



The preservation of marine biodiversity in West Africa, the Case of Cape Verde Islands: proposal of a new biodiversity policy management

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Summary

Despite the low contribution of fisheries to the GDP in Cape Verde they play a strategic social and economic role. This sector provides a 26.2 kg/ per capita consumption of high quality protein and employs, approximately 5.2% of the economically active population. However, in spite of the last decade increase of the fishing effort, landings stand for around 9.000-10.000 ton per annum. Besides, linked to the decrease of tuna and small pelagic fish captures, stocks of demersal species (lobsters, cephalopods, and fish) are overexploited. Currently, near shore artisanal fishery has almost disappeared and in fact it has moved more than 10-20 nautical miles off the shore and in deeper grounds. Parallel to fisheries, the rapid coastal development (industry and urbanism) and tourism, are putting further pressure on marine resources and their environment. The current treat of these activities aren't only a real challenge for both conservation and sustainable use of marine and coastal ecosystem, but also a threat to national food security. In the meantime, in addition to updated conservation measures, new environmental policies and the actualize legislation, as well as alternative ways of use of marine resources are investigated. Marine biodiversity in the archipelago is full of emblematic species: more than 17 cetaceans, 5 marine turtle's species, high rate of endemic marine invertebrate, important populations of whale shark and one of the most interesting in the world to sport fishing species, blue marling populations are found in the archipelago. Among marine habitats corals and sea mountains are worth mentioning, but much more remains unknown. Therefore, studies have been undertaken with regards to governmental orientations demanding the increase in added value for the use of marine and coastal environment and its resources. Protected areas are widely known to be among the most effective means *in situ* conservation of biological diversity and for this purpose the creation of MPAs is a priority. The Santa Luzia, Raso, Branco, Sal, Boavista and Maio MPA's complexes have been created this last 10 years. These areas concentrate representatives to the archipelago of marine biological diversity and also important fishery stocks and nursery grounds. MPAs can be a tool not only for the conservation of biodiversity and management of fisheries stocks but also, for as much as possible harmoniously integrate the developing human populations and tourism in the local natural environment. The widespread experience from many countries, show that in protected areas often generate significant revenue making significant



contribution to local economies. In this way, marine biodiversity can objectively be a source of economic benefit for a sustainable development of the Cape Verde islands. Though that, on the basis of correct planning, marine and coastal biodiversity represent a big potential and can contribute to the sustainable development of the country, providing goods and services. Given the existence of a very important marine and coastal biodiversity in Cape Verde, in comparatively good conservation shape, as well as the existence of the tourism as a key sector for the development of the country, we propose a biodiversity conservation model for the Cape Verde based on educational and ecotourism activities, further benefits for local community and concerned institutions.

Introduction

The 10 islands and 8 islets of Cape Verde (14°23 to 17°12 N; 22°40 to 25°22 W) constitute a small archipelago about 600 km west off the coast of Senegal. Cape Verde belongs to the group of volcanic islands known as Macaronesia region (Azores, Madeira, Canaries, Salvages and the North East coast of West Africa, from Morocco to Senegal). The total area of Cape Verde archipelago is 4 033 km², consisting of a northern ('Barlavento', i.e., windward) group of islands and a southern group ('Sotavento', i.e., leeward). The islands are of volcanic origin, rising from a depth of at least 3 000 m, and the continental shelves, generally narrow and irregular, are limited to a total area of 5 394 km² [1] The eastern islands Sal, Boavista, and Maio, form one system with a more extensive continental shelf compared to the other islands. Although the continental shelf area is of limited area, the EEZ of Cape Verde covers an area of about 789 400 km², much of which is not exploited by the national fisheries.

The archipelago is situated in the southern part of the Canary Current System. Although, the waters arriving at Cape Verde are generally cold ($\leq 23^{\circ}\text{C}$), they transport nutrients from the upwelling areas in northern Africa, creating favourable conditions for primary production around the islands most affected by this north-eastern current [2]. During the period from July to November, changes occur in the intensity and position of the St. Helena and Azores anticyclones, resulting in a predominantly southwestern current along the southern islands, thus causing warmer waters to reach these southern islands. These warmer waters (24° - 27°C) create the necessary conditions for pelagic fish such as tuna [2].



More than 90% of the Cape Verdean resident population (450.489 inhabitants in 2002; [3]) is settled in the coastal areas, and most of the socio-economic activities (fisheries, tourism, industrial activities) are closely linked to the sea [4].

The current state of many important fisheries resources world-wide can be characterised as seriously depleted or in danger of depletion due to poor management practices and fishing pressure (e.g., [5]; [6]). Unsustainable fishing practices coupled with an excessive level of investment in fishing capacity have resulted in serious degradation and low yields in the stocks of developed countries, creating new pressures on the resources of developing countries.

The growing importance of the tourism industry has, over the last years, attracted the attention of most governments around the world, and particularly those of developing countries. Tourism that is respectful of the environment and the well-being of local people, i.e. ecotourism, should be encouraged and promoted [7]. However, the numerous negative impacts of mass-tourism could involve a drastic decrease of biodiversity (e.g. [7, 8]).

In the following, characteristics of fishing and tourism activities are discussed at an economic and ecological (i.e. impact on biodiversity) point of view. The next sections provide a brief overview of marine and coastal conservation processes in Cape Verde and review MPA settlement as tool for marine biodiversity conservation and fishery management in the frame of the regional program for the conservation of the marine and coastal environment (PRCM).

The Fisheries and fishing resources

Fishing is a strategic source of animal protein providing a 26.2 % of the per capita consumption in 2000; it also provides 5.2% of employment to the economically active population [9]. According to data from the last general census carried out in 2005 (still provisional) in the 77 disembarkation ports, this activity involved the use of 1,036 artisanal fishing boats by 3,087 fishermen, most of whom (46 percent) operate in the islands of Santiago and Sal.



Despite its wide EEZ, the Cape Verde potential of fishery resources is estimated at 36 000 to 44 000 tones [9]. The country's fishery resources can be considered generally under fished, although resources such as lobster, which are costly demersals, are considered fully or even over tapped. [16]

During the last decade, the fishing efforts increased considerably, but landings have maintained average annual captures around 9 000 to 10 000 tons per year, and the catch of the national fleet in 2006 being estimated at 9,950 tons. Fishery catches are dominated by large migratory pelagic fish, mainly tuna fish and sword fish, and small pelagic fish, mainly horse mackerel (Tab. 1) accounting for approximately 60 to 70% of the landings [10]. Among the invertebrates, lobsters and cephalopods are important (octopuses, scuttlefish and squids). The others resources are crustaceans, molluscs, coral, and sharks. The export of tuna fish, processed fish, and live lobsters contributes to the balance of payment. The lobsters were the most valuable source of incomes in 1993: deep sea and coastal lobsters export was worth around \$1 million and \$242,000 USD respectively [11] but in some islands their exploitation is not economically profitable any more.

The contribution of the fisheries sector to the GDP has progressively diminished between 2000, and 2005, representing only 1.1% of the GDP in 2007 (Tab. 2) [9]. The sector's contribution to the GDP is yielded only one percent in 2007 [57]. The contribution of the artisanal fishery to total landings was always greater than industrial fishery: 64% and 36% respectively.

Artisanal fisheries

According to the INDP, in 2001 [12], the artisanal fishing fleet was composed of 1 257 vessels (929 motorized boats). The total number boats decreased between 1995 to 2000 but the ratio of motorized boats increased from 69% to 74% in the same period (Tab. 3). Between 1994 and 1998, the number of fishermen was around 5 500 but had reduced considerably after 1999, to reach 4 283 in 2001 (Tab. 3). The main fishing gears are the handline, the beach seine, the seine net and the gillnet. Some other fishing gears are also



used: pots for the capture of spiny lobsters in deep waters and SCUBA diving to catch spiny lobsters and the cephalopods in shallow waters. Today sportive fishing is less a sport than a new way to commercially target demersal species, with the help of SCUBA diving. As a result, it becomes a highly threatening fishing technique and new species are fished, like molluscs (*Strombus latus*) and limpets. These intensively exploited species in the Barlavento region face a dramatic depletion due to the over-fishing [12]. The artisanal fisheries yield in average 37 kg per catch, i.e. 4 tons per vessels by year or 1.3 tons per fisherman by year. In 2001, 5 649 tons of fish were landed, of which 41% of tuna fish, and 33% of other pelagic fishes.

Industrial fisheries

Concentrated in the islands of S. Vicente, Sal, and Santiago, the industrial fishing vessels use mainly poles with living baits and handlines to catch tunas, lobster, and small pelagic fish. In 2001, the industrial fishing fleet was composed of 726 active fishermen, divided into 66 boats [12]. The main species targeted by the industrial fishing are: *Thunnus albacares*, *Thunnus obesus*, *Katsuwonus pelamis*, *Euthynnus alletteratus*, *Auxis thazar* and *Acanthocybium solandri* [13]. In 2006 the total catch was 4,048 tons, 35 percent of which was tuna and 73 percent pelagic fish. Lobster represented only one percent of the total catch.

After 1992, due to the introduction of 11 m length boats equipped with seine nets, the small coastal pelagic fish yielded more than tunas. However, the landings are decreasing since mid 90s. The demersal coastal fishery has almost disappeared in most populated islands, and in coastal waters lobsters, molluscs and other valuable invertebrates are under strong pressure. The lobster fishery was already defined as commercially not viable in 1980 around the Sal Island [11]. The fishery sector stakeholders agree that collapse of fish landings is due to the abundant foreign industrial fleet and uses of illegal, threatening and destructive fishing methods. In addition, at the local level, the free access to different fishery resources, the systematic fishing, with no interruption during the spawning season for stocks as small pelagic, demersal and others species are the main concerns. In 2002, a



total of 112 foreign fishing vessels were authorized to fish in the EEZ of Cape Verde; more than 90 percent of these vessels came from the European Community. Less than 10 percent declared their catches in the EEZ (National Directorate of Fisheries, pers. comm., 2005) but this value was probably under-estimated because Cape Verde authorities are not able to control these foreign vessels. At a larger scale, all the West African fisheries resources are considered as overfished ([5], [14-15]).

Fishery product exports declined between 2000 and 2003 mainly because of the embargo imposed by the European Union in 2000. But once Cape Verde was placed, in October 2003, on List I showing countries authorized to export to the European Union, in 2004 fishery product exports totaled 353 tons, valued at Esc 109 million (near 1200000 US Dollars); this increased sharply in 2005 and 2006 to 9,124 tons and 15,707 tons respectively [12].

Tourism sector

Cape Verde has experienced robust economic growth in recent years. GDP increased by 5.7 percent during the period 2000–05, reaching 10.8 percent in 2006, and for 2007. Economic growth is propelled especially by strong growth in the tourism, telecommunications, financial services, civil construction, and fishing sectors [16].

The contribution of the tourism to the national economy is in constant progress: 12.5% of the GDP in 2005 and 18% of the GDP in 2006 and 2007[57]. Tourism now stands out as a main economic activity for Cape Verde and represents 70% of the external investments. In terms of Foreign Direct Investment (FDI), the volume of approved projects, preponderantly in the tourism sector, went from about US\$44 million in 2004 to about US\$509 million in 2006 and creates 9,427 jobs. In 2006, FDI in the tourism sector contributed about 37.9 percent to the real GDP growth rate; revenue represented 18 percent of GDP in 2006, compared with 12 percent in 2005, as a result of the 23 percent increase in the demand for Cape Verde as a tourist destination.



Between 2000 and 2007, the number of beds and nights showed respectively a 30.8% and a 20.9% increase. The number of tourists increased from 145.076 in 2000 to 312.880 in 2007, with an annual increase of more than 20%. The hotel offer rose from 1.825 rooms in 1999 to 5.368 rooms in 2007. In 2012, the hotel offer should reach approximately 15 500 rooms [58].

As one important economically expanding sector (20% annual flow), tourism has been strategically designed by the State as generator of economic benefits for the country development, creating employment and improving the professional profile of the sector working forces [17]. Tourism sector also allows the enhancement of natural resources and culture added value and, in this way, it contribute to the Sub-region development (NDP, National Directorate of Plan, pers. comm., 2007). However, tourism does not yet significantly contribute to the national economy, it is still generating little employment (0.4%), with no contribution to the balance of payment, and provided no benefit to local populations (National Directorate of Plan, pers. comm., 2007).

The generally unnoticed but direct tourism bias towards its development on environmentally sensitive areas raises awareness towards the attention to be put to their future impact and trends. Biodiversity concentration areas are major hotspots in Cape Verde, where mass tourism and marinas are targeted. Not less dramatic is the 30,000 beds tourism project to be initiated in the island of Boavista, the most representative in terms of biodiversity site in the country. In some islands, namely Boavista and Sal, one can notice an increasing number of tourism infrastructures in the coastal area. Some constructions do comply with the minimal distance of 80 m from the coastline [18]. Nevertheless, tourism suffers from a certain weakness due to lack customers and tourist product. The Government is preparing a Tourism Master Plan that should clarify how the country's development strategy will pursue tourism development, what kind of tourism should be pursued [57]



A brief characterization of the marine biodiversity of Cape Verde islands

Oceanic nature, insularity, isolation and stressing climate conditions are among characteristics delimiting Cape Verde natural resources richness. Among marine species several species are reported as emblematic: marine mammals, marine turtles, marine birds and sharks. The level of endemism is high within benthic invertebrates [19-20]).

Concerning the fish, the fish fauna inventory of Cape Verde reported 639 species [21]. The main emblematic fish species are manta (*Mobula* sp.) and whale sharks, *Cetorhinus maximus*, mainly observed between Sao Vicente and Sao Nicolau islands [22].

More than 17 species of whales and dolphins are reported, [23]; [24]). For Jann et al. [24], the humpback whale (*Megaptera novaeangliae*) population of North Atlantic use the Cape Verde archipelago as a breeding area. Sperm whales are still fairly common around the island of Cape Verde [25].

Five species of marine turtles are also reported [26]: *Caretta caretta*, *Chelonia mydas*, *Eretmochelys imbricata*, *Lepidochelys olivacea* and *Dermochelys coriacea*. The *C. caretta* population is the most important nesting population in the West African eco-region and one of the world's largest [27]. Marine turtles are regularly accidentally killed by drifting nets, as elsewhere in the world [28], but in Cape Verde hunting by free diving is not infrequent [29].

Nearly 50 species of the marine gastropod genus *Conus* are endemic to the Cape Verde archipelago [30]. This unusual concentration of endemic species within a single set of oceanic islands is extremely uncharacteristic. The Cape Verde archipelago hosts 10% of the worldwide species diversity of *Conus* [31,32]. Of the 52 described species of *Conus* in Cape Verde, only three (*C. ermineus*, *C. genuanus*, and *C. tabidus*) are non endemics [33].

Birds in general and especially marine birds [34] are among the best studied species in Cape Verde due to the great importance of the archipelago as pathway during migration



(130 species) or as nesting area (40 species) [35]. Four marine bird species are threatened of extinction: *Fregata magnificens*, *Sula leucogaster*, *Calonectrix edwardsii* and *Phaethon aethereus mesonauta* [34-35]. Alarming is the local habit for consumption of marine birds: in summer 2004, more than 8000 individual endemic species *Calonectrix edwardsii*, were reported to had been slaughtered in the Raso islet, North West of the archipelago (fishermen pers. comm.).

Surprisingly, a recent global study of coral community endemism, biodiversity, and threats identified the coral reefs of Cape Verde as one of the world's top 10 coral reef hotspots of biodiversity [36].

The marine and coastal conservation processes in Cape Verde islands

Since the national independence in 1975, five national development plans were elaborated. During the First Republic (1975-1990), the guidelines mainly benefited the rural development, while privileging the fight against desertification through programmes, and of building up of soil and water conservation structures, while promoting, at the same time, the productive work. The political openness in 1990 led the country to the first multi-party elections and to the political orientation change. The Program of 2nd Republic (1991/1996) maintained the programme for the environment, with important differences in terms of political content: the Government recommended the protection and preservation of the environment and natural resources, while underlining that a stable ecosystem was essential to the development and to the quality of life of the Cape-Verdean citizens.

The Government of the Third Republic (1996-2001) has given an important place to the environment. By the first time, the sea and coastal environment was treated as an important ecosystem for Cape Verde: "The sea environment and the coastal areas of our country will be treated as a coastal ecosystem. A coordinated strategy will be defined with the prime role of preservation of the natural resources and balance of the environment, and the promotion of a sustainable and harmonious development of the coastal zone".



The Government has then proposed: (i) the implementation of an integrated management of the coastal area and its resources; (ii) to prevent marine pollution; (iii) to reinforce surveillance of the coastal area; (iv) to set up protected zones and marine resources; (v) to update and disseminate the legislation concerning the protected species.

Considering the importance of the environment for the Government, the Executive Secretariat for the Environment, a national institution in charge of the ecological and environmental policy was created. This structure gave light to the current General Directorate for Environment in 2002. During this period and as a result of the accession to the Convention on Biological Diversity, by resolution n°73/IV/94 of October 20, 1994 and its ratification in March 29, 1995, the national Strategy and the action plan for Biodiversity were elaborated and approved since 1999. During the same period, a series of initiatives aiming at Biodiversity conservation of the marine and coastal areas were identified: (i) National Research Program of Marine Biodiversity Conservation; (ii) National Research and Marine Biodiversity Conservation Programme (2002-2006 ; financed by the Netherlands); (iii) Project « Cabo Verde Natura 2000 » (1999-2001): coastal planning and natural resources management and first proposition for the creation of a network of protected area in Cape Verde; (iv) Coastal Zone Management Project (2004-2008): setting up of a policy of utilization and management of the coastal area.

With the support of Netherlands, in 2003 and following a participatory approach, the Second National Environment Plan (PANA II) was elaborated for the period 2004-2014. The participatory process established with the elaboration of the PANA II during 2003-2004 was a good framework for producing sectoral and municipal environmental action plans, for providing the framework for future development and strengthening of the national environmental politics involving a broad range of stakeholders. An inter-sectoral Biodiversity Plan and a Fisheries management Plan were elaborated. The conservation of the maritime resources was recognized by the PANA II and the Government as a key priority for the sustainable development of the country.

In April 2000, a regional workshop of various stakeholders of the coastal zone, took place in Saint Louis (Senegal) to reflect on the wide conservation priorities in West Africa. The



four international organizations for conservation intervening in the sub-region, namely FIBA, UICN, WWF and Wetlands International, decided to join their efforts within the Regional Program for the Conservation of the Marine Coastal Zone of West Africa (PRCM). Cape Verde has adhered to this program in March 2003.

In September 2004, in the framework of PANA and PRCM, the Marine and Coastal Conservation Project have been initiated. The first aim of this project is the marine and coastal conservation and the capacity building of the institutions (Cape Verde's central government, municipalities and local NGO's) to manage marine, coastal and wetlands biodiversity effectively. The expected outcomes of the project can be stated as follows: (i) national legislation and international biodiversity conventions, which strengthen the protection of marine, coastal and wetlands biodiversity adopted; (ii) environmental planning and management capacity of target municipalities and NGOs strengthened and applied; (iii) environmental planning and management capacity of key sectoral ministries strengthened; (iv) selected key species and habitats protected and monitored. Consequently, two MPAs have been put in place (Santa Luzia and Murdeira), as well as management plans for the wetland and the preservation plans for the threatened species.

The PRCM approach and values of the marine biodiversity

On the whole, the West Africa eco-region is internationally important as one of the major fishing zones worldwide [14], but also as natural sanctuary for marine biodiversity [37]. The intensity of human pressure on marine systems has led to a push for stronger marine conservation efforts. Recently, marine reserves have become one highly advocated form of marine conservation, and the number of newly designated reserves has increased dramatically [38]. Reserves will be essential for conservation efforts because they can provide unique protection for critical areas, a spatial escape for intensely exploited species, and potentially act as buffers against some management miscalculations and unforeseen or unusual conditions [39]. The best way to conserve marine diversity is to conserve habitat and landscape diversity in the coastal area. However, reserves are insufficient protection alone because they are not isolated from all critical impacts. Consequently, marine



protected areas are only a part of the conservation strategy needed [40]. Then, the already ongoing regional MPAs network strategy emerges as promising instrument to sustain fisheries and protect biodiversity. In such context, the regional program for the conservation of the marine and coastal environment (PRCM), in parallel with its NGOs (WWF, UICN, FIBA, WI), rises as technical support, and as catalysers of the whole region participation, not only in the training but also for the development of participatory and conservation management skills. It is also a prominent factor for the design processes of concrete proposals for policy conservation, at not only the regional but also national and local levels. Evidence on the importance of the Santa Luzia MPA as nursing grounds have been confirmed through scientific studies [13, 41] and fishermen interviews by one of the authors (November 2004). Similarly, the MPA of Murdeira has confirmed the important ecological value in terms of reproduction zone, presence of rare and endemic species [42].

Funding and the lack of institutional infrastructure are the major limiting factors for fully implementing MPAs. Thus, the lack of conservation efforts in the past, and later, the inadequate financing for conservation has resulted to depletion and even destruction in many of the MPAs [43]. Dixon and Sherman [44] highlighted that “for various economic reasons that economists call market failure, the benefits of protection and conservation are only partly accounted for whereas the costs of protection receive thorough coverage. As a result, fewer (and smaller) areas are protected than is socially desirable. And because governments find it difficult to capture these benefits, budget allocations for management of protected areas are frequently inadequate.”

Economic valuation can be defined as the attempt to assign quantitative values to the goods and services, which include ecosystem services, provided by environmental resources as biological resources or biodiversity, whether or not market prices are available to assist us. From the economist’s point of view, the economic value of any good or service is generally measured in terms of what we are willing to pay for the commodity, less what it costs to supply it [43].

A major reason for the excessive depletion of biological resources is often the failure to account adequately for their non-market environmental values in development decision-



making. Many environmental resources are complex and multi-functional, and many of the benefits or values of natural or managed environmental resources are generally ignored in private and public development decisions.

Sustainable use of Marine Biodiversity and its potential contribution to the country economy

Tourism is now a primary source of income in many developing countries and frequently exceeds the value, particularly the foreign currency value, of marine fisheries in those nations. Well-managed marine protected areas are often major tourist attractions [39]. Visitors may be attracted by opportunities for snorkelling, SCUBA-diving or whale watching, to hire boats or to take boating tours to enjoy the natural beauty of marine protected areas [45]. The establishment of a marine protected area with a “no-take” reserve is an excellent way to raise the profile of an area for marine tourism and to broaden the local economic options. It is important that the introduction and development of tourism is carefully planned to ensure that it is acceptable and sustainable in terms of impacts on local human communities as well as the ecosystem. Well-managed tourism to MPAs can be a major source of income and pride for local communities, as well as for governments.

There is now widespread experience from many countries to show that protected areas often earn significant revenue and make an important contribution to local economies. For example, in 1991 Costa Rica spent about \$US12 million to maintain its national parks, but foreign exchange earnings were more than \$US330 million from 500,000 overseas visitors. Park-generated income made national park tourism the second-largest industry in the country [46]. According to De Meyer [47], the Bonaire tourism industry has successfully helped to protect the marine environment and has used programs to educate tourists and industry professionals concerning the sustainable use of the Bonaire Marine Park. In Australia, the Great Barrier Reef attracts about 1.6 million tourist visits with the industry valued at over \$1 billion per year [48]. This may be compared with estimates of \$250 million for the annual worth of Great Barrier Reef fisheries.



Sharks have traditionally been considered as a detriment to coastal tourism, but since the early 1990s, shifts in attitudes amongst divers have led to growth in the popularity of shark watching as a tourist activity. An estimated 500,000 divers a year find, photograph, feed, and swim with sharks, contributing millions of dollars to local and regional economies [49]. Sharks are the main tourist attraction in the coral reefs of the Maldives islands among tourist divers. It is roughly estimated that shark watching generates US \$ 2.3 million per year in direct diving revenue [50]. In the Galapagos Islands, a single tourist pays about 3,000 to 4,000 dollars to go offshore to watch sharks and mantas. In Costa Rica and Brazil, marine turtles are tremendous tourist and scientific attraction providing revenues to those countries, not only for conservation but also for local population survival [51, 52].

Similarly, among the marine mammals, cetaceans are an attraction for international tourism. They provide more than \$1 billion USD to at least 87 countries around the world (USA, Canada, Japan, the Caribbean and Canary Islands, Hawaii, the Azores etc.) Hoyt [53] highlighted that in Iceland whales are worth more alive than dead, providing jobs and business to local population. For Iceland, whale watching incomes are around \$8 million USA per year, almost twice more than what whaling yearly produced (\$3-4 million) in 1986-1989.

A framework for the development of whale watching has been proposed by Berrow [54]. This work includes monitoring, code of conduct, research and education project and activities. Done properly, whale watching not only provides economic benefits, but can make a significant contribution to the conservation of cetaceans and their habitat. In Cape Verde the most successful operations are those that incorporate other activities, such as turtle or bird watching. In the same way, coral reefs are source of highly priced resources (necto-benthic fish and lobsters), and then could yield goods and services (snorkeling, recreational diving, etc), and a source of foreign exchange (lobster export).

Merino and Berrow [55] highlighted that eco-tourism, as distinct from traditional tourism, could contribute to the knowledge and conservation of marine biodiversity around Cape Verde. At a world wide scale, many examples are available to sustain this proposition. The high biodiversity of marine ecosystems in the archipelago and the frequency of patrimonial



species clearly allow developing an economical approach of tourism [7, 44]. However, to avoid environment degradation due to over frequentation, it is important to assess in parallel the carrying capacity of marine ecosystems in Cape Verde [56].

Conclusions

Protected areas are widely held to be among the most effective means of conserving biological diversity *in situ* [38-40]. Marine biodiversity can objectively be a source of economic benefit for a sustainable development of a country. Proper planning and responsible management are the main challenges [39, 40]. From those facts, it is fair to strongly believe that in Cape Verde with those resources and much more that are mentioned, on the basis of a proper planning and responsible management of the marine resources, conservation has a tremendous potential to contribute for the sustainable development of the country, providing goods and services but also warranting the future generation survival [55].

Given the existence of a very important biodiversity for the Cape Verde, in comparatively good conservation shape, as well as the existence of the tourism as a key sector for the development of the country, we propose a biodiversity conservation model for the Cape Verde, closely linked to eco-tourism activities (Fig. 1). This model shows the existence of very strong links between biodiversity and the social economic aspects, through the conservation activities management of the environment. Eco-tourism activities, linked to marine and coastal biodiversity could be developed only if good management and administration, good environmental education and scientific research are implemented. These eco-tourism activities are likely to provide economical gains and consequently, it will have various social economical benefits especially for the local population, directly linked to such activities and will also contribute to the reinforcement of some sectors namely tourism, the fisheries, scientific research and environmental management.

If on the one hand both sectors and stakeholders are reinforced in view of the benefits emerging from eco-tourism, on the other hand this means that they should have increased



financial and technical capacity for providing better contribution to the biodiversity conservation. The local population, once integrated in eco-tourism projects, will benefit from more favourable socio-economic conditions, from poverty reduction and better living conditions. This means that there will be better contribution to the biodiversity conservation and a reduction of harmful activities to the environment.

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Table 1. Most fished species in Cape Verde's fisheries [modified from 13]

Groups	Main species
Large pelagic	<i>Acanthocybium solandri</i> <i>Auxis thazard</i> <i>Euthynnus alletteratus</i> <i>Katsuwonus pelamis</i> <i>Thunnus albacares</i> <i>T. alalunga</i> <i>T. obesus</i>
Small pelagic	<i>Decapterus macarellus</i> <i>Decapterus punctatus</i> <i>Lichia amia</i> <i>Sardinella maderensis</i> <i>Selar crumenophthalmus</i> <i>Spicara melanurus</i>
Demersal	<i>Cephalopholis taeniops</i> <i>Chaetodon hoepleri</i> <i>Conger conger</i> <i>Diplodus fasciatus</i> <i>D. prayensis</i> <i>D. puntazzo</i> <i>D. sargus lineatus</i> <i>Epinephelus marginatus</i> <i>Lethrinus atlanticus</i> <i>Lutjanus agennes</i> <i>Mycteroperca rubra</i> <i>Scorpaena</i> sp. <i>Seriola</i> sp.



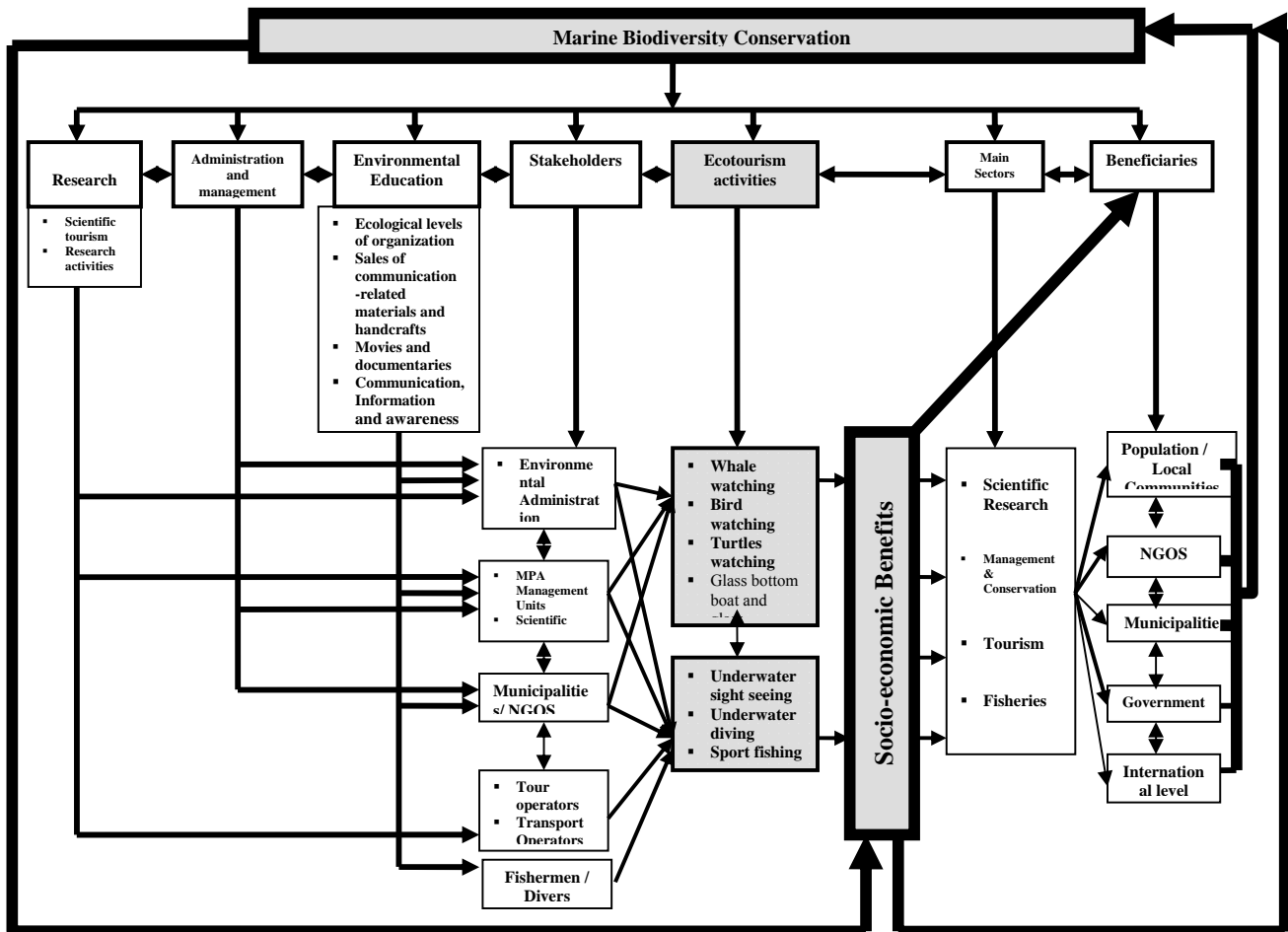
Table 2. Gross Domestic Product in Cape Verde at Current Prices, between 2000 and 2005
(source: Ministry of Finance, 2006).

Main sectors	2000	2001	2002	2003	2004	2005
	%(In percent of GDP)					
Agriculture, forestry, and livestock	10.7	9.7	9.1	8.9	8.5	8.2
Fishing	2.2	1.7	1.3	1.3	1.2	1.1
Industry and energy	7.6	6.2	6.8	6.9	7.5	7.7
Construction	7.6	7.4	8.1	7.7	7.7	9.1
Commerce	17.4	16.9	18.6	18.7	18.9	18.7
Hotels	2.2	2.4	2.2	2.2	2.0	2.1
Transport and communications	19.6	22.8	20.5	21.5	20.9	19.4
Banks and insurance	3.9	4.4	4.5	4.1	4.1	3.8
House renting	5.2	5.4	5.5	5.2	5.1	5.1
Public service	13.3	12.6	12.6	13.0	12.2	12.2
Other services 3/	10.1	10.5	10.8	10.6	11.8	12.7
Real GDP growth (annual percentage change)	7.3	6.1	5.3	4.7	4.4	5.8





Table 3. Evolution of the artisanal fishing fleet between 1990 and 2001 [modified from 12]

Artisanal Fisheries	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Unmotorized boats (oars and sails)	729	748	653	567	455	535	438	414	414	337	337	337
Motorized vessels	634	628	675	801	1000	934	986	986	986	920	929	929
Total Vessels	1363	1376	1328	1368	1455	1469	1424	1400	1400	1257	1257	1257
Number of Fishermen	4392	4576	4143	4376	5481	5538	5406	5675	5675	4283	4283	4283

Figure 1. Proposal for a Biodiversity policy management in Cape Verde



Legend

-  New activities to develop or reinforce
-  Current Factors
-  Current relations
-  New relations