dry areas of the crab Dotilla. According to Kalk (1995), these sludge areas feature seagrass of the species *Halodule wrightii*. The most conspicuous animal is the ocypod crab *Macrophthalmus grandidieri* and a large number of other animals associated with polychaete worms (*Scolelepis squamata, Magelona cincta, Cirriformia tentaculata, Scolops madagascariensis, Notomastus aberans, Graviriella multiannulata, Glycera* sp*., Marphysa mackintoshi, Lycidice corallis, Lumbrinereis papillifera*),snails of the families Naticidae (*Polinices mammilla* and *Natica gualteriana*) andNassariidae (*Nassarius albescens gemmuliferus, N. coronatus, Volema pyrum*),hermit crabs of the genera Clibanarius and Diogenes, stars (Amphioplus*integer),*brachiopods (Lingula*unguis),*nemertine worms (Cerebratulus*marginatus)*andanemones (Ceriantharia).

In the intertidal areas are several birds that feed on worms and small crustaceans. Most of these birds are migratory routes between Africa and North Africa (Canada, Russia, Greenland). The most common species of birds of the intertidal zones include *Crocethia alba*, *Calidrius ferruginea, Squatarola squatarola, Charadrius marginatus*.

Still on the West coast, there is an area of seagrass exposed during the living tides but which remains covered by water at dead tides (Kalk, 1995). According to Bandeira (1989), a defined zone of plant species occurs in these areas, depending on tidal levels and associated factors. Due to the large primary production and structurally complex habitats, verified in these areas, they support a variety of benthic, demersal and pelagic organisms, attracted, especially in their juvenile stages, by food and shelter, being then important areas for fisheries both locally and regionally.

Common species of seagrass found include *Halodule wrightii* (a pioneering substrate-stabilizing species, which occurs between the limits of dead and living tides), *Zostera capensis* (species confined in the southern and northern bays), *H.uninervis,*, *Halophila ovalis* and *Cymodocea serrulata* (species that is closer to the low live tide mark occurring in large depressions that retain water at low tide) (Kalk, 1995).

Some algae can be found on the sandy shores to the west of the island, namely *enteromorpha seaweed compress* which covers solid surfaces such as rocks and coral fragments, *Udotea orientalis* and *Caulerpa cupressoides* which grow among the seagrass, *Padina boryana* and *Feldmannia irregularis* that occur in sandy areas covering rocks and in sludge areas, respectively; in summer occurs the seaweed Lyngbya majuscula, a blue-green algae that covers the surface of large areas of wet sand (Kalk, 1995). Associated with seagrass and algae are several species of worms, sea cucumbers, molluscs, crustaceans and eating fish.

Two species of worms are common on the West Coast namely *Balanoglossus studiosorum* and *B.hydrocephalus* running in sandy areas of the lower margin and in more limestone sand zones among coral debris, respectively. Three species of sea cucumbers are common and include the species *Holothuria scabra*, *H.atra* and *H.leucospilota*. Gastropod species, abundant among seagrass, include *Cypraea annulus*, *C.moneta*, *C.helvola*, *Conus lividus*, *Murex brevispinna*.

Most bivalves in the sandy-soid areas are essentially subtidal organisms although some extend their distribution to the intertidal seagrass zone, the cases being *Eumarcia paupercula*, *Trachycardium flavum* and *Anadara antiquata.* Crustaceans common in seagrass include crabs of the genera Portunus and Charybdis; Shrimps (Caridea) include the species *Alpheus crassimanus, A.rapax, A.rapacida, Harpilius brevicarpalis, Hyppolyte* sp., *Latreutes pygmeus, Process aequimana* while prawns (Penaeidea) include the species *Penaeus semisulcatus* and *P.japonicus* (Kalk, 1995).

The east coast of the island extends from Ponta Torres, to the south, to Cape Inhaca in the North with about 12 km. It is, according to Kalk (1995), a sandy coast that leans from high dunes to rocky areas below the level of low dead tide. According to him, this coast is exposed to the moderately strong action of the waves and constant winds, the lower banks of the dunes and the intertidal area is devoid of vegetation. The sand is coarse except in an area, at the level of low tide, at the extreme south (here fine sand is deposited on the lower margin by action of the current that occurs through the Strait of Ponta Torres from Maputo Bay. The ecological conditions prevailing on this coast contain a different fauna and flora of the West and Southwest coasts.

On the slope inhabit crabs of the species *Ocypode madagascariensis*. Two species of sea turtles, *Caretta caretta* (Loggerhead turtle) and *Dermochelys coriacea* (Leatherback turtle), also frequent the shallow waters of the East Coast; the females of these turtles, after mating between September and October, come to shore at night, from October to January, to prepare their nests and lay eggs. The eggs of sea turtles hatch between January and April after about 62 – 72 days of incubation; juveniles return to the sea through the dunes although many are preyed upon by crabs of the genus Ocypode. At the level of the dead tide or full tide it is possible to observe dense populations of the worm *Convoluta macnei* which has associated single-celled green algae.

At the middle level of the slope of the dunes are whelks of the species *Bullia natalensis* which emerge from their burrows in the sand when the tide hits them. On the lower bank of the dunes, especially at the southern end of the Island, is the *Austro-African Emerita* crab that has no segments in the abdomen; these crabs are pushed by the waves to the middle edge of the shore as the tide advances, and feed here (Kalk, 1995).

On the northeast coast, less exposed, are beetles of the species *Baldios* sp. which settle in a narrow horizontal band at the level of the full dead tide living in small and narrow tunnels in the sand. Still on the Northeast coast, between the middle and high levels of the dead tide is a small bivalve, *Donax madagascariensis*, which buries below the surface. Protists and meiosfauna are not numerous on the exposed coasts finding a species of copepod, *Karllangia psammophila*, dominant, among others 40 (Kalk, 1995).

The South and North bays are influenced by estuarine and marine, conditions that lead to several differences compared to the West and East coasts of Inhaca. The two bays differ in appearance and shape and are subject to different regimes of marine currents. A strong stream of ocean water flows through the Ponta Torres Strait towards the South Bay; the North Bay receives a large expanse of water from Maputo Bay (Kalk, 1995).

The South bay has a triangular shape about 10 km long (North - South) and 6 km wide (in the mouth). The bay opens onto Maputo Bay by opposing the Machangulo Peninsula which forms the southern boundary of the Ponta Torres Strait. The "head" of the bay forms a "bilobed bag" occupied by mangais; this bag (Saco da Inhaca) connects to the widest part by a strait of about 2.5 km. The widest part of the bay is dominated by ocean currents that occur between the Ponta Torres Strait and the Machangulo Peninsula.

In the middle zone the current divides north towards the mangroves and southwest towards Ponta Ponduíne and Maputo Bay. This area is bordered on the shore by Trees of Avicennia and in certain places there are rocks; the banks in the middle of the canal are covered by pools of seagrass different from those found on the West Coast. At the mouth of the bay is a large sandbank covered by the sea grass *Zostera capensis*. A coral reef grows along the east bank of the canal for about 2 km from the rocky cliff at Ponta Torres. The animals, at the mouth of the bay, are associated with coral reefs, as this is limited by rocks in Ponta Torres and Ponta differing in shape and habitats.

The rocky cliff in the Ponta Torres area presents growth of corals of the species *Tubastrea microanthus* and tunicates of the species *Pyura stolonifera*. The coral reef in Ponta Torres is a low reef whose surface is exposed at low tide and extends to a depth of about 2 m; branched corals of the genus Acropora and massive corals of the genus Favia are also very common sea urchins*(Diademma* spp.), starfish and holoturias.

Kalk (1995) refers to the existence of other coral species namely the genera Porites, Pocillopora, Stylophora, Goniopora, Platygyra, Echinopora, Pavona, Galaxea and Montipora. The end of the peninsula at Ponta Torres is sandy, stabilized by dune aggregating plants such as *Scaevola* sp. and *Ipomoea* sp. (Kalk, 1995). The sandy areas of the south bay include crabs (*Dotilla fenestrata*) and prawns (*Penaeus semisulcatus*).

In the muddy areas you can see flamingos (Phoenicopterus ruber), crustaceans (Macrophthalmus grandidieri, Alpheus malabaricus), polychaetes (several species, especially Dendronereides zululandica and D.arborifera), bivalves (Dosinia hepatica and Loripes clausus) and diatoms. On banks of dead shells are a variety of worms (Owenia fusiformis, Armandia longicaudata, Sipunculus nudus) and diners (the bivalve Montacuta sp. and the polychaete Ancistrosyllis falcata).

The sludge zones around the canal are rich in starfish (Amphioplus integer, African Amphiura, Paracrocnida sacensis) and molluscs (Nassarius arcularius plicatus, Volema pyrum, Haminoea petersi, Atys cylindrica, Philinopsis cyanea, Hydatina physis). Among the sea grasses around the canal there is a variety of Stomatopoda shrimps (Lysiosquilla maculata, Squilla nepa, Pseudosquilla ciliata), shells "in fan" (Pinna muricata, P.bicolor, Atrina pectina, A.vexillum) and diners (shrimps of the species Anchistus costs and the crab Pinnotheres sp., who live in commensalism with the shells).

The north bay is bordered to the east by the peninsula directed north, south by mangroves, to the west by the Portuguese Island and to the north by a sandbank that extends from the north of Inhaca Island to the Portuguese Island. Seagrass and a coral reef are on site. The bay measures about 10 km from east to west and 5 km from north to south. The prevailing dwellings are similar to those found in the south bay: mangroves, sandbanks with Dotilla, sandy-sludge areas with Macrophthalmus and associations of seagrass.

This bay is exposed to three water sources, namely estuarine influence of Maputo Bay, ocean water from the Indian Ocean and salubrious water that drains from mangroves. The substrate, joining that of the west coast, is largely covered in an association between *Cymodocea serrulata*, *Thalassodendron ciliatum* and

Syringodium isoetifolia. Most of the bay is covered by an association of *Halodule wrightii*, *Thalassia hemprichii* with *Zostera capensis* and *Cynodocea rotundata*. The lagoon south of the sandbank supports the growth of *cymodocea serrulata* seagrass (Kalk, 1995). In the southwestern part of the bay a sandy-slime waist holds some species of worms and polychaetes. A little throughout the area can be found sea urchins (*Prionocidaris baculosa*, *Eucidaris metularia*), bivalves (Pinna and Atrina, Tellina, Codakia, Mactra, Modiolus, *Malleus anatinus*),starfish (*Ophiothela nuda*),solitary corals (Fungia sp., Herpetolitha limax, Pocillopora spp.) and gastropods (Pleurobranchus inhacae, P.peroni, P.gemini) (Kalk, 1995).

3 Population and Socio-economic aspects

3.1 History of human occupation

It is believed that the emergence of the island is linked to changes in the level of sea waters, as it is said that there were times when the sea covered the entire south of Mozambique until reaching the Libombos mountains (Estação, 2008)[1]. And, according to some research, "his name comes from an elder who lived in Maputo around the 16th century, *Tsonga Nhaca.* He offered hospitality to the merchant Portuguese Lourenço Marques and his struggling navigators." [2nd]. Thus, the initial settlement of the Inhaca Archipelago is closely linked to the peoples of the continent (Impacto, 2001).

However, the origin of inhaca's population is unknown, but hypothesis[3] of a group from the North, from the Land of the *Chikunda* (Seine?), is suggested around 1325. However, recent reports say that part of the *Nhaca* population would have come from the inner plateau, more specifically from the present areas of Swaziland (Manzine?), while another would have
coming from the South (Matutuine), as is the case of the *Manganhalas* who, according to the same sources, shortly after, *would have* entered into small conflicts with the *Nhaca,*the first fixed here. [4] They found on the Island a set of propitious natural characteristics that facilitated the settlement. Various types of vegetation were used for the construction of straws, boats and fishing traps. The forests provided wood, fuel, fruit and natural remedies.
The waters of the sea abounded in fish, shellfish and crustaceans. The inhabitants who populated the island were long led by regians of the Nhaca dynasty. It was the name of this clan that gave rise to the name of Inhaca Island (Impacto, 2001).

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[1] *Inhaca Maritime Biology Station, sixty years building excellence in*research. (http://macua.blogs.com/moçambique_para_todos/2008/05/estão_de_biolog.htm/).

[2] Cotrim, Teresa. *Mozambique: Inhaca Island*. (http://xitimela.blogspot.com/03/2009/mozambique-inhaca island.htm).

[3] Apud; Cricket, Vitor Hugo Velez. *Inhaca's ethnology.* Bol. Society of Studies of Mozambique, XXVII, Nr.112, Sept.-Oct. 1958. Lourenço Marques.

[4] Interview with Matias Mapanga, secretary of the Ribzene district, and Mr. Sambo, reserve guard, on 5/6/2009: 10 h (C.P.)

Inhaca is probably known to the Portuguese, between 1498 and 1502, during vasco da Gama's expeditions to India (1497-98). Although not mentioned in the chronicles of expeditions, it is thought to have been João de Novoa the first European to reach Inhaca. [5] Due to its splendid characteristics and geographical situation, Inhaca was chosen as the stopping point for several ships that frequented the then Bay of Santo Espírito (today, Maputo Bay). They were first Portuguese ships, and later English, Dutch and Austrian ships.

In the 16th *História Trágico-Marítima*century, Chief *Nhaca* ruled a vast area that stretched from the island to the south, starting from its headquarters on the continent, and its power was felt up to the santa lúzia bay region, where it maintained a group of warriors. At that time, the island was already visited regularly by Portuguese ships that came to trade the bay, maintaining, according to the same reports, good relations with him (Chief Nhaca). Thus, from 1560, Portuguese merchants established a base on this island, from where they left for Lagoa Bay or *Delagoa Bay* (name by which it was called the present-day Maputo Bay), in search of ivory. In 1593, a navigator Portuguese was killed by one of *Nhaca's* rival bosses and then plundered his boat.

After 1621, Portuguese sailors began to seek asylum on the island of Xefina. We find, northwest of Inhaca Island, a small island called *Island of the Portuguese,* also known as *Elephant Island* that together constitute the Inhaca Archipelago. During the 15th to 17th centuries the latter had served as a refuge for sailors who sank on the coast, then began to serve as a trading warehouse for ivory, hence the designation of Elephant *Island.* It is interesting to observe, even today, the permanence of this commercial tradition on this island, through the holding of *sasonais* fairs on its beautiful beaches South- Southwest, where, according to reports, a little of everything is sold.

The effective occupation of the Inhaca Archipelago by Portugal occurred from the 19th century, when a small military fortress was erected, where today the District Administration operates, a building built in 1894, at the same time that maritime transport services began. [6]th
Around 1911, Inhaca's tropical atmosphere and coral banks caused a community of fishing *experts,* mainly from South Africa, to create a small hotel thus giving a new dynamism to the island.

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[5] Eduardo Mondlane University. Inhaca Maritime Biology Station - 1948. InhacAmbiente: Community Journal, Nr. 01/07, March. Maputo: p.1

[6] - Ibidem.

In 1948 the Inhaca Maritime Biology Station was created, which, after successive changes of direction, is currently under the tutelage of the Faculty of Sciences of Eduardo Mondlane University.

From 1960, visits continued to increase. Inhaca Island has now housed several families of fishermen, many returning from the mines of South Africa, others from the war, living mainly from fishing and agriculture. As Cotrim (2009) notes, this subsistence economy is still maintained today. But tourism, as we will see later, has begun to have some weight on the family budget of the islets. 7th
In 1965, *forest reserve areas* were created and demarcated, and then, in the same decade, the Maritime Reserve *Areas* for the preservation of coral banks and some breeding sites of marine fauna.

3.2 Population, its evolution and spatial distribution

During the first years of national independence, the present population was estimated at about 2815 inhabitants, being the western part of the island densely populated, reaching an average population density of about 70.4 inhabitants/km2. At that time, the population distribution varied according to the regions, with Inguane being the most densely populated. 8th. In 1985, inhaca's permanent population was estimated at 5,300 people, of whom 53% were
women, and about 49% were under 15 years of age, and 7% were over 60 years of age. In the age group between 15 and 59 years, for every 100 women there were 70 men, meaning that approximately 30% of the men in this group were absent, probably to seek work outside the island (CNP-INPF, 1990:32).

According to the same study, the population growth of the island had accelerated considerably by the war, and that before national independence inhaca's natural growth rate (1.9%) was roughly the same as in the rest of the country (2.1%)[9].

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7 - Cotrim, Teresa. Op. Cit.

8 - EMU. Inhaca's integrated work plan: final report of the 1st phase.- Maputo, 1976: p. 26.

9 CNP-INPF, op. cit. p.31.

Since 1980, the insecurity and uncertainty caused by the war on the continent and the relative calm in Inhaca have transformed this island into a center of attraction for the continent's population. As a result, inhaca's population growth has accelerated considerably by immigration. Thus we see that the natural growth rate has increased to 3.1%, while the average natural growth in the country was 2.6% and about 88% of families always lived on the island. At that time (1985), it was estimated that 736 families were living on the island, corresponding to 7.2 people per family.

The Archipelago housed a population of close to 10,000 inhabitants (this at the time of the 16-year war in the country). As the CNP-INPF (1990) noted, "currently part of traditional practices have been lost, the population has increased, needs and demands have increased, the (often inadequate) exploitation of local natural resources has intensified. This aggravated the environmental damage and the risks of Inhaca Island reached its limits of ecological support, triggering a process of environmental transformations of unpredictable effects." (CNP-INPF, 1990: 21). And continuing in its line of analysis adds saying that this is where problems arise from the degradation of the environment caused by the excessive demand for woody fuels by the population leading to the *"irrational"* slaughter of mangroves. And notes: in Inhaca there is no fresh water course and, consequently, the population depends on the underground water (CNP-INPF, op cit., 27). It should be noted, for example, that 50% of the territory needs almost full protection to safeguard the Inhaca Archipelago.

The population of the island is divided into three neighborhoods, namely Ribzene (1,910), Nhaquene (1,230) and Inguane (2,140) and each neighborhood is divided into blocks. The inhabitants of Inhaca maintain regional relations. The relations between Machangulo and Inhaca have been established for several generations. They are essentially of three types: commercial, infrastructural and family. Machangulo has more fertile land and for a long time the people of Inhaca went there buy non-existent products on the island. [10th]

Another factor not less important for the people of Machangulo is the existence of a health post on Inhaca Island that they have always considered to be superior. On the other hand, there is a strong network of family connections between Machangulo and Inhaca, and a constant movement of relatives side by side which makes it difficult to identify who is *displaced* or who is visiting. Many of the people of Machangulo currently have machambas in Inhaca provided by relatives.

Many of those who left the island for reasons of marriage returned (CNP- INPF, 1990:32). Moreover, there are indications that approximately 31% of *displaced* families now have machambas on the island, which means an increase of 200 machambas on the island.

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[10] ibidem.

How to as a result, all land outside the reserves has owner and almost all productive land is being cultivated[11]. The Portuguese Island is not currently inhabited.

3.3 Socio-economic aspects

3.3.1 Agriculture

On Inhaca Island, agriculture does not have much expression as fishing and tourism due to the low productivity of sandy soils and reduction of arable land that is, the land available for agriculture is approximately 700 ha of which 186 ha are located in the lower part where the most fertile land is located and the remaining 514 ha are sandy soillands of low fertility and weak water retention. It should be noted that agriculture is mostly practiced by women who head about 70% of households (Muacanhia, 1999).

Inhaca's soils are becoming less productive, making families increasingly need land to put pressure on forest reserves with machambas and uncontrolled burning in the pasture areas. According to Engelen & Kauffman (1977) inhaca soils are classified into three distinct units namely; dune soils, deep-sea hydromorphic soils with fresh water (wetlands), salty hydromorphic soils (low areas with influence of the seas).

Freshwater hydromorphic lagoon soils mainly cover wetlands, with soils ranging from white to grey. The latter occur in the lakes.

Considering the type of soils one can divide agriculture into (2) two groups namely:

- **Agriculture in wetlands or swamps -** is characterized by having clayey soils, suitable for the cultivation of vegetables, legumes, roots and tubers and we can find in three zones:
    - Ribzene District: Secheswane Swamp and Lake Tivanine;
    - Inguane Quarter: Secheswane Swamp;
    - Nhaquene District: Muchina Swamp and Chidacanine Lake.

11th Ditto.

- **Agriculture in the high zones** (reserves) - is practiced in poor sandy soils. The areas most affected by this practice of agriculture are the Districts of Nhaquene and Inguane. In the Inguane District, local communities open machambas inside the reserves forming patches of areas without vegetation, thus creating conditions for erosion and affecting in a certain way the mangroves by thumping and giving rise later to sedimentation. Coastal communities use mangroves on a small scale to provide local wood needs for firewood and various buildings such as boat and house, as it is a wood resistant to deterioration termites. Some plant species are used in tropical medicine.

According to Kalk (1995) the average annual rainfall is about 800mm and the average annual temperature is 23C. The relative humidity is about 77% and the evaporation is not very high. The dominant winds are from the East and South, greatly influencing the topographic configuration of the Island (Moura1969; National Plan Commission, 1990).

The main crops in Inhaca are vegetables, corn, cassava, sweet potatoes, peanuts, nhemba beans, yoke beans, pumpkin, watermelon and saccharine cane. In community areas beyond these crops there are also some fruit trees such as mango trees, papayas, coconut trees, citrus and cashew trees that are used to supplement the diet and family recipes. In terms of the potential of the cashew crop, the Nkalane area can be considered due to the high number of cashew trees in relation to Nhaquene and Inguane.

For the sustainable use of natural resources, both within the Forest Reserves and community areas, it is important that a demarcation and/or zoning of these areas is made according to the potentialities or productivity of the soils in order to ensure the proper use and management of resources. To increase the productivity of different types of soils it is necessary to know the cultivation system / production system, appropriate technological packages, technical assistance through an agrarian extension team, involvement and formation of communities.

Cattle raising: The number of goats on Inhaca Island varies from one zone to another, with Inguane being the area with the highest number of goats. In this neighborhood the goats are left to graze on the vegetation of the ingrime dunes of the eastern coast which has caused wind erosion, leaving the dunes without vegetation, thus destroying ecosystems and biodiversity. However, in other areas goats are tied to fallow machambas. Therefore, it is necessary to make a bearing of the herd to help the goat-breeding communities choose the type of production or breeding system suitable for inhaca island. To ensure a good integrated handling namely:

- Identification of the area and type of existing pastures (graminâcea, shrubby, mixed, among others);
- Animal production system;
- Water sources for watering;
- Livestock infrastructures (treatment mango, fenced drinking fountains).

To ensure animal protein it is important to promote the breeding of other small species animals such as poultry and pigs.

3.3.2 Fishing and Harvesting of Invertebrates

Due to the aspects of environmental protection, neither semi-industrial nor industrial fishing is practiced in coastal areas around the Inhaca Archipelago. However, in the south of the Republic of Mozambique, the deep shrimp industrial fishery known as *gamba*islicensed. In economic terms this fishery is the second most important for the country after the industrial fishing of surface shrimp in the Bank of Sofala, North Central Mozambique. The area of Inhaca goes from 25º 40' - 26º 50' representing about 30% and covers

the areas outside the Marine Resevas but adjacent to the eastern coast of Inhaca Island, Machangulo and area of the Ponta de Ouro Partial Marine Reserve. Inhaca is an area of great abundance and recruitment for the two most abundant species in fishing, namely For *H. triarthrus and A. foliácea* (Figure 4.1).

The fishery is licensed for the use of bottom trawling vessels. The most important deep shrimp species in the catches of *the gamba fishery* are: *Haliporoides triarthrus* (Pink or pink*gamba*), *Aristaeomorpha foliacea* (Red or red*gamba*), *Penaeopsis balssi*, *Plesiopenaeus edwardsianus* and *Aristeus antennatus*.

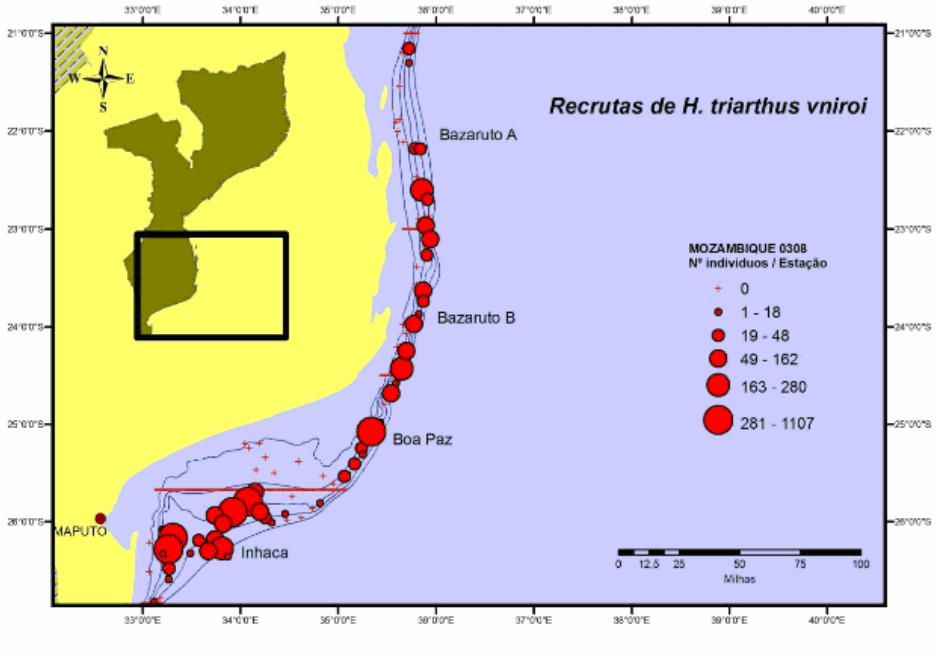


Figure 4.1: Geographical distribution of the number of recruits (carapace length less than 26 mm) of H. triarthrus vniroi captured during the cruise.

Artisanal fishing, fishing gear and catch trend: Small-scale fishing is the most important activity for generating income and source of protein for local communities in the Arquilepago de Inhaca.

The Institute of Fisheries Research carried out the process of collecting data from artisanal fisheries in Inhaca Island in 2007 and 23 tons of miscellaneous fish were reported. The art with the highest catch was drag with 20 tons (87%) and the remaining 3 tonnes (13%) were obtained through the art of surface emalhe. The captured resource was fish of several species. In 2008, the catch increased to 37 tonnes, about 60.8 % compared to the previous year. The most captured resource was once again the fish with 35 tons followed by penaeid shrimp with 2 tons.
According to the small-scale fishing census conducted in 2007 by IDPPE, in Inhaca Island there are 11 fishing centers (Table 4.1). Most of these are small in size and are not easily accessible by land. The continental shelf and the irregular bathymetry of the coast of this island contribute to different types of fishing gear being used. The main fishing gears are beach trawling and surface emalhe, with about 51 and 100 units respectively (Table 4.1).

Table 4.1: Fishing centres and their use of fishing gear (Source: IDPPE 2007 Census).

	Type of fishing gear by fishing center						
	Emalhe, Georgia	Drag	Hand line	Cage	Siege redede	Other	Total
Fishing Centre							
Lighthouse (1)		36					36
Noge (2)	6	2					8
Chichuane (3)	3						3
Portinho (4)	31	5	12			1	49
Nango (5)	4	2	1				7
Shallow Point (6)		1	1				2
Muchina (7)	28	2	6		1		37
Ntlomene (8)	20	2	5	1		9	37
Nkolombondwene (9)		1					1
Nwampessuane (10)	5		1				6
Inhaca Bag (11)	3						3
Total	100	51	26	1	1	10	189

The largest number of trawl art units is found in the Lighthouse fishing center, with about 70% of the total number of units existing in Inhaca Island (Table 4.1). The art of fishing emalhe is most used in the fishing centers of Portinho, Ribzene district (30%) and Muchina, Nhaquene district (28%) as shown in Table 4.1. Handline art is predominant in the fishing center of Portinho, Ribzene district, with about 46% compared to other centers (Table 4.1).

The fishing center with the largest number of different fishing gears is Portinho, headquarters of inhaca Municipal District, being the main fishing gear used are beach trawling, surface emalhe and hand line.

The fishing centers located near the pier bridge in Portinho da Inhaca, near the Inhaca Hotel, and in front of inhaca's Maritime Biology Station are the most important in artisanal fishing activity.

Fishing takes place seasonally and is only practiced in the low tide period. During the live tides involves groups of fishermen operating beach trawl units. In Portinho da Inhaca there are about 6 fishing groups that were observed operating with beach drag, with 10-12 fishermen each on average. All fishing groups operating with the engine off board use beach trawling and then save the catch of the day aboard their vessels.

All groups of fishermen in the center of Portinho da Inhaca operate within the limits of 3-5 km away, with about 4-5 hours for each operation. There are no night operations or during bad weather.

Characterization of fishing areas: The sandbanks and seagrass of the North and Centre are the most frequent by fishermen who catch with trawling to the beach, open sea fishing for fishermen with hand line and southern region of Machangulo for gillnets (Figure 4.2). Fishing takes place seasonally and is only practiced in the low tide period.

Most fishing areas have a predominantly sandy substrate covered with seagrass. According to Bandeira (2000), there is a well-defined distribution of herbs, the Biology Bank, Portinho Bank, Portuguese Island (South Zone), Muchima, Nango have the same type of herbs called po *Thalassodentrum ciliatum* and

Cymodocea serrulata. The *sangala*bank, Nolwe, Ribjene bank, Portinho-Norte area is characterized by a structure of herbs similar to *Thalassia hemprichii* and *Halodule wrightii* .

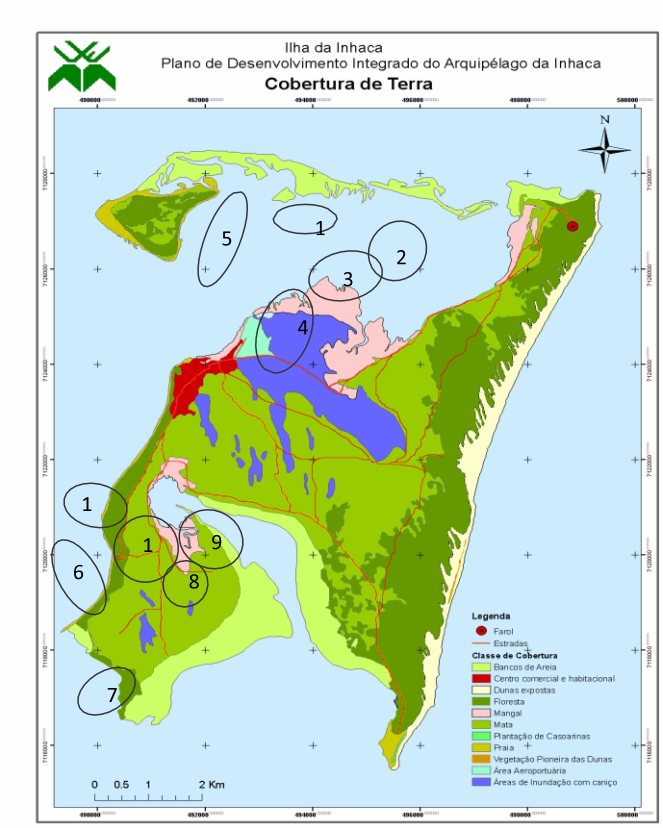


Figure 4.2: Main fishing centers in the Inhaca Archipelago.

Recommendations for the management of harmful effects of trawling: Greater attention should be paid to the use of beach trawls due to the damage caused to the seabed by the modification and destruction of its natural conditions, resulting in low fishing and financial yields due to the low quality of fish that are obtained with this type of fishing gear over time. Probably a progressive replacement of this art by more selective ones can be a punctual way to better manage the resources of this island.

Mechanisms for the management of artisanal fishing activity: On the island of Inhaca, two Community Fisheries Councils are known in the process of regularization. These take part in the Fisheries Co-Management Committees (GCC) which is an advisory forum of the local fisheries administration authority where matters of interest and the scope of preservation are analysed
fishing resources and fisheries management. The objectives of the GCC are emanated from Decree No 43/03 of 10 December approving the General Maritime Fisheries Regulation and defining, in Article 15(3), in order to grant participatory management of fishing resources and where all types of interest are represented.

Ornamental fishing related to small-scale fishing: The practice of fishing for ornamental fish in the Inhaca Archipelago is carried out by a company licensed in the harvesting of ornamental fish that occur as a surplus of the accompanying fauna of small-scale fishing (Figure 4.2).

The occurrence of ornamental fish comprises a very large variety of dermersal species. The extensive presence of seagrass and the relative proximity of corals within the Marine Reserve explains the diversity of fish in the area and the regular occurrence of ornamental species as accompanying fauna in beach trawl. Studies indicate that about 20 species of fish occur. Among them are the families of:

- Chaetodontidae (6 species of *Butterflyfish);*);
- Scorpaenidae (3 species of *Scorpionfish);*);
- Tetraodontidae (2 species of *Pufferfish);*);
- Ostraciidae (3 species);
- Pomacentridae (7 species).

The less representative species may be related to seasonal distribution. Table 4.2 presents a list of the main species of ornamental fish that occur in the Inhaca Archipelago.

3.3.3 Extraction of forest products

Local communities on Inhaca Island explore a diversity of forest products. Barbosa (1995) found that in Inhaca Island, as in many remote areas of Mozambique, dependence on firewood, cuttings, lacquers and medicinal plants is still enormous.

Firewood: Barbosa (1995) identified 19 species used for woody fuel being *Psydrax locuples, Mimusops caffra, Pavetta revoluta* and *Syzygium cordatum* the most common species. These species have been selected because they produce little smoke, strong fire, and burn continuously. Most of these species come from forest reserves and machambas. For example in the Nhaquene District, communities devastate large tracts of forest reserves throughout the western expanse and near inhaca Maritime Biology Station. On average the affected area extends for about 3000 meters North-South and an average width of about 200 meters.

On Inhaca Island, the volume of firewood that reserves can offer is already lower than the demand for woody fuel by local communities, estimated at 1,840 ha for about 734 families (CNP-INPF, 1990). When evaluating the availability of firewood in Inhaca, the authors concluded that the supply of woody fuel for energy needs would be made at the expense of environmental degradation.

Building materials (piles and lacquers): Plants are a source of low-cost building materials in many remote areas of the country. The species of *Sideroxylon inerme, Diospyros rotundifolia, Terminalia sericea, and Apodites dimidiata* are some preferred species as cuttings on Inhaca Island while the species of *Catunaregam spinosa, Rhizophora mucronata, Ceriops tagal* and *Dipyros rotundifolia* are used as lacquers (Barbosa, 1995).

Medicinal plants: Knowledge about the healing power of plants is common in Africa. Medicinal plants are the first resource used to cure various diseases that rural families face in Mozambique. In a brief evaluation of the plants used in traditional medicine on Inhaca Island, Barbosa (1995) identified 45 plant species used by local communities whose main source is native vegetation. However, there is still no systematized knowledge about what type of native vegetation is most important as a source of medicinal plants.

Plants cure various diseases among dysenteries, diarrhea, stomach pains among other diseases. *Terminalia sericea* para disenterteria, *Bridelia cathartica, Strychnos spp*. para dores de anaesdia de dentes para tratamento de dentes are among the most mentioned.

3.3.4 Alternative sources of income for local communities

Inhaca's population comprises about 5,300 inhabitants, part of which are families led by women. The food sources of sustenance are corn, sweet potatoes, cassava, nhemba beans produced in small plots of land in the interior of the Island or in the surrounding areas of forest reserves. The majority of the population does not depend on agriculture but on fishing.

3.3.5 Tourism

Legislation on tourism development: From a legal point of view the tourism sector is governed, among others, by Law No. 4/2004 of 17 June, by Resolution No. 14/2003 of 4 April of the Council of Ministers, which approves the tourism policy and strategy of its implementation, by the Government's Five-Year Program for 2005-2009, approved by Resolution No. 16/2005 of 11 May of the Council of Ministers.

According to the Government's Five-Year Plan, the government's tourism objectives are, among others, to contribute to job creation, economic growth and poverty alleviation; develop responsible and sustainable tourism; promoting the conservation and protection of biodiversity; develop tourism that respects cultural values and encourages self-esteem in communities, etc.

In addition to the instruments referred to, the Government's Action Plan for the Eradication of Absolute Poverty (PARPA) establishing strategic actions and mechanisms for reducing poverty through development processes is of great importance. From this perspective, tourism is assumed as a complementary sector to the reduction of absolute poverty. On the other hand, the development of tourism contributes to the consolidation of national unity and to the enhancement of historical, cultural and landscape heritage. In this context, taking the necessary measures and necessary measures, it is advisable to practice tourism on the Island without other restrictions than those contained in the law.

Tourism Management: All over the world, tourism is the sector that reveals a growing economic importance of which Mozambique is no exception. As a factor of economic growth and development, tourism in the Inhaca Islands and the Portuguese, when well managed, can provide a satisfactory standard of living to islanders among other benefits. To this end, it is important that the tourist activity be managed in a healthy, strategic and sustainable way in harmony with its transversal character.

Tourism management involves balancing economic interests and sociocultural and environmental considerations. In conservation areas, ecotourism, game tourism, recreational diving and other identified activities may be developed in accordance with the management plan and other legal provisions, Article 9(1) of Law No. 4/2004 of 17 June.

Therefore, it is recommended to exercise the industrial activity of ecotourism in view of the growth and development of Inhaca Island and that of the Portuguese, which will provide more jobs and living conditions of the inhabitants of these islands, among other merits.

Current status : Tourism on inhaca island is currently growing, but it is difficult to estimate the real direct benefits to local communities because there is no data. The revenue stemming from tourism still does not reflect improvements in the conditions of the inhabitants of the Island, although EMU makes efforts to improve the living conditions of islanders. Undoubted fact is that the island does not have many tour operators, with some operating underground, which have degraded the tourist environment of Inhaca Island.

3.3.6 Transport and communications

The existing communication routes, by land, are highways that form a dispersed and very irregular network, connecting the communities and connecting with the sea. These are sandy stings that are best run in four-wheel drive vehicles. This creates some constraints for the inhabitants who also need to move from one point to the other, mainly to the center of the village, to the trade, or to the sanitary post, etc..

The issue of transport should also be seen in terms of its connection with the continent, especially with Machangulo and the Capital, places that have strong historical ties. Therefore, the difficulty of access to the island is one of the factors that prevent the improvement of the lives of families. The only vessels that make the route Maputo - Inhaca are not regular, an aspect that leads to the reduction of demand from the Island on weekends for occasional visits; they also do not offer much convenience especially for children, the elderly, the disabled who are exposed to the possible risks of accidents during shipments and disembarkations in addition to the physical effort required.

Air transport from the mainland to the island is more certain and safer. The only disadvantage stems from the passage prices that are not within reach of the pocket of the average tourist who wants to climb inhaca. In terms of communications, the Inhaca Archipelago is covered by the networks of mobile and fixed telephony. However, access to the mcel network may vary depending on the time and altitude of the location.

3.3.7 Education and health

Formal education is administered in only three official (state) schools, and already has a secondary school that teaches up to 10th grade. However, compared to the rural level of the rest of the country, the illiteracy rate is low (CNP-INPF, 1980:30).

As for the sanitation of the environment, there is no sanitary landfill, being mainly solid household waste that comes from the hotel, from the houses and formal commercial institutions deposited nearby and the hospital waste produced in the health centers of Inhaca and Muchina is indiscriminately incinerated.

3.4 Aspects of Natural Resource Management

3.4.1 Cutting and burning agriculture (dryland)

About 70% of the families in inhaca Municipal District are headed by women due to the migration of men to urban centers on the continent or to the Republic of South Africa. Women heads of families face many problems for their livelihood and to care for their children because they benefit little from the fishing and tourism that are the main economic activities of the island. Thus, they have systematically invaded the Forest Reserves for the practice of subsistence agriculture based on cutting and burning, which contributes to the destruction of ecosystems and their biodiversity.

The cutting and burning agriculture of the vegetation exterminates the biotic composition, thus altering the soil structure, leading to the loss of nutrients from the same, which makes the erosive process rapid and consequently lowering productivity (Serra King, 1995).

The situation of Inhaca Island needs the adoption of low-cost land management technological options (because the economic power of its inhabitants is low), which maintains soil fertility, improving agricultural yields and ensuring the conservation of forest areas.

Thus, conservation agriculture would be the set of management practices of agricultural soil that aims to reduce changes in the composition structure and biodiversity of the soil advocating erosion and

degradation, this type of agriculture would have positive impact on all environmental compartments soil, water, atmosphere and biodiversity.

3.4.2 Opening of new machambas in the Reserves

The soils of the Inhaca Archipelago are sandy and characterized by low fertility. As the local production system depends on natural soil fertility, the decrease in this fertility leads to the abandonment of agricultural land and the search for new areas for farming. On Inhaca Island, the population has resorted to forest reserves to open new machambas (Kalk, 1995). A study conducted on the Island by Serra King (1995) indicates that the conversion of the forest into a machamba implies a drastic reduction, among other nutrients, of soil organic carbon, total nitrogen and humidity. According to the same author, the areas of 7 and 15 years of abandonment (fallow) had a slight recovery of these nutrients, but still far from reaching forest levels. Contrary to this,
levels of Ca^{2+}, K^{+} and Mg^{2+} recorded an increase soon after the burn, and with trends in
in subsequent years. Apparently, these nutrients were released in the burning of trees and can then. be captured by growing plants or lost by leaching.

The creation of forest reserves led to the reduction of arable land areas for local communities and the consequent reduction of the fallow period of machambas, having since motivated a chronic conflict in the use of natural resources. The inadequate management of the land, that is, the lack of crop rotation practice, incorporation of stubbils in its machambas, does not favor the recovery of fertility of its soils. Most islanders, to facilitate soil preparation (crops made manually with the hoe), burn all plant residues, however protecting fruit trees.

According to studies by Kalk (1995) the population of Inhaca still depends on agro-forest resources for their life, thus constituting the main cause of the devastation of forest reserves in Inhaca, through:

- Cutting and burning of vegetation for agriculture practice;
- Cutting and slaughtering of plant species consumes as woody fuel;
- Cutting of cutting and lacquer for construction and sale purposes in the local market;
- Tree felling for boat construction.

To reduce the invasion of the reserves it is important that communities are involved in the sustainable management of natural resources through community organization (groups/associations).

3.4.3 Fishing in corals

Corals are authentic nurseries of marine species. They are tropical ecosystems with a high biological diversity and that occur in shallow, relatively warm (more than 20^{o} C) and transparent waters. In Mozambique, there are areas with these conditions and so we have many coral reefs. It is estimated that coral reefs in Mozambique occupy an area of about 1,290 $km2^{2}$.

There are many causes of coral destruction in Mozambique, including fishing. Coral reefs are integrated in the Marine Reserves managed by inhaca Marine Biology Station, therefore fishing in these places is prohibited. Some measures are taken to ensure the non-practice of fishing in these places, including the awareness of the fishing community about the risk of this practice, through lectures and the supervision of coral reef areas.

3.4.4 Harvesting of marine invertebrates and ornamental fish

The harvesting of marine invertebrates for commercial and ornamental food purposes is done indiscriminately in time and space. However, there is an urgent need to promote civic and environmental education to local populations and visitors to the Island for a sustainable harvest that obeys and guarantees the periodic reproduction and breeding of marine species.

3.4.4.1 Conservation of sea turtles, dugongs and dolphins

The conservation of species of sea turtles, dugongs and dolphins needs to be excluded from any type of marine and coastal developments in the breeding areas of these species, particularly on the eastern coast of Ponta Torres da Ilha de Inhaca.

3.4.4.2 Cruises and sports boats on the Portuguese Island

In the last three, four years Inhaca has received from November to April each year cruises bringing tourists who on average remain two days based preferably off the Portuguese Island. The cruises that frequent Inhaca belong to *Mediterranium Shipping Company,*the 2nd largest shipping company in the world. In the last campaign (2008-2009), the cruise visited Inhaca at least twice a week disembarking about 1000 to 1500 tourists.

On the days of the cruise the tourist movement increases, the local communities move to the Island of the Portuguese for the transport of tourists as well as for temporary assembly of a fair of various products for tourists. On the other hand, the cruise takes with it companies providing various tourist services that also disembark and settle at the local fair to exhibit their products and services.

Meanwhile, these activities have created many problems of garbage management, mainly non-biodegradable, sanitation of the environment (changing rooms and others), conflicts of management of landingand transport of tourists to various locations of Inhaca.

Sports Boats: Every year Inhaca receives about 40 boats from South Africa for sport fishing. This practice is mostly carried out in the Marine Reserves, mainly in the Northern Area of Inhaca and the Portuguese Island. The philosophy of sportsmen has been to distribute the product by disadvantaged local communities through the Directorate of Women and Social Action of inhaca District.

On the other hand, dishonest tourists have practiced motor sports on coral reefs mainly in Ponta Torres, South of Inhaca. This activity not only interferes with the normal life of corals but also of dugongs that lately register a significant increase in individuals in the Ponta Torres channel in search of food (sea grasses in Saco).

3.4.5 Use of coastal forest resources

Coastal forest resources provide a great diversity of products, goods and services (Barbosa, 1995). The main forest resources used include mangrove trees, associated vegetation, cuttings, firewood, lacquer and wild fruits. Inhaca Maritime Biology Station in coordination with local communities has defined the standards of access to forest resources (e.g., lacquers, cuttings, medicinal plants) in the reserves to allow them to benefit from these resources.

3.4.6 Cultural aspects - Protection of historical and cultural sites

In addition to the aspects related to the protection of historical and cultural sites (Fortaleza, Fortin, Barracks, Administration, Health Post, Inhaca Maritime Biology Station, etc.) already physically constituted, needing only their rehabilitation, it is important to carry out other activities of local cultural scope: survey

and study of the uses and customs of the native population of Inhaca, also taking into account, also, in account of , their constant mobility and dissemination.

4 Challenges in Management and Development

4.1 Incidence of Poverty

"The incidence rate of poverty measures the proportion of the population defined as poor, that is, people whose consumption is below the defined poverty line. Two important additional poverty measures are calculated across poverty lines: the poverty depth index and the poverty severity index. The depth and severity indices are more sensitive, particularly to changes in living standards among the poor. For example, if a poor person increases their consumption but is still below the poverty line, it can be said that poverty has reduced because the person has become less poor. The incidence rate of poverty does not capture this reduction in poverty, but the other rates capture it." – PARPA II, 2006-2009

The relatively high rate of poverty – which means lack of access and opportunities – is a general concern. This situation is contrary to the economic potential (especially at the level of tourism) that is recognized in the archipelago and this is also opposed to the preservation that many parts of the archipelago. In this circuit, it is necessary to find a middle ground, by promoting the alternative value of the resource, which means giving additional value to conservation to the use of the resource. This implies a positive assessment of the resource in order to prepare its maintenance for future generations. The satisfaction of communities and conservation of resources involves the involvement of local communities in the sustainable management of resources and very specifically in the sustainable management of the archipelago's Forest and Marine Reserves.

4.2 Alternative sources of income for local communities

Many studies conducted in Inhaca have pointed out that the islets are economically based on fishing and agriculture, both carried out in small dimensions. In addition, forest exploitation and the breeding of small animals as other sources of subsistence of the islanders. However, agriculture is not currently the potential economic activity and tourism activity is the one that offers the best potential for the Archipelago. The creation of an alternative of sustenance involves the production of alternative consumer goods that do not imply degradation of natural resources as well as the production of supply of goods and services for tourism. For example, promoting beekeeping can also help improve the diet because honey and wax can be alternative sources of family income. Other alternative sources of household income include:

- promote and produce good quality fruit trees tolerant to pests and diseases through the creation of community nurseries;
- Promote agro-processing of vegetables, fruits including wild fruits;
- promote the rearing of chickens, ducks, rabbits and pigs;
- Promote and deploy community forests in different areas prone to erosion;
- Promote sac horticulture for HIV/AIDS patients and the elderly.

4.3 Environmental degradation

4.3.1 Deforestation of mangroves and coastal forests

Deforestation of mangroves and coastal forests is a reality in the Inhaca Archipelago. Although there are no data on the size of this activity in the archipelago, it is known that local communities deforest forests for agriculture and prospecting for forest resources.

Agriculture is the type of cutting and burning with fallow periods and the same agricultural area is usually used between two to three consecutive years before being abandoned to regain fertility. The fact that local communities depend on agriculture for their survival combined with poor soil productivity, drives increasingly intense demand for new areas of culture. Communities generally have between two and three plots of land for cultivation, at least one in the low (flooded areas) and the other in the high zones, making up about 0.60 ha on average, per household. In 1990, the agriculture area was estimated at about 700 ha, being 186 ha and 514 ha in the low and high zones, respectively (CNP, 1990). Low-lying agriculture is on hydromorphic soils, characterized by high moisture retention capacity for long periods per year. Some of these areas are located in the marshes of Secheswane, Tivanine, Muchina and Chidacanine where second-season crops such as vegetables, tubers and beans are practiced throughout the agricultural campaign. According to Kalk (1995) the swamps of Inhaca Island have between 20 and 45% of their area dedicated to horticulture and about 65% (out of 674) of households that practice agriculture, produce vegetables. Therefore, the prospection of new agricultural areas contributes greatly to the degradation of coastal forests and biodiversity.

Forest degradation also occurs through the prospection of forest products. The main forest products taken from forests and mangroves include cuttings, lacquers, ; firewood and coal (energy source); and medicinal plants. Most of the dwellings are of precarious construction. They are constructed by piles and lacquers taken from local forest ecosystems. Currently, the Forest of Inguane and mangroves have been used as a source of lacquer-lacquers and cuttings due to the scarcity of good quality products in the western part of Inhaca. Intensive exploitation of this material contributed to the degradation of the red barrier forest.

The Inhaca Archipelago has benefited from the electric current of the Cahora Bassa network since 2000. However, a large part of the population still does not benefit from this good. In order to meet energy needs, local communities rely on firewood and charcoal from forests. The dependence of the local population on woody fuel to meet contrubui energy needs for forest degradation. Therefore, energy sources in addition to woody fuel should be identified for their implementation in the archipelago.

4.3.2 Goat breeding

The number of goats on Inhaca Island varies from one area to another, with the area with the highest number of goats being the Inguane district. Here the herds walk free causing wind erosion on the seafront

of the eastern coast leaving them exposed. As a result, the sands are transported by the ocean winds covering other dunes with vegetation thus destroying the ecosystems and the associated biodiversity of the areas of Ngomela, Malengana, Machúngwe and Mazóndwè. Goats are tied up in fallow machambas in the Ribzene and Nhaquene districts thereby reducing their impact on surrounding ecosystems. However, it is necessary to make a bearing of the existing herd of goats to help the breeding communities to establish production or breeding systems suitable for inhaca island. To ensure a good integrated handling, the:

- Identify existing areas and types of pastures (grasses, shrubs or mixed pastures among others);
- Establish an animal production system appropriate to Inhaca's conditions;
- Identify water sources;
- Establish appropriate livestock infrastructures (treatment sleeves, fenced drinking fountains, among others).

To ensure animal protein in the diet of local communities it is important to promote the breeding of other small species animals such as poultry and pigs.

4.3.3 Erosion

One of the island's biggest problems is coastal erosion. On the east coast erosion is caused by winds and waves and on the west coast it is caused by water. Erosion is also a problem for coral reefs that are covered in sand. The bay is also subject to topographical changes. Aerial photographs indicate that the area covered by sandbanks has increased by about 10% between 1967 and 1989 (de Boer et al., 2000) and this trend continues to evolve in recent years.

Erosion can be attributed on the one hand to natural factors such as the sea, wind and rainfall that lead to marine, wind and rain erosion. On the other hand, erosion is caused by the action of man, an anthropogenic factor, namely local communities through deforestation, herding of goats in the dunes (Ngomela), practice of agriculture in the Forest Reserves (Nhaquene) and wetlands (Lake Tivanine), implantation of camps and holiday homes in the dunes and mangrove (Saco da Inhaca, agriculture in the Forest Reserves). (Muacanhia, Achimo & Deniasse, 2008).

According to Muacanhia (2004) wind and marine erosion increases in the rainy season (October to March) because this is the season of strong winds and giant waves responsible for erosion in much of Inhaca (Muacanhia, 1988; Muacanhia & Deniasse, 2007).

Analyzing the data of Engelin and Kauffman (1977), on average, up to 1m deep inhaca soils have 94% sand and 6% clay and organic matter. It must be recognised that this proportion must have changed due to the increase in the percentage of sand caused by deforestation and exposure of soils to erosion.

Clay is primarily responsible for cementing sediments. The reduced percentage of clay in inhaca soils justifies by itself the vulnerability of soils to external agents causing erosion.

Most of the sites of the Inhaca Archipelago suffer from a combination of erosion (wind-marine-rain erosion). Wind-marina erosion occurs simultaneously almost throughout the year. The places most affected by this type of erosion are the Red Barrier, Malengana, Machúnguè, Ngomela, Ponta Mazónduè, Ponta Ponduíne, Ponta Rasa and Ilha dos Portuguese.

The combination of the three types of erosion (marine-wind-rain) is accentuated in the Red Barrier due to the sharp slope slope which favors the action of the force of gravity which also plays an important role in this combination of erosion factors. The erosion process in the area endangers red barrier reefs and can therefore reduce interest as one of the main destinations of scientists and tourists.

Erosion in Inhaca occurs with facilities not only due to external agents but also due to the fragility of sandstones before erosion agents. According to Engelin & Kauffman (1977), the rocks are characterized by poor compaction and cementing suffering easy physical disintegration. In some places the chemical-mineralogical composition$^{(Ca^{++}}$, Mg^{++}, K^{+}, Na^{+}) makes them vulnerableto chemical-physical degradation processes.

4.3.4 Maputo Bay: Sea level evolution from the last glacial period

Sea level variations in the Quaternary Period, which begins about 2 million years to the present, are marked by rising sea levels, with the melting of polar caps since the last glacial period about 18,000 years ago, when sea level was at depths of about 130 m (e.g. Lambeck and Chappell Chappell , 2001; Ramsey, 1997). The evolution of the inhaca island coastline is associated with the evolution of Maputo Bay (Figure 3.1; Achimo et al. 2003), reconstructed from bathymetric curves as a function of the sea level curve to Southeast Africa.

Sea level experienced rapid transgression in the period between 18,000 and 9,000 years due essentially to the thawing of the main part of the glacier while the effect of thermal expansion was less significant. In the period between 9,000 and 6,500 years before the present, sea level rise was slower and the current sea level was reached at the end since the interval.

Sea level, 3 meters above the present, was determined from a sedimentary rock (calcarenitos – beachrock) along the southeast coast of Africa, in the Holocene period i.e. Between
5,000 and 4,000 years before the present (Ramsey, 1995). Later, the author considered that the high sea level, above the globally accepted, for this period was the result of thermal expansion. On the other hand, it is known, through the study of corals in the Mozambique channel, that the sea surface temperature was at its highest degree around 5,000 years before the present, and about 6° C higher than in the last glacial period. It was also at that time that the sea surface temperature was higher than in our day.

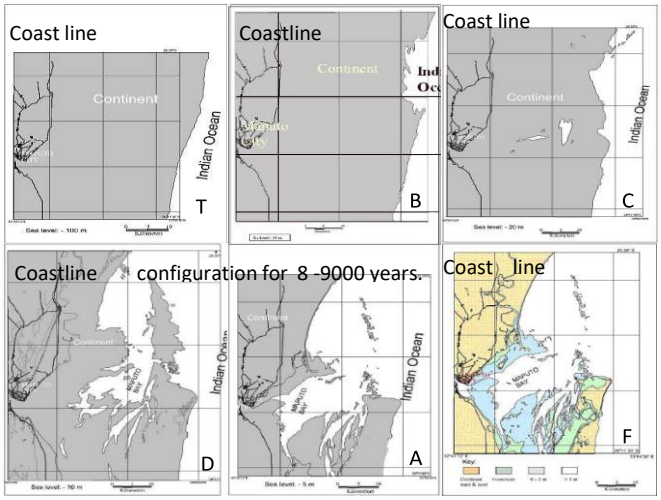


Figure 6.1: Holocene evolution of Maputo Bay from the last glacial to the present (adapted from Achimo at al 2003).

The Holocnic evolution of Maputo Bay (Achimo at al 2003) had the following steps: (A) – Configuration of the coastline 18,000 years before the present; The coastline was about 70 km from Maputo City at a depth of 100 m below this sea level.
(B) – Between 11,000 and 12,000 years before the present, the coastline at a depth of 50 m was about 60 km from the city of Maputo with a bay to the Northeast. (C) - Between 9,000 and 10,000 years before the present, the coastline at 20 m depth, had an N- S orientation and had retreated a few kilometres westward. A chain of small islands oriented towards NE – SO near the shoreline and a lagoon had formed, as well as some lakes near the shoreline. (D) - Maputo Bay began to form about 8,000 to 9,000 years before the present when the coastline was 10 m deep. A huge Island to the north of this Inhaca Island protected the Bay, from the sea and a tidal channel associated with the respective deltas of flood and ebb tide, separated the island from the peninsula to the south. What today is inhaca island was the extension of the current Machangulo peninsula. The mouth of the Maputo River was configured and the elongated lakes were probably forming due to marine floods and/or rising groundwater levels. (E) – With the level of 5m deep about 8,000 years ago, the great barrier island was submerged, emerging locally only the highest parts of it. A new barrier complex had formed at the expense of the old flood and vasante tide deltas due to progressive marine flooding. (F) – At present we have the complete configuration of Maputo Bay and Inhaca Island with their modern sedimentary environments.

4.3.5 Evolution of inhaca island coastline in the last 50 years

The evolution of the inhaca island coastline in the last 50 years was determined based on two line boundaries: the 1958 coastline boundary extracted from the INAHINA nautical chart and the limit obtained by lifting the coordinates of the high tide level line during the field observations carried out in March , May and June 2009. In this survey, the Garmin III Plus GPS was used.

Table 6.1: Minimum, medium and maximum displacement of the shoreline in the last 50 years

Zone	Minimum offset (m)	Medium displacement (m)	Maximum displacement (m)
The	26,80	76,60	229,70
B	41,50	88,30	321,90
C	20,60	64,35	330,00
D	10,68	81,47	154,14

The minimum displacement of the shoreline was determined by the minimum distance of the two lines, while the average and maximum correspond to the average and maximum distances in the respective zones (Table 6.1).

Based on the above results and for zoning purposes the Island was divided into 4 zones according to Table 3.1, to allow the identification of critical displacements of the shoreline:

Zone A extends from Piri-piri to Ponta Torres and from a part of Uapessuane Bay to the southeast coast of the island. The maximum displacement of the shoreline is observed in the Ponta Torres area (see Figure 3.5). This fact shows the fragility and vulnerability of this place. The area constituted by the dunes on the Southeast coast is roughly characterized by minimal displacements which confers a relative stability of the line, despite the already known threat of wind erosion, caused by stormy winds.

Zone B extends from Ngomela to the northern end of the island and from the Northeast coast to the Inguane area. The maximum displacement of the coastline of this zone is observed in the western part of Cabo da Inhaca while the Northeast coast shows a relative stability of the line (minimum displacements), despite the effect of wind dynamics on the dune system.

Zone C extends from Inguane to Hotel Inhaca and from the northern part of the airport to the central part of Lhangua. Maximum displacement occurs in a more pronounced way in Lhangua and with disturbing signs even around the Lucas Restaurant given the geomorphological characteristics of that place.

Zone D covers the entire west coast of Inhaca Island from Hotel Inhaca to Ponta Punduíne and the westernmost part of Saco da Inhaca. Maximum displacements are recorded in the Red Barrier range including ebmi and Punduíne Tip, although significant displacements are recorded in Saco da Inhaca. A particular aspect of the Red Barrier is removed from the vegetation cover by man for the practice of agricultural activities that accelerate the erosion of the dunes.

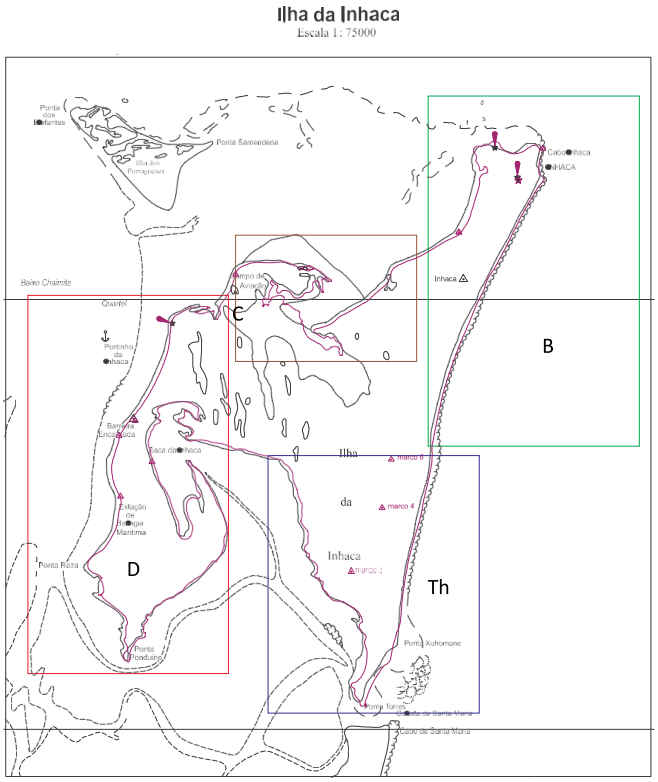


Figure 6.2: Evolution of inhaca island coastline in the last 50 years

4.3.6 Implication of climate change in Mozambique and vulnerability of Inhaca Island

Climate change refers to "significant statistical variations that persist for a period that extends in the order of decades or for relatively longer periods." Classic climate measurement parameters include e.g. temperature, precipitation, sea level, extreme events, floods, droughts, and storms. This definition explicitly involves extreme weather-related events, therefore variations in sea level, floods, droughts, and storms.

Recent studies on climate change suggest that exposure to the risk of natural disasters in Mozambique will increase in the next 20 years or more (INGC, 2009). As a result, the vulnerability index will increase as climate impacts reduce people's livelihoods (e.g. health, water and infrastructure) and affect food production. On the other hand, climate change and related extreme events will be felt, particularly on small islands (e.g. IPCC, 2001; Parks and Robers, 2006). According to the IPCC (2007), sea level rise from 0.18 to 0.59 m by 2100 will cause most of these islands to be flooded or exposed to waves and storms creating great difficulties in obtaining water and food (Ralston et al., 2004; Parks and Robers, 2006; IPCC, 2007). This situation may be exacerbated due to the melting of the polar ice cap in Antarctica leading to the disappearance of many islands (Vaugh and Sooge, 2002; Tol et al. 2006).

Inhaca Island, located in the southern part of Mozambique, is one of these islands that shows clear signs of climate change. One of the main signs is coastal erosion and the retreat of the coastline (Figures 6.3 and 6.4) that is observed in the different segments of the island in recent years due to its exposure to the sea, the action of stormy winds and waves. Although the relative variation in sea level produces a number of impacts on the coastal zone, it should also be recognised that all existing analyses only consider some aspects of these impacts and responses due to local and quality data limitation stemming from a more appropriate analysis.

Figure 6.3: Effect of the swell that reaches the base of the cliffs on the eastern**.** coast of the Island, destabilizing the sands and overlying sands.

Figura 6.4: Efeito das águas pluviais e a acentuada desnudação de solos aceleram o processo de erosão de Barreira Vermelha na costa ocidental da Ilha.

Current trends in observations and results of the models indicate that climate change will affect the characteristics of tropical cyclones in the Southwestern Indian Ocean region. Recent observations, theories and results of model simulation (Emanuel, 2005; Trenberth, 2005; Emanuel, 2008) show that intensity of tropical cyclones as well as their destructive power could increase in the southern hemisphere, and particularly in the Southwest region of the Indian Ocean that includes the Mozambique Channel. Nevertheless, the same studies reveal a generalized tendency to reduce the total frequency of these events. Climate change could, in turn, affect the characteristics of tropical cyclones in the Southwestern Indian Ocean region.

4.3.7 Future scenarios of sea level rise and tropical cyclones in the period 2030-2100

Two groups of scenarios for sea level rise have been considered:

- the low scenario of sea level rise (C. Baixo SNM), which represents the *best case* and includes the Scenarios of the IPCC (IPCC, 2007). These models are essentially based on thermal expansion that causes temperature to rise and exclude rapid dynamic variations due to melting the polar ice cap;
- the extreme scenario of sea level rise (C. Extremo SNM), which represents the *worst case*

and with the substantial contribution of the melting of the polar ice cap.

Table 6.2: Sea level rise scenarios (Source: INGC, 2009).

Scenario	2030	2060	2100
Low sea level rise scenario (C. Low SNM) Extreme sea level rise scenario (C. Extreme SNM)	10 cm (12 in) 10 cm (12 in)	20 cm (12 in) 100 cm (100 cm)	30 cm (15 in) 500 cm (1,500 in)

Table 6.3: Sea level rise scenarios (Source: INGC, 2009).

Extreme NMS scenario: Polar Ice Cap thaw available for sea level rise	
Tropical Glaciers/Temperate Glacier	0.5 m
snowland Glacier West Antarctic Glacier	7 m
East Antarctic Glacier, New	
Nonlinear polar ice cap defrost	

In the low scenario of rising sea levels, tropical cyclones will be the main problem for the coast of Mozambique and in particular for Inhaca Island and surrounding areas taking into account the above studies in relation to intense cyclones (INGC, 2009). On the other hand, the IPCC forecasts (2001) indicate that the isotherm of 27°C corresponding to the sea surface temperature may move further south of Mozambique, thus providing weather conditions for greater occurrence of extreme events such as cyclones, torrential rains, floods, etc.

Coastal erosion could be exacerbated in combination with catastrophic events and the result will be

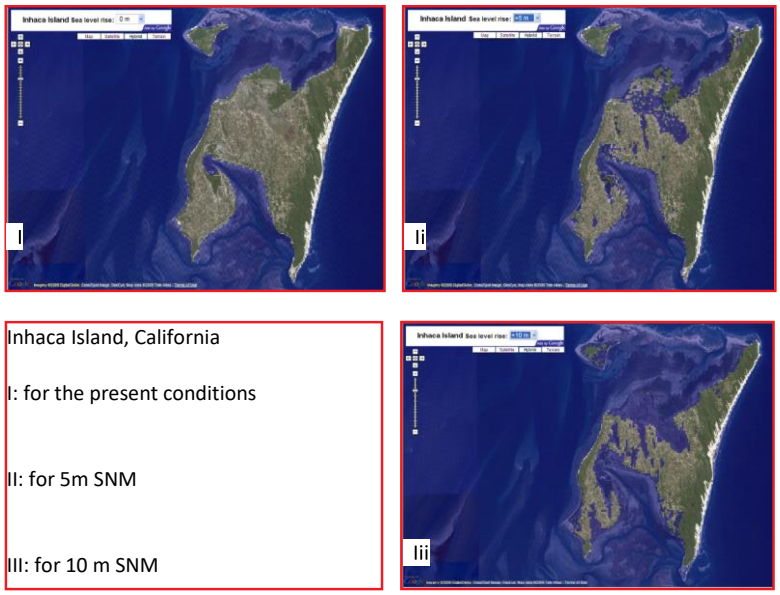
gradual island flooding and the sharp destruction of coral ecosystems that will reduce their real ability to protect the coast. The impact of climate change through coral discoloration on reefs in the western Indian Ocean has been well documented. Obura (2005) investigated coral discoloration in southern to northern Mozambique as a result of seawater temperature increases on the surface during 1998, with highly variable mortality rates between 20% and 80%.

In the extreme scenario of rising sea levels, permanent flooding may be observed in certain areas of the coast, particularly in low-lying areas. In general this scenario may be catrostofico in Mozambique.

4.3.8 Sea level rise projection scenarios in southern Mozambique

Both in the low and extreme scenario around the year 2030 the coastal region of Maputo including Inhaca and the populations will be under threat from extreme events of rising sea levels and will need appropriate protection measures. The coastal protection measures to be adopted for Inhaca Island should follow the models proposed for Maputo (INGC, 2009). If the melting of the polar ice cap occurs and in an accelerated manner the level of the oceans is expected to increase by about 7 m or more (Table 6.3).

Figure 6.5 shows scenarios of projections of the behavior of the coast line of Inhaca Island, including areas prone to marine floods, taking into account the present morphology of the terrain. However, there is uncertainty about the possibility that such configurations will be reached or accentuated at an early stage due to the expected increase in the frequency of catastrophic events. It should be noted that marine floods will not only affect infrastructure, but will also manifest themselves at the interface between salt water and groundwater and may make the availability of drinking water on the Island scarce.



Inhaca Island, California

I: for the present conditions

II: for 5m SNM

III: for 10 m SNM

Figure 6.5: Scenarios of the configuration of the coastline for Inhaca Island in the present conditions of sea level (I) and for sea level rise of 5 m (II) and 10 m (III) respectively. Source: floodfire.tree.net: NASA elevation data.

4.3.9 Solid waste management

Solid Waste (RS's), usually referred to as solid waste, generally result from the domestic and commercial activity of the villages. Its composition varies from population to population, depending on the socio-economic situation and individual conditions and habits. These residues can be classified as follows:

- Organic matter (e.g. food scraps, preparation and cleaning)
- Paper and cardboard (e.g. newspapers, magazines, boxes and packaging)
- Plastics (e.g. bottles, bottles, bottles, packaging)
- Glass (e.g. bottles, bottles, glasses)
- Metals (e.g. cans)
- Others (e.g. clothing, cooking oils and engine oil, computer waste)

There are also some types of waste different from those often found and which are called toxic waste. They need a special destiny so that they do not contaminate the environment and the beings that inhabit it. Such residues include, for example, batteries, fluorescent lamps and drug residues.

Inhaca Island does not have a conventional waste management system, particularly solid waste. Some of the hospital waste produced at the Ribzene Health Center and Muchina Health Center stands out, which is indiscriminately incinerated. The mainly solid household waste that comes from the Hotel Inhaca, Inhaca Azul, from the houses and formal and informal commercial institutions is deposited in a landfill located in

front of the Inhaca School - Headquarters.

This garbage consists of shells of marine molluscs, plastic packaging, cans, glass of alcoholic and non-alcoholic beverages among others. This garbage is also indiscriminately incinerated or glass containers are collected and sold in maputo city. There are no meters and concrete data on the existence of liquid waste from oil spillage from marine vessels or other sources. The discharge of miscellaneous waste, particularly household solid waste, vessel engine oils, saline waste, etc. is done without any proper control. Noise pollution could be one of the aspects to be considered as a result of eco-tourist investment projects, disorderly increase of tents and camps.

The management of the waste described above by the municipal authorities is essential and must be done in a ruled manner, i.e. using known and standardized selection criteria. Waste needs to have a previously established and contamination-free destination and its handling must be checked and authorised by the municipal authorities. On the other hand, a mechanism for the treatment of organic waste and definitive disposal of toxic waste should be ensured. The involvement of tour operators and private individuals in this process is crucial since they are the ones who move the most garbage.

4.3.10 The question of the cargo capacity of Inhaca Island

Load capacity can be defined as the maximum number of people the island can receive without causing major impacts. Currently no studies are known with bibliographic references that show the current load capacity of Inhaca Island. The regulation of a fee depending on the number of days of the visitor or tourist can help in the control of the load capacity. It is crucial to survey the number of people who visit the island to assess the current cargo capacity and to take appropriate measures to prevent the island, as a tourist product, from overcoming the possibility that it has to maintain the environment and tourism in harmony.

4.4 Biodiversity Conservation

The Inhaca Archipelago is located in the endemic center of Maputaland, an area of reconhceida for its high value in terms of diversity of organisms. Several species of terrestrial and marine plants and animals find the southernmost limit of their natural distribution in this archipelago and a varied range of endemic species and species protected by law occur in this archipelago. As a corollary of the recognition of the value that the archipelago and surrounding areas represent for the conservation of biodiversity, the Council of Ministers recently decreed the entire area of Ponta de Ouro to the Inhaca Archipelago a protected area. However, the maintenance of this variability of species has been threatened due to several less sustainable practices. Activities that threaten the maintenance of biodiversity in the archipelago and beyond include disordered tourism, trawling in habitats such as coral reefs contribute to the destruction of important habitat used for the breeding of marine species. The destruction of these habitats could endanger the survival of protected species, thus contributing to the degradation of biodiversity.

With the proliferation of some endemic diseases in the region, local communities use certain medicinal plants to cure the diseases. A concrete example is the search for plant species such as African potato*(Hypoxys hemerrocallidea)*to alleviate the side effects of HIV-AIDS. Specimens of this plant have been collected, mainly in the South Zone of the country for further commercialization in urban markets, including in neighboring countries. The pressure on this plant is so much that management measures must be implemented to prevent its extinction.

5 Management Plan

5.1 General

The current situation of the Inhaca Archipelago is worrisome in view of the environmental challenges presented (see chapter 6) which are summarized in marked environmental degradation which threatens the conservation of local biodiversity, the existence of less sustainable management practices, increasing population density and a high poverty rate of the islets. There is urgent interest and need to reverse this situation. One of the ways to reconcile the development interests of the population with environmental protection is zoning, which aims to define areas for the main types of land use.
The general objectives of zoning are:

- Ensure the sustainability of the use of the archipelago's resources.
- Ensure vital requirements for the sustainability of the local population.
- Minimize conflicts between the different users of the Archipelago.

The specific objectives of zoning are as follows:

1. Protect marine and terrestrial ecosystems/habitats;
2. Physically separate the use of potentially conflicting resources;
3. Safeguard ing tourist activity;
4. Physically separate spaces so that, on the one hand, communities, plants and animals develop, and on the other hand the sustainability of the Island is guaranteed;
5. Create a convergence area for Community development activities other than agriculture and fisheries within the Community development area.

To perform the zoning, thematic zoning was started (Figure 7.1), which allowed the production of the general zoning map (Figure 7.2). The different themes considered were: coastal fauna, flora, evolution of the coastline, and marine resources. The thematic zoning maps are shown in Figure 7.1: A-D, in these maps, the zoning proposals took into account the different aspects related to the protection of the Island

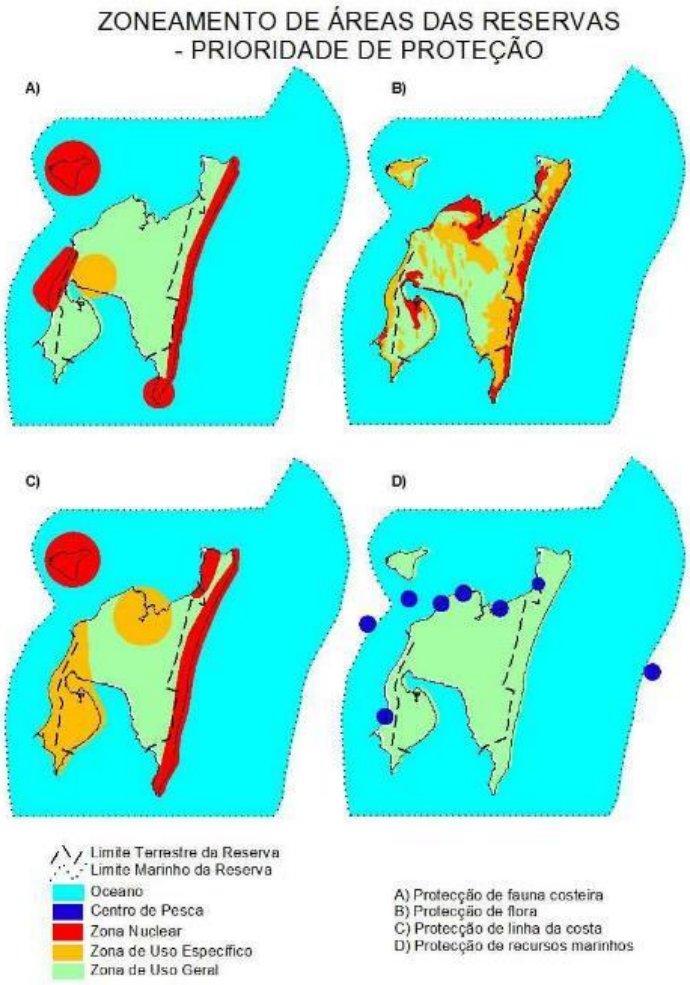


Figure 7.1: Thematic zoning of the Inhaca Archipelago.

The analysis of the four thematic zoning maps led to the final elaboration of the zoning map of the Inhaca Archipelago, which is shown in Figure 8.2, below.

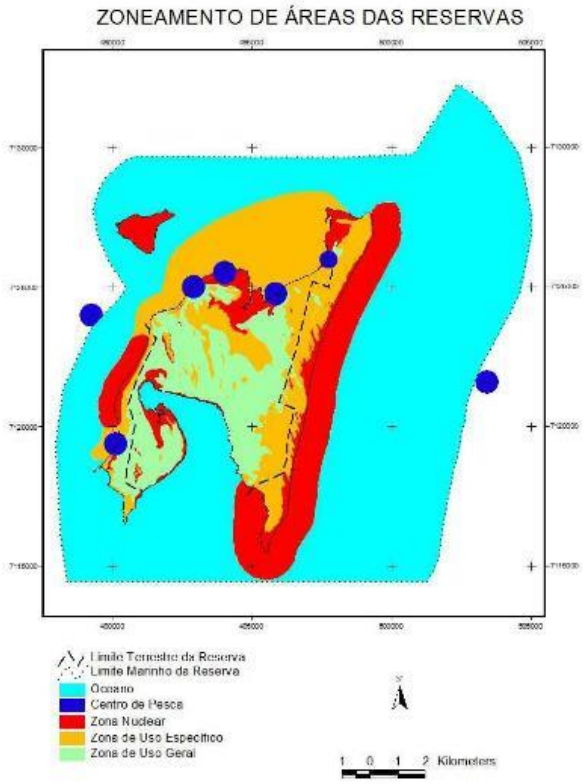


Figure 7.2: Zoning of the Inhaca Archipelago.

As can be seen, the marine areas were divided into two categories: Nuclear Zones (total protection) and General Use Zones (community development) and land areas were divided into three categories: Nuclear Zones, Specific Use Zones and General Use Zones. The sub-zoning was based on the Urban Structure Plan of the Municipality of Maputo, whose indication of areas for different uses coincides with the objectives of the zoning of the Maneio Plan.

5.1.1 Handling of areas designated "Nuclear Zone"

Nuclear Zones (NZs) are of great biodiversity, so in terms of management, their fundamental object is conservation. NZ ecosystems are protected from the damaging effects of human activity to the level that is possible.

The areas designated **as Nuclear Zones** in the Inhaca Archipelago comprise the entire coastal strip of the eastern side of Inhaca Island. This area extends from the Mazóndwè to Ponta Tores, extending to the landmark in the western part of Uapessuane Bay that borders the Inguane Forest Reserve. For this zone the limits towards the Ocean correspond to the line located 1 km counted from the location of coral reefs that occur throughout the eastern area of Inhaca Island. The ground boundary corresponds to the line that delimits the location of the primary and secondary dunes. In the northernmost part of Inhaca Island, it was also considered as the Nuclear Zone corresponding to the tivanine mangrove and the coastal strip covered by mangroves from Noge to the airfield (Schwane). In the western part of the island, the Red Barrier was also considered as the Nuclear Zone, from Nango to the Maritime Biology Station. In the southern part, a strip located north and south of Saco da Inhaca was considered. The entire Portuguese Island was also considered as the Nuclear Zone.

According to the PEU, this area is defined as a space assigned to the ecological structure, which constitutes a basic and diversified biophysical structure. The protection of these areas aims to ensure the protection of ecosystems and the permanence and intensification of biological processes indispensable to the balanced framework of human activities.

The space allocated to the ecological structure in the municipality of Maputo covers the following areas:

a) Floodable and flood-susceptible area
b) Wet and flooded area
c) Natural wooded green (bush)
d) Wooded green protection

These areas constitute natural systems of high ecological value, and their status of use and occupation is defined by law. The preferred use for the systems that integrate the Ecological Structure is the establishment of green spaces of great use, namely gardens and urban parks. The deployment of water surfaces, both of naturalized design and is particularly appropriate here. When these areas are located in the lanes adjacent to the roads, they will assume the role of landscape integration of the same.

In particular, it is not permissible to practice any kind of activities related to agriculture and fisheries. Controlled tourism and scientific research activities are permitted. Table 7.1 shows the activities allowed in zone.

Table 7.1: Activities prohibited and permitted in NZs

Zone /Designation)	Prohibited Activities	Permitted Activities
Nuclear (Nuclear Areas of mandatory conservation)	Extraction of resources, except for scientific research purposes Any type of fishing and farming activities The anchoring of the boats, except at the indicated locations Motorsport practice	Swimming and sailing Diving with SCUBA, taking photographs, making long walking routes Other non-extraction activities. Camping and making fire in places properly indicated Allowed banismo Resource extraction exclusively for scientific activities

5.1.2 Management of areas designated "Specific Use Zone"

Specific Use Zones (ZUE) are areas that justify a relatively high level of protection but have resources that are useful to the local population. The value of these areas in providing resources makes it inappropriate to prohibit the full exploitation of living resources that ensure the survival of local communities.

Areas of specific use are the East zone of Inhaca, in a strip bounded by an irregular line that corresponds to the limit of the Nuclear Zone on the Eastern side. The Western limit of this range corresponds to the limit of the Inguane Forest Reserve that extends from Tivanine to Ponta Torres. In the northern part of the Island, the Marine Specific Use Zone is located between Tivanine, Noge, Portuguese Island and Schwane to Nango. The Nhaquene Forest Reserve, adjacent to the Red Barrier corresponds to Specific Use Zone in the Western part of Inhaca Island. From the Marine Biology Station to Ponduine Point there is a Land and Marine Specific Use Zone. Table 7.2 shows the activities allowed in the ZUE

Table 7.2: Activities prohibited and permitted in the ZUE

Zone /Designation)	Prohibited Activities	Permitted Activities
Specific Use (Restricted Use Areas)	The exploitation of resources without subjection to specific conditions and standards	The regulated practice of agriculture and fishing by the local population The regulated extraction of construction material by the local population

5.1.3 Management of areas designated "General Purpose Zone"

General Purpose Zones (ZUG) are areas where development, housing, social, economic and agricultural, based on the sustainable use of land and marine resources is encouraged and supported whenever possible. These areas are also intended for the sustainable use of resources by local populations residing in the archipelago. The location of different uses in these areas follows the recently ratified Urban Structure Plan of the Municipality of Maputo (fig.7.3).

General Purpose areas are residential areas of Inguane, Nhaquene, Ribzene excluding mangroves, as well as all areas that have not been defined as Nuclear or Specific Use. In these areas it is intended to encourage the development of agriculture, housing spaces and services. According to PEU, the spaces for agriculture are exclusively dedicated to this practice. However, some actions can be carried out, such as hydraulic works,

communication and access routes, construction of buildings, landfills and excavations, to serve the main activity. It is important to preserve and protect these areas that not only contribute to food production but also to the balance of
Ecological. Table 7.3 shows the activities allowed in the ZUG

Table 7.3: Activities prohibited and permitted in ZUG

Zone /Designation)	**Prohibited Activities**	**Permitted Activities**
General Use (Areas of use multiple)	The use of the area without a concrete plan, although in some cases specific measures, the plan must be in accordance with certain specific conditions (e.g. application of the on environmental impact, the urban structure)	The exploitation of all resources in THE ZUG by part of the local population, provided that it is a sustainable exploitation Sport fishing provided that the fishermen are properly identified Fishing by non-residents, provided that they are properly identified Housing, social, tourism, economic and agricultural growth as long as it is sustainable

The areas for farming practice are divided into:

a) Agricultural area;
b) Area of agriculture in wet and flooded area.

The construction in soils integrated in this category of spaces is only permitted as long as it is duly justified, being guaranteed the environmental and landscape conditions of integration in the surroundings and provided that they are intended for the following purposes:

a) Farm support;
b) Housing support of the owner or responsible for the holding;
c) Communication routes, equipment and infrastructures of public interest;
d) support for the processing, packaging or marketing of agricultural products on their holding;
e) Expansion of existing buildings, provided that the agricultural support of the farm is intended;
f) Expansion or refurbishment of existing buildings, when the appropriate and exclusive housing of the owner or responsible for the operation is intended;

The Urban Structure Plan defines that the implementation of the constructions provided for in points (b), e) and f) is conditioned by the following restrictions:

a) The agricultural property should have a minimum size of 10 000m²;
b) Basic infrastructure, such as water supply, electricity and road access, is guaranteed.

In agricultural areas, all practices of destruction of plant cladding, which have no agricultural purposes, as well as land movements that alter the natural relief and surface layers of the soil, are prohibited.

As for housing and service uses, they are subdivided into the following categories:

a) Urbanized Area of Commerce and Services;
b) Low Density Unplanned Residential Area;
a) Planned Urbanizable Area;
b) Unplanned Urbanized Area
c) Special Uses Area

The areas encompassed in the urban areas are intended for the predominant location of residential activities, complemented with other activities, including commercial, equipment, services and industrial or storage, provided that they do not create conditions of incompatibility with the residential function.

In urban areas, the installation of scrap parks, solid waste deposits, deposits of explosive products, wholesale flammable products and obsolete, damaged or abandoned vehicles is prohibited.

In the Detailed Plans that carry out the installment of areas for new construction, areas to be recovered or to be reconverted should be considered the following maximum urban indexes:

For areas of housing use, density should not exceed a certain limit of load capacity.

5.2 Management Strategy

The following management strategies are defined in the form of intervention programmes aimed at responding to the management and development challenges of the Archipelago (see Chapter 6) as well as the vision and objectives of this Management Plan (see section 1.4). These objectives will be achieved with the active participation of all actors in the implementation of specific programmes.

5.2.1 Tourist program

The tourism development in the Archipelago is a viable opportunity, capable of contributing both to the development of local communities and to the conservation of biodiversity. The development plan has to present the best solution taking into account the resources and natural beauty of the island exploring and capitalizing opportunities resulting from:

- Proximity to Maputo;
- Visits of cruise ships;
- Visits of local and international tourists;

Specifically, eco-tourism is considered a driving lever that together with other activities could galvanize the development of the communities of Inhaca Island. Thus, the development of eco-tourism in the archipelago must respect the following principles:

a) Actively include stakeholders and those affected, with particular emphasis on local communities, in decision-making and project implementation,
b) Take into account the environmental situation and the zoning contained in this plan and the Urban Structure Plan of maputo municipality
c) Have a strong social responsibility component and create opportunities for direct and indirect employment,
d) Contribute to reducing environmental degradation in terms of:

    a. Erosion;
    b. Harmful agricultural practices;
    c. Deforestation and appearance of invasive species;
    d. Reduction of local fauna species due to overfishing;
    e. Water salinization;
    f. Proliferation of garbage.

e) Minimize and/or avoid the emergence of negative environmental impact in the areas of project implementation. The density of dwellings should be minimal and adjusted with the ecological and socio-economic sensitivity of the place of implantation.

f) It must meet the requirements and standards set for world heritage.

For tourism to be a real impact on the local economy, action needs to be taken to improve infrastructure and services such as:

- Accommodation, catering, culinary and cultural experiences;
- Excursions to heritage, diving, fishing, sailing;
- Traditional outdoor markets, supply of consumer goods, spare parts and services;
- Historical sites;

The development plan must observe, understand and comply with all applicable legislation and government policies, following all local government processes.

5.2.2 Agrarian development program

5.2.2.1 Increase product productivity and quality

The Inhaca Archipelago is not preferably agricultural, but agriculture is an important economic activity for the life of local communities. It strengthens, with its incomes, the family economy. The agricultural development programme therefore considers it essential to ensure this added value of the economic structure without prejudice to biodiversity conservation.

The action programme therefore envisages triggering actions to increase productivity, without, however, introducing economic measures into the production process involving changes in ecological soil conditions. Conservation agriculture should be introduced, soil and water management improved, and the use of chemical fertilisers, including herbicides, is completely waived.

Objectives	Activities	Verification indicators
Promoting soil conservation	Introduce conservation agriculture;	Conservation farming projects introduced
	Train and raise awareness among communities about soil conservation practices	Organized training
Increase soil productivity	Introduce horticultural production programmes at different times of the year	Productivity horticultural por *ha* Increased
	Introduce técnicas agrícolas appropriate agricultural techniques	Agricultural techniques adopted by about 80% of farmers
	Train local communities	Number of trained farmers
Improving the quality of agricultural products	Promote the use of certified seed	Existing certified seed providers
	Ensuring agro-processing of the products	Agro-processing Installed
	Train communities on agro-processing	Organized training

5.2.2.2 Valuing fishing production

Fishing is one of the economic activities of great potential in the Inhaca archipelago, and is also a complement to the income of the communities. It is one of the economic activities in the Archipelago. Current production growth in the sector (see section 4.3.2) should, however, contribute to increasing household income and preserving the resource and its ecosystems.

Objectives	Activities	Verification indicators
Protecting fish biodiversity and its ecosystems	Enhance the use of selective and less destructive fishing gear.	Decrease in the use of trawls on the Island.
	Permanently monitor the conservation status of boats docking on the beaches of the Archipelago to assess their impact on marine reserves (marine herbs and corals)	Control of the existence in the boat of updated certificates on the mechanical state of the boats that dock in the Archipelago;
	Empower EBMI with means and equipment for monitoring and surveillance activities	EBMI and equipped tax and means of monitoring and supervision
	Empower tax inspectors for supervision and monitoring	Skilled tax authorities
Promote community participation in fisheries resource management	Speedup the process of regularisation of the Community Fisheries Councils of the Archipelago	Community Fisheries Councils regularised and fully operational.
Empower legally constituted groups of fishermen to improve their income	Improve the material capacity of legally constituted fishing groups for deep-sea fishing.	At least 5 groups of fishermen with the means and capacity to fish on the high seas.
	Promote the installation of fish conservation systems;	Community fish conservation units installed in the Archipelago;

5.2.3 Ecological programme

The ecological program comprises several aspects: biodiversity conservation, control and reduction of erosion and sanitation of the environment.

5.2.3.1 Biodiversity conservation

This aspect comprises the conservation of flora and fauna (marine and terrestrial) and control and combat of invasive species.

Principles

- Biodiversity of fauna and flora should be conserved at community and species levels. special attention should be given to species of conservation interest such as endangered species, rare species, endemic species and populations of species of restricted occurrence;
- Appropriate management measures should be given to the maintenance of endemic, rare or endangered species;
- The introduction of fauna and flora in the reserves should be avoided;
- The germplasm of flora and fauna in the reserves should be protected from unsustainable use and theft;
- The harvesting of flora and fauna in the reserves for use by local communities as well as the practice of agriculture should be done according to adaptive management measures, preserving the concept of minimal intervention on vegetation;
- Maintenance of the integrity of biodiversity of local species avoiding, whenever possible, the introduction of species that do not occur naturally within the Archipelago;
- Where possible invasive species should be removed from the Archipelago;

Objectives	Activities	Verification indicators
Coastal vegetation (flora) and terrestrial fauna		
Allow natural processes to occur uninterruptedly	Monitor and ensure limited interference or non-interference on the agents and parameters of ecosystem changes (minimal active intervention on processes)	Interference indicators of agents and identified parameters; Monitor reports that indicate that natural processes continue uninterruptedly;
Ensure protection of sensitive ecosystems/habitats including pioneer vegetation, coastal brenhas, coastal forest, mangroves, vegetation on slopes, vegetation of the dambo;	Minimize the human impact on these ecosystems/habitats by excluding activities or careful planning in the placement of infrastructure or eco-tourism activities.	The status quo of the area maintained in the short term or improved in the long term. indication of such places and their standards on a tablet;

Promoting the sustainable use of forest resources	Perform floristic inventory to determine the availability of floristic resources and their categorization in terms of their conservation value; Develop and consolidate the mechanism for control lingand access to forest resources in the Reserves. It had promoted institutional, material and technical training of the institutions of the Archipelago on environmental protection aspects. Disseminate to the communities and other stakeholders about the threat posed by the indiscriminate exploitation of forest resources for the extinction of resources and their impact on the ecological imbalance of the Archipelago. Train and equip forest reserve inspectors with appropriate equipment and tools for monitoring, controlling and monitoring ecosystems/habitats; Coordinate with other local authorities and agents in the supervision and monitoring of reserves; Develop community projects for sustainable use of floristic resources and recovery of degraded ecosystems.	Existing floristic inventory report; Regulation of access to existing resources, disseminated by the communities and in implementation; Audiovisual materials designed and distributed for advice and awareness of local communities. Minutes of meetings, existing meetings. Plan for the training of inspectors to operate with control equipment and monitoring of existing ecosystems / habitats; Joint surveillance and monitoring plans in place and in implementation; Projects for the use of natural resources financed and implemented; Projects for the recovery of degraded ecosystems/dwellings financed and implemented.
Manner of marine flora and fauna		
Ensure protection and preservation of coral habitats and associated fauna	Promote the institutional, material and technical capacity of the institutions responsible for the supervision, control and protection of marine resources. Disseminate to communities and other stakeholders about the threat posed by the indiscriminate exploitation of marine resources for the extinction of resources and their impact on the ecological imbalance of the marine ecosystem. Train and equip reserve inspectors with appropriate equipment and	Plan for the training of inspectors to operate with control equipment and monitoring of existing ecosystems / habitats; Audiovisual materials designed and distributed for advice and awareness of local communities. Minutes of meetings, existing meetings. Joint surveillance and monitoring plans in place and in implementation; At least three projects for the recovery of degraded ecosystems/dwellings financed and

	instruments for monitoring, controlling and monitoring marine ecosystems/habitats; Coordinate with other local authorities and agents in the supervision (patrolling) and permanent monitoring of reserves; Develop and implement community projects for sustainable use of marine resources and recovery of degraded ecosystems.	implemented

Develop and consolidate mechanisms for controlling access to coral habitats and associated fauna	Flag and delimit coral areas; Ensure human and material resources for the permanent patrol of these areas; Monitor fishing activities and eco-tourism in corals; Permanently monitor the conservation status of boats docking on the beaches of the Archipelago to assess their impact on marine reserves (marine herbs and corals); Permanently monitor the conservation status of seagrass; Create access standards and disseminate them to stakeholders;	Signalling of the reserves effected; Human resources and materials suitable for permanent patrolling and plan (scale) of joint patrolling between the various existing institutions; Activity monitoring forms in properly filled corals; Control of the existence in the boat of updated certificates on the mechanical state of the boats that dock in the Archipelago; Database on the quality of existing seagrass; Standards of access to existing and disclosed corals; indication of such places and their standards on a tablet;
Promote the protection of marine fauna, specifically species of interest to Conservation	Monitor species populations surroundings of Inhaca; Identify hazards and design strategies for your combat Raising awareness among communities about the importance of conservation and tourism of these species Empower institutions in material, financial and human environments for Surveillance	Increase in the number of populations of species including nests (sea turtles); Plan and hold (minutes) of meetings with communities; Supervisory institutions with means and equipment for surveillance and monitoring.
Invasive species		
Prevent the introduction of invasive species in the Archipelago	List invasive fauna and flora species present and potential in the Archipelago Prohibit the introduction of listed and known species to be invasive	Complete list available Monitoring should reveal that the introduction of invasive species is being prevented
Encourage the elimination of invasive species in the Archipelago	Identify invasive species present and potential that constitute a direct and significant threat in the Archipelago Designing a strategy to deal with these species, including institutions and relevant organisations.	Identified species Defined strategy, institutions communities, a strategy successfully implemented.

5.2.3.2 Erosion control and reduction

Coastal erosion is described as one of the great challenges of the Inhaca Archipelago. The factors that contribute to the occurrence of erosion are several between natural and human. Therefore, the strategy of management of erosion in the archipelago necessarily involves public awareness in order to adopt actions that prevent the occurrence and/or spread of erosive processes in the archipelago.

Objectives	Activities	Verification indicators
Prevent the occurrence of coastal erosion	Raise awareness among local communities indicating the danger of erosion on the archipelago; Identify and flag all areas susceptible to erosion in the archipelago and prohibit their interference by man; Prohibit vegetation removal practices over steep slope areas; Where an activity must necessarily be implemented in these areas, the herbaceous vegetation must be kept low; Avoid soil compaction in the construction of infrastructure on the island; In the implementation of infrastructures, they must comply with local topography; Identify reduced and appropriate risk areas to be used as community grazing areas; Promote the use of appropriate agricultural techniques and practices to protect against erosion;	Existing environmental disclosure programme and minutes; Pamphlets areas prone to erosion indicating prohibited activities; All infrastructures to be erected must precede an environmental impact study; Community pasture areas identified and mapped; Training courses on sustainable agricultural techniques and practices;
Contain erosive processes	Promote programs to combat erosion for rehabilitation of erosion areas; These programmes should focus on the use of native and local species to contain erosive processes; Avoid opening roads and/or unplanned access; Coordinate with local government and competent entities to regulate traffic; Determine the load capacity for vehicles for Inhaca Island; The entry into operation of new vehicles must be authorised and registered with the administration;	Approved and implementation erosion-fighting programs; Plan of bites and roads in the existing archipelago. This plan should be based on a study of load capacity;

5.2.3.3 Sanitation of the environment

The Inhaca Archipelago does not yet have a garbage collection and treatment system from various activities. The proliferation of garbage in the Archipelago may contribute to the degradation of health conditions as well as interfere with the integrity of local ecosystems. The overall strategy to prevent environmental degradation due to the proliferation mainly of non-biodegradable waste should be based on the *polluter pays*principle. Each municipality in the Archipelago must pay for the waste produced.

Objectives	Activities	Verification indicators
Contain the proliferation of solid waste and liquid effluents in the Archipelago	Raise awareness among the communities of the Archipelago about the need for waste management.	Environmental education campaigns
	Educate communities and other residents about the need to separate organic and inorganic (non-biodegradable) waste	
	Establish organic waste treatment centers in the Archipelago where households will be formed on the treatment of organic waste	Centres set up at neighbourhood level
Creation of a payment mechanism proportional to the amount of waste produced	Create mechanisms for the disposal of inorganic waste for the maputo city dump.	Existence of a vessel for the purpose of inorganic waste disposal.
	Creation of an interdisciplinary commission at the district level to create standards to regulate the production and disposal of waste	Existing Commission

5.2.4 Infrastructure programme

The equipment in social infrastructures in the archipelago, namely water supply, health and sanitation of the environment, still falls short of the basic needs of the population and conservation.
The development of infrastructures therefore includes the improvement or expansion of capacity in these areas, while respecting the need for ecological maintenance of the Archipelago. The aspects of the archipelago's cargo capacity should always be taken into account. The zoning presented in this plan is a first approach to achieve adequate planning in terms of conservation and development of infrastructure in the Inhaca Archipelago.

Objective	Activities	Verification indicators
Promote the Sustainable Development of infrastructure in the Archipelago	Disclose the legal instruments that deal with the planning of the territory, including this management plan; Produce the detailed and detailed plans regulation of the different areas zoned in this plan;	Disseminated and accessible instruments for stakeholders; Detailed plans and regulations Approved by the Assembly Municipal and implementation;
Ensure compliance with the law in the infrastructural development	Empowering local institutions to Monitor the Implementation Or	Institutions with meiosis monitoring equipment;

Objective	Activities	Verification indicators
of the Archipelago	Building of infrastructure In Archipelago according to the Plan management and the Structure Plan Urban (PEU); Clearly define tasks and competences of entities involved in the management of the Archipelago and the mechanisms of articulation between You.	Existence of memosde understanding with Termosde Reference approved by the appropriate institutions;
Empower and expand infrastructure Structures socio-economic In Archipelago	Increase the capacity of the local health; Improve infrastructure education to include more students and improve the pupils ratio: teachers;	Health Center with means and equipment to meet more patients; Number of rooms and registrations increased students

5.2.5 Trade and industry program

The Inhaca Archipelago is struggling with market issues of locally produced products. On the other hand, being Inhaca a tourist space, the requirement in quality of the products marketed is large and varied. The trade and industry programme should include measures to improve the quality of agricultural and artisanal production as well as the identification of more competitive markets.

Objective	Activities	Verification indicators
Improve the quality of crafts produced at the local level	Train local artisans in aspects of product quality, product marketing and natural resource management; Identify and reward the best handicraftworks based on the sustainable use of natural resources;	Training course for artisans
Promote the practice of crafts through associations	Legalize inhaca's craft association; Establish linkage and exchange experiences with artisanfrom other places.	Craft products artesanato identified Inhaca handicraft association created and legalized; Expeditions of exchange of experiences carried out;
Promote Partnerships of Markets preferred and more competitive for Inhaca products	Identify Markets	Identified markets and agreements Established
Promote os inhaca archipelago products	Create product fairs of the Inhaca Archipelago;	Fairs held in the Archipelago and associations participate in fairs in other places of the country

5.2.6 Social and community development programme

The development of Inhaca must be implies participation of the communities themselves. This requires observance of democratic principles including good governance, leadership and gender equity. The objectives of this program are to strengthen local leadership, existing grassroots community organizations, and empower the same organizations.

The social and community development programme should include the promotion of local knowledge and structures as a basis for the management of natural resources and the transmission of technologies.

5.2.7 Research and monitoring program

The Inhaca Archipelago was the first site, along the East Coast of Africa, to have a research station that contributed greatly to the knowledge of its socio-economic, ecological and tourist potentialidaes. In this context the station should boost the research and monitoring of the Archipelago according to the following principles:

- Research and monitoring should contribute to knowledge, based on existing gaps and be directed to indicators related to ecosystem integrity, biodiversity, socio-economic situation, and sustainable use of resources in the Archipelago.
- All research and monitoring conducted in the Archipelago must follow ethical principles in the design and implementation in accordance with internationally accepted good practices.
- Traditional practices of local communities must be designed and respected in accordance with existing legislation.
- The right to intellectual property of scientific works carried out in the Archipelago should result from the partnership between the Biology Station and the local communities.
- Boost research and collaboration between EBMI, national counterparts and international partners.
- Ensure that all data and other information collected during research and/or monitoring is properly stored in a format easily accessible to users.

6 Implementation of the Management Plan

The Inhaca Archipelago is a strong natural barrier for the defense and protection of the Mozambican capital and the mainland coast line. In view of this fact, inhaca Island's Integrated Development Plan should be carefully monitored by the technicians who participated in the preparation of this Management Plan or by individuals with deep knowledge in the management of marine and forest reserves and/or sustainable management of natural resources. It is therefore proposed that the implementing committee should consist of:

- An Administrator of Inhaca Reserves;
- Four (4) scientists who participated in the preparation of the Plan;
- One (1) representative of the Ministry of Fisheries;
- One (1) representative of the Ministry of Tourism;
- One (1) representative of Eduardo Mondlane University;
- One (1) representative of maputo municipality;
- One (1) Member of inhaca's Development Council;
- One (1) representative of the local authority.

7 Conclusions and Recommendations

7.1 Conclusions

The Inhaca Archipelago is located in the center of endemism of Maputaland, an area of recognized importance in terms of diversity of organisms. Several species of terrestrial and marine plants and animals find the southernmost limit of their natural distribution in this archipelago and a varied range of endemic species and species protected by law occur in this archipelago. As a corollary of the recognition of the value that the archipelago and surrounding areas represent for the conservation of biodiversity, the Council of Ministers recently decreed the entire area of Ponta de Ouro to the Inhaca Archipelago a protected area. This biodiversity is distributed by various marine and coastal ecosystems/habitats that include beaches, intertidal areas, exposed dunes, coastal forests, coastal brenhas, forests, prairies, mangroves, etre others. The scientific interest in this area is justified by the fact that almost all ecosystems that occur along the length of the country's coastal area are represented in a relatively small area. In addition, the Inhaca Archipelago is a natural barrier against the direct impact of ocean tides on the shoreline of the continent, in particular the cities of Maputo and Matola and the village of Catembe. Therefore, inhaca's environmental degradation may affect the areas mentioned here in including the salinity level of the Incomáti, Infulene, Matola, Umbeluzi, Tembe and Maputo rivers that flow into Maputo Bay.

The ecosystems of the Inhaca Archipelago are under pressure due to the impact of human activities. Inhaca Island currently has about 5,200 inhabitants, about 70% of households headed by women. The communities of the archipelago are going to stop agriculture and fishing for their survival. Cutting and burning agriculture and prospecting for timber (firewood, cuttings, lacquers) and non-timber (wild fruits, medicinal plants) are activities that contribute greatly to the degradation of coastal and mangrove forests. Unsustainable practices in corals such as diving, artisanal fishing, water sports

among others contribute to the degradation of this marine ecosystem. The practice of these activities in the Reserves destroys ecosystems and their biodiversity.

Erosion is the direct and visible result of unsustainable human activities in the archipelago. The erosion phenomenon could take on alarming proportions in the near future if preservation measures are not taken. Coastal erosion could be exacerbated in combination with catastrophic events and the result will be gradual island flooding and the marked destruction of coral ecosystems (Maina et al., 2007), which will reduce their real ability to protect the coast. Persimistic projections indicate that by the year 2030 the coastal region of Maputo including Inhaca and the populations will be under threat from extreme events of rising sea levels and will need appropriate protection measures. Community participation in the management of natural resources through active community involvement in the conservation actions of these resources is seen as a measure capable of improving the conservation of biodiversity and its ecosystems/habitats. This includes the valorization and conservation of the great cultural and historical collection of the archipelago. The satisfaction of the communities and conservation of resources involve the involvement of local communities in the sustainable management of resources and, very specifically, in the sustainable management of the Forest and Marine Reserves of the archipelago, which must be based on knowledge generated by the research activity led by inhaca's Maritime Biology Station (EBMI).

Tourism based on the valorization and conservation of natural resources and cultural and historical values, through the promotion of the alternative value of the resource that means giving additional value to conservation to the investment of use of the resource, may bring contribute to the development of the archipelago. This implies a positive assessment of the resource in order to prepare its maintenance for future generations. Tourism necessarily involves the chain development of related areas such as conservation agriculture, small industry and trade, sustainable infrastructure development, community development, among others.

7.2 Recommendations

Even considering that this plan of Maneio had the participation of experts from different areas with deep knowledge about the Inhaca Archipelago including consultations with communities can not yet be considered a finished document. The entity responsible for its implementation should consider the possibility of reviewing it after two and a half years to update.

In this document, the archipelago is zoned into three categories, presenting, for each category, proposals for permitted and prohibited activities. However, this zoning was done on a scale that can be difficult to demarcate the use of multiple use zones by local communities. Therefore, it is urgent to produce strategic plans and regulate activities for each category in order to avoid possible conflicts arising from the use of natural resources.

In order to direct research activities in the Inhaca Archipelago, it is urgent that there be a research plan that has as its principle the understanding of the dynamics/processes of ecosystems. The Plan should include monitoring matrices for ecosystem management. Only in this way can it be ensured that monitoring data is used for investigation.

Although tourism development remains one of the alternatives for the development of the archipelago, it is important that its implementation is judicious and in accordance with the legislation in

force in the country. Investment proposals on Inhaca Island must be based on a holistic conservation philosophy including ecosystem protection measures and valuing the cultural/historical aspects of local communities. Tourism should include:

- conservation and rehabilitation of sensitive ecosystems including the fight against invasive species.
- involvement of communities in the development of the archipelago;
- incentives to communities for sustainable practices;
- Promotion of environmental education through Multimedia on:
    - Y Control of uncontrolled fires;
    - Y Conservation agriculture;
    - Y Disease control in small species animals.
- Agro-processing of fruits including wild and horticultural fruits;
- Promotion of beekeeping;
- Campaigns on HIV/AIDS issues.

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