DESIGN PROPOSAL FOR A MARINE PROTECTED AREA FOR CUPICA BAY – CHOCÓ, ON THE COLOMBIAN PACIFIC COAST

DESIGN PROPOSAL FOR A MARINE PROTECTED AREA FOR CUPICA BAY – CHOCÓ, ON THE COLOMBIAN PACIFIC COAST

By: BOSQUE COLOMBIANO FOUNDATION

RESUMEN

Based on an ecoregional planning exercise for the selection of priority sites for conservation in the Colombian Pacific and the qualification of ecological criteria, 14,400 hectares of Cupica Bay were identified as a potential site for the establishment of a marine protected area (MPA). This area presents a mosaic of marine and coastal ecosystems that encompass a number of fish, planktonic, benthic and species that, in set with the half, constitute an area of high heterogeneity and biodiversity only in the department of The Choco. The purpose of this job was designing the first AMP for the north of the department based on the evaluation of ecological criteria, proposed conservation and management objectives; postulating a management category within the current National System of Protected Areas (SINAP). By consequent, to leave of information secondary and Following the scheme methodological for the planning of The Nature Conservancy's "Five S Scheme" sites, five conservation targets were identified (oC) of filter thick either habitats: formations corallines, grasslands of phanerogams, Beaches sandy, coast rocky and forests of mangrove swamp and three odC of filter fine: areas with presence of Great Hammerhead (Sphyrna mokarran), areas of feeding sea turtles such as the Hawksbill turtle (Eretmochelys imbricata) and migratory bird congregation areas. A feasibility analysis was developed for each object finding the area in a good state of biodiversity health. The analysis of criteria, feasibility and definition of the management objectives of the area made it possible to postulate the management category "National Park Natural" as the most appropriate for the area. On the other hand, from a systematized process and with the help of a system medium of decisions (SSD) called MARXAN (University of queensland) identified three intangible zones with which the minimum protection of 30% coverage of each of the objects, as initial contribution to zoning internal of AMP.

WORDS KEY: Areas marine protected, Bay Cupica, Biodiversity, MARXAN, Park National Natural.

Cite this document as: HERNÁNDEZ, M. 2012. DESIGN PROPOSAL FOR A MARINE PROTECTED AREA FOR CUPICA BAY – CHOCÓ, ON THE COLOMBIAN PACIFIC COAST. Bosque Colombiano foundation. SAN ROQUE, Chocó. 28 pag.

INTRODUCTION

Inside of the 54 areas protected belonging to the System of parks National Natural Areas (SPNN), twelve are protected marine areas (AMP) that is, of marine and/or coastal character; In total, the SPNN represents only 4.4% of the territory national. It includes the 144Km2 of territory Marine. Is So as less of the 1% of marine areas in Colombia are protected by protection figures belonging to the SPNN. When we have in account figures of protection declared by Resolution, through the Ministry of Environment, Housing and Territorial Development (MAVDT), such as the regional AMP system (Resolution 876 of 2004) within the Booking of Biosphere seaflower and he AMP of the archipelagos corals of the rosary beads and San Bernardo (Resolution 679 of 2005) the protected percentage is increased to 8% (INVEMAR-UAESPNN-TNC, 2008).

An analysis of empty of representativeness of the MPAs of the SPNN for the Colombian continental Pacific, carried out by Alonso et al. (2005) showed an excellent representativeness for the reefs corallines; opposite to it observed for pastures sailors, Beaches sandy, gaps coastal and estuaries, determining that he department of El Chocó, despite having very important areas in terms of biodiversity, only It has the Sanctuary of Fauna and Flora of "Los Flamencos" as a protected area marine-coastal.

Based on the above, the project "Design of a network of Areas marine protected for he north of the Peaceful continental Colombian" where HE They found various priority conservation sites for the El Chocó area, particularly Cupica Bay, due to its special conditions (INVEMAR, 2007). so said project gave origin to this investigation, whose purpose was proposed the design of an AMP to leave of the assessment of criteria ecological and the selection of objects of conservation viable, generating an appropriate management category according to the objectives and advance in the first inputs for zoning inside the area.

AREA OF STUDY

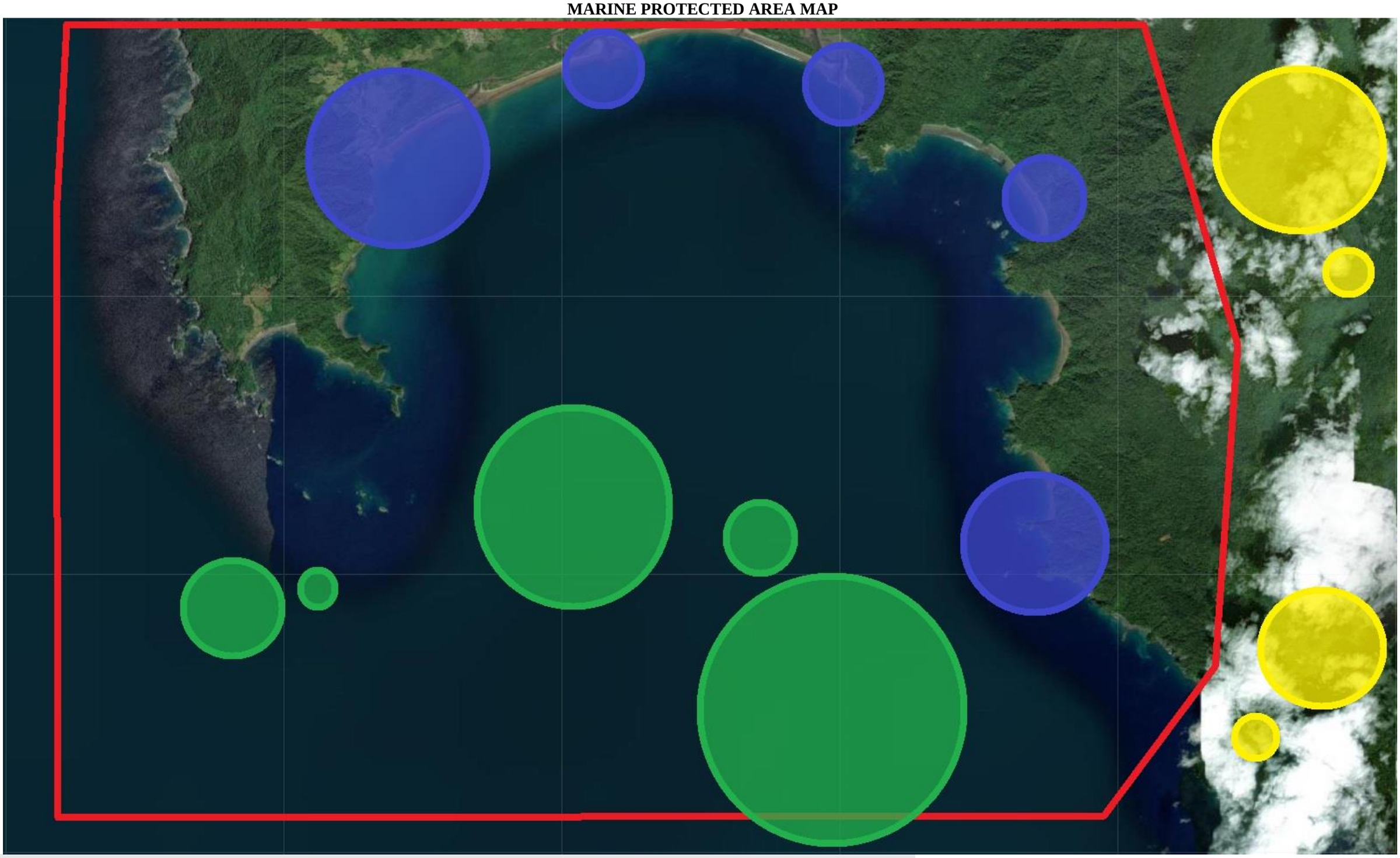
Bahía Cupica is located north of the department of El Chocó, Pacific continental Colombian and this located between the cape le petite and Tip chickens, to the 6°39'07.6"N and 77°30'17.9"W and 72° 02' W (Figure 1). It covers an approximate area of 144 km 2 reaching some 13 km of diameter approximately and this communicated with the sea open by a mouth 6 kilometers wide. In general terms, it is a very shallow bay, in average is ninety meters deep, with a minimum of three and a maximum of 200 m. presents conditions marine with salinities tall (3. 4 to 37), restraining continental influence only to runoff during the rainy season (May to November) (Solano, 1994; INVEMAR, 2004).

There are coral formations concentrated on the southern and western of the bay, the which it develops from the level half of the tide until the four meters deep (Solano, 1994). The fund consists mainly by sediments fine of guy clayey, without embargo he sector southwestern is widely dominated by substrates sandy with a component bioclastic considerable (diaz et to the., 2003). The coastline is bordered by mangrove forests and seagrasses develop along the coast, mostly in a mixed form (Thalassia-Syringodium either Thalassia-Syringodium-Halodule).

The population human in the bay this in his most shaped by Wauyuú indigenous ranches, according to information from DANE (2005) for Cupica exist approximately twenty towns (Ranches), with a total approximately than 500 people, however the number of inhabitants has varied accordingly to the displacement by the violence. This community highlights some acts cultural and religious directed to deities feminine, the which are associates to the zones of droughts and winds; These places are called Pulowi or Pulouv sites, also known as sites of payment (Vergara-González, 1986). The economy of the Embera based mainly in the activities livestock, especially to grazing of goats, due to its adaptation to the xerophytic vegetation characteristic of the region.

Likewise, though fishing is economically important for indigenous people living near the coast, it is considered a work of the poor class and lower hierarchy according to the Emberá who reside inside the bay. Regarding the mining sector, a special sector has been recognized so that the Emberá exploit the salt flats in a traditional way. In addition to the activities already mentioned, today the exploitation of the coal industry has opened as poles of economic attraction for many indigenous people. Within Cupica Bay finds the Puerto Bolívar mining port, located at the southern tip of the mouth of the bay, 150 km north of the “El Cerrejón” mine, north zone.

MARINE PROTECTED AREA MAP



DESIGN PROPOSAL FOR A MARINE PROTECTED AREA FOR CUPICA BAY – CHOCÓ, ON THE COLOMBIAN PACIFIC COAST

CONVENTIONS

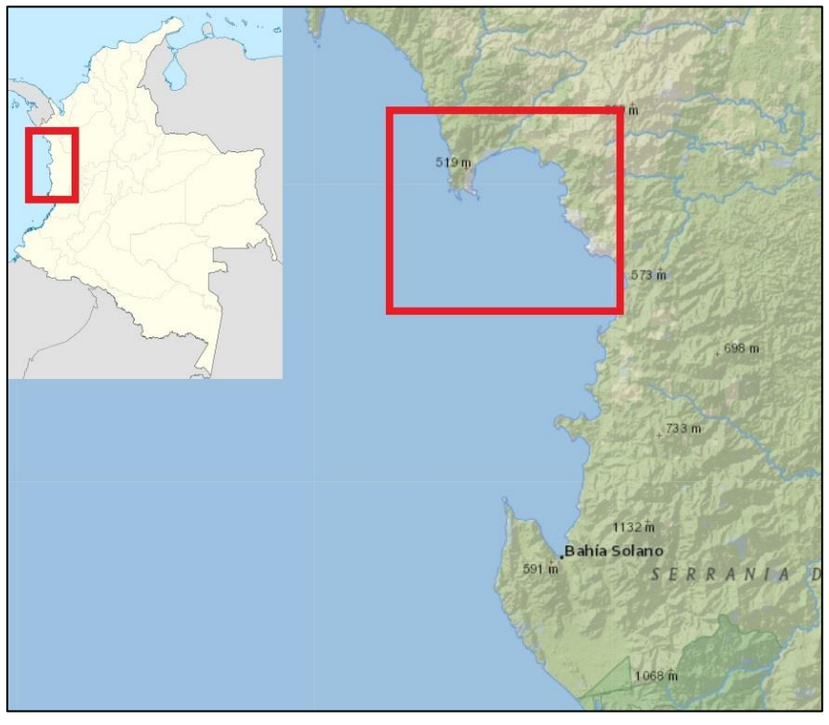
	Delimitation of marine protected area
	River mouths: estuaries
	Illegal, unreported and unregulated fishing
	Embera indigenous cities

SCALE

1 cm = 2,500 meters

SOURCES:
- Bosque Colombiano Foundation
- Google maps
- IMAP

- **Country:** COLOMBIA
- **State:** CHOCÓ
- **City:** San Roque
- **Site:** Emberá indigenous territory
- **Water body:** Pacific Ocean; Cupica Bay
- **Geographical coordinates:** From 6°41'44.8"N 77°32'03.8"W and 6°42'24.0"N 77°57'26.5"W, to 6°18'59.2"N 77°57'36.4"W and 6°26'11.6"N 77°21'01.3"W



BOSQUE COLOMBIA FOUNDATION; **Email:** officer@bosquecolombiano.org;

MATERIALS AND METHODS

As a general method for the design of the MPA, the methodology of planning for the conservation of sites or "Scheme of the five S for conservation of sites", developed by The Nature Conservancy (2000a), where he name "five S" comes from the five elements that are evaluated and that begin with the letter s in English: systems/systems (objects of conservation found in the site and the processes natural that the keep, in the which HE will focus the planning), stresses / pressures (guys of degradation either destruction that affect to the objects of conservation either processes ecological factors on the site), sources/fuentes (agents that generate the pressures), strategies/ strategies (types of conservation activities employed to mitigate sources of pressure and the pressures persistent) and success / success (measures of health of the biodiversity and mitigation of threats at a site). The present investigation only evaluated the three first items. The definition of objects of conservation (systems) and of the threats critics (pressures and sources of pressure) were the first Steps in the planning of the AMP; So same, the assessment of criteria ecological for his delimitation and zoning was tackled to leave of the methodology developed by Roberts et to. (2003a) and adapted to the conditions of the study.

Selection of the objects of conservation

The selection of the objects of conservation (oC) arose of the list obtained in the ecoregional planning exercise for the design of the MPA network in the north of the Colombian continental Pacific, where the objects were reviewed taking into account the planning of the sites, their possible threats and he development later of strategies and Actions for fight the dangers (Alonso et to the., 2008). With base in it former HE performed the list of focal objects of the study area. From the "coarse filter" strategy (systems ecological and communities) and "filter fine" (species both sites of congregation of species) selected eight odC that fulfilled with the following criteria:

(1) Reflect ecoregional conservation goals, (2)
(2) Adequately represent the different levels of organization of the biodiversity and distribution space either geographical (from the regional to the local) and
(3) Present high levels of threat.

A time identified sayings objects HE collected the elderly amount of secondary information; In addition, a field trip was carried out where, from the tools of sensing remote (Image ASTER 2001) and with aid of a System of positioning Global (GPS) (GARMIN, eTrex venture), HE verified the distribution and extension of odC of filter thick. To the same time, it was collected information about the current state of the objects, their different uses, the state of the resources and their possible variations in time and main threats, using two methods of data collection called: direct observation (qualitative descriptions of what that he cluster noticed) and interviews semi-structured (based in a game of questions open questions or discussion points) proposed by Brunce et al. (2000) for evaluations socioeconomics on the management of coral reefs; the queries were worked with communities natives Embera, main population of the area. Finally, the information was introduced to a Geographic Information System (GIS) with the help of the Software ArcView 3.2.

Assessment of viability of objects

With the end of determine the viability to long term of the odC in the place, We worked with the automated book in Microsoft Excel, "Workbook for the Site Conservation and Measures of Conservation Success" developed by TNC (2000b) . The information used to incorporate it into the book was compiled from existing literature, expert judgment and field observations; finally to each OdC was assigned one of the four general hierarchical levels (VjG) defined as follows: very good = 1 (ecologically desirable state, requires little intervention for its maintenance); good = 2 (requires some intervention to sustain it); regular = 3 (requires human intervention) and poor = 4 (needs high levels of protection); this final qualification was obtained through the evaluation of three criteria ecological:

(1) Size (extent of the area either abundance of the locations of the OdC),

(2) Condition (comprehensive measure of the composition, structure and biotic interactions that characterize it) and (3) Landscape context (integral measure of the regimes and processes environmental dominant that establish and keep the location of the odC and connectivity). For the definition of said VjG, the combinations of values proposed by the authors (TNC, 2000a). A weighting value of 1 for OoC of filter thick and 0.75 for objects of filter fine, due to which objects of a high level biological (systems ecological) dominate he functioning and the health of the lower-level objects (TNC, 2000b).

Delimitation

The identification of the appropriate ecological limits and the size of the area is the major problem in the design of an MPA, since there is no general rule for the design optimum

and he size of the same (Roberts and Hawkins, 2000; psalm et to the., 2000). The debate of a "area big either several little" either SLOSS (Single big gold Several Small), widely discussed in terrestrial environments, it is also the main problem in the design of areas marine (Carr et al., 2003). However, for MPAs to have economic and social durable, must be effective biologically and his stability to long term depends of the protection of entire marine communities. Currently regardless of size, MPAs have shown multiple benefits; however, they must be sufficiently large enough to include habitats that are viable in the long term (Roberts and Hawkins, 2000; Roberts et al., 2003a).

For this investigation, it was established as first approach to the delimitation of the area the following three assumptions, to know:

• He area shall contain the total coverage of the eight odC selected.

• The inland limit will be from a 200 m buffer (buffer zone) to leave of the perimeter external of the the objects terrestrial. HE estimated this as the distance optimal to mitigate possible disturbances by human activities.

• Exclude the areas with activities port and with presence of aggregations human (ranches).

In the figure 1 can notice the boundaries defined of the AMP to leave of the three assumptions previous, without embargo is left over clear that is necessary contemplate some criteria additional of character social and economic for pin up a limit definitive in the area.

ID of zones intangibles

The ID of zones intangibles as input initial to the process of zoning of the AMP allows safeguard a sample of the ecosystems with the least possible human interference and where for this case the extraction of resources. For the process of selection of zones intangibles was used the system medium of decisions (SSD) or MARXAN software (version 1.8.2), designed in Australia by Ball and possingham (2000) and used mostly in the last years for the design of networks of AMP, but very bit explored for carry to cape exercises of zoning to the inside of AMP. As passed initial the gender for the area of study, a grid of 6632 units of planning (UP) of hexagonal shape, with an area of 2.6 ha each.

The function objective used by the DSS was (ball and Posingham, 2000):

$$= \Sigma Cost\ \_ + BLM\ \Sigma\ Boundary + \Sigma\ Penalty$$

Where:

Cost: is he cost total of all the UP selected, he which can be measured as he area of the UP, either he cost economic, social either a combination of these.

Boundaries: is he perimeter around of the UP selected.

BLM (Boundary Length Modifier): is the length modification factor perimeter, which controls the importance of the length of the perimeter relative to the cost of the UP selected, in where to elderly BLM minor fragmentation.

Penalty: is a worth additional of penalty in the function for all the goals that are not met, based on cost and additional perimeter length needed to fulfill them.

For can execute the DSS was necessary define of beforehand goals of conservation measures for each of the eight OdCs, which are descriptions explicit indications of the state of viability that is desired for an OdC (Groves et al ., 2000). Some authors ensure that at least 20% of each type of habitat must be under a category strict either of protection total (No extraction) also call intangible either "No take" (Bohnsack, nineteen ninety six; schmidt, 1997; NRC, 2001); So same, numerous research affirms that to the increase these goals between a twenty and fifty% for each habitat generates an enormous biological benefit, which with a good implementation serves as an effective tool at an economic level, both for the sustainability of fisheries and snorkeling, among other non-consumptive activities (Robert and Hawkins, 2000; NRC, 2001; Leslie et al ., 2003; Roberts et al ., 2003a, 2003b, 2003c; Prada, 2004; Loos, 2006). According to the above, a value of 30% was set. as goal of conservation strict for all the OdC. In the board 1 HE he took to cape a comparison of the goals proposed by different authors with the specific objective of represent the diversity biological.

Meanwhile, the process executed by MARXAN produced two graphical outputs, named the "better solution" and the "solution added"; the last was the that directed the exercise of identification of intangible zones, since it identified the number of times that each UP was selected during the total number of runs, pointing out the UPs irreplaceable, that is, the units that were always selected to meet the goals of conservation. For this exercise the number of cumshots was of 300 with 1 million of iterations each a and HE identified a BLM of 0.2.

Aim	Goal of Conservation (Area)	Criterion	Source
Representation of biological diversity	10 -36%	Representation of species and complementarity (fish)	Turpie et to the. (2000)
	36%	Representativeness of habitat	Bustamante et al. (1999)
	40%	Ward Species and Habitat Assemblage	et to the. (1999)
	10%	Representation or replication of habitats	Halfpenny and Roberts (in revision)
	37 – 56%	Habitats representative	Hall et to the. (2002)
	5 – 50%	habitats representative and species	Areces *et to the.* (2003)
	30-60%	Habitats representative and species (fish)	Friedlander *et to the.* (2003)
	28 – 50%	Habitats representative and species (fish)	Alonso *et to the.* (2004)
	30 – 50 %	Habitats representative and species (fish)	Airame *et to the.* (2003)
	30 %	Representativeness of habitats and species	Present study

Table 1. Values of the goals of conservation used by different authors for the aim of representation of biological diversity. **Sources:** This study

RESULTS AND DISCUSSION

Selection of the objects of conservation

The eight odC identified that fulfilled with the three criteria defined for his selection were, to level of systems ecological either filter thick: formations corallines, grasslands of phanerogams, Beaches sandy, coast rocky and forests of mangrove swamp; and to fine filter level, areas with the presence of Great Hammerhead (Sphyrna mokarran), areas of sea turtle feeding areas and seabird congregation areas. This step is performed to leave of the hypothesis that to the establish multiple objects in the levels biological high (coarse filter) most of the species associated with them will be preserved (filter fine) (Noos et al., 1997; Anderson et al., 1999). In this case 33 species between fish, corals, mollusks, crustaceans, reptiles, echinoderms and birds present in Cupica Bay, identified in the red books of Colombia in some category of threat (Table 2), they would be “covered” through OoC protection at the habitat level. Of such manner, the processes biological between the different species threatened found for the selected area and objects, allow us to assume that by keeping these would guarantee the protection of the greatest amount of biodiversity present in the area of study (Figure 2).

The selection of the three objects of filter fine the basis in his relevance and to the not be captured within the OoC filter thick that support them. They were selected For this exercise, the feeding areas for sea turtles and the congregation of sea turtles seabirds, as they are important contributions to current and future networks of functional sites that support these populations at broader regional levels of conservation (Ceballos-Fonseca, 2004; Franco-Maya and Bravo, 2005) and the areas with presence of C. acutus , which is a critically endangered species (Castaño-Mora, 2002), accurate conditions and requirements specials for his driving, as it pose Abbey (1995) and Rodríguez (2000) for Cupica Bay and other areas of the Colombian Pacific. (Rodriguez, 2002).

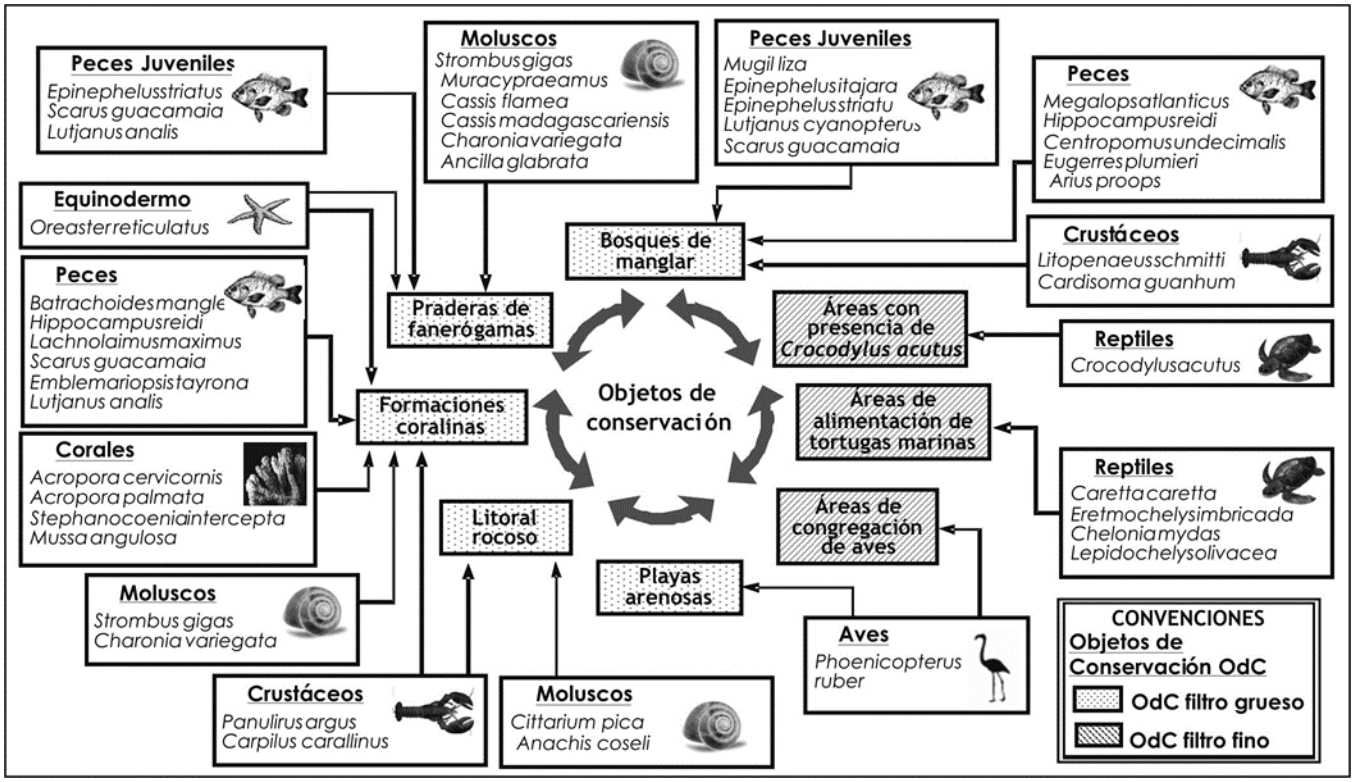


Figure 2. Scheme of the relationship between the species present in the Global IUCN Red List for bay Cupica, with regard to the eight objects of conservation selected.

SPECIES COVERED BY THE MARINE PROTECTED AREA

2,156 species of animals and plants will inhabit the marine area covered; of which, 78 species are cataloged as CR, EN and VU. The most representative species are shown below:

Name	Kingdom – Class or orden	IUCN Conservation status
Great Hammerhead (Sphyrna mokarran)	Animalia - Chondrichthyes	Critically Endangered (CR)
Hawksbill Turtle (Eretmochelys imbricata)	Animalia - Reptilian	Critically Endangered (CR)
Scalloped Hammerhead (Sphyrna lewini)	Animalia - Chondrichthyes	Critically Endangered (CR)
Galapagos Petrel (Pterodroma phaeopygia)	Animalia - Aves	Critically Endangered (CR)
Oceanic Whitetip Shark (Carcharhinus longimanus)	Animalia - Chondrichthyes	Critically Endangered (CR)
Largetooth Sawfish (Pristis pristis)	Animalia - Chondrichthyes	Critically Endangered (CR)
Scoophead Shark (Sphyrna media)	Animalia - Chondrichthyes	Critically Endangered (CR)
Pacific Smalltail Shark (Carcharhinus cerdale)	Animalia - Chondrichthyes	Critically Endangered (CR)
Scalloped Bonnethead (Sphyrna coron)	Animalia - Chondrichthyes	Critically Endangered (CR)
Great Green Macaw (Ara ambiguous)	Animalia - Aves	Critically Endangered (CR)
Chilean Angelshark	Animalia - Chondrichthyes	Critically Endangered (CR)

(Squatina armata)		
Blue Whale (Balaenoptera musculus)	Animalia - Mammalia	Endangered (EN)
Green Turtle (Chelonia mydas)	Animalia - Reptilian	Endangered (EN)
Baudo Guan (Penelope ortoni)	Animalia - Aves	Endangered (EN)
Horned Marsupial Frog (Gastrotheca cornuta)	Animalia - Amphibia	Endangered (EN)
Baird's Tapir (Tapirus bairdii)	Animalia - Mammalia	Endangered (EN)
Spinetail Devil Ray (Mobula mobular)	Animalia - Chondrichthyes	Endangered (EN)
Oceanic Manta Ray (Mobula birostris)	Animalia - Chondrichthyes	Endangered (EN)
Brown-headed Spider Monkey (Ateles fusciceps)	Animalia - Mammalia	Endangered (EN)

Table 2. Species with the greatest anthropic threat in the area.

Habitats: formations corallines, grasslands of phanerogams, Beaches; Areas of importance biological 1, 2, 3, 4 and 5 sandy beaches, rocky coastline, mangrove forests, muddy bottoms and sedimentary. Presence of shark, turtle feeding, seabird congregation, breeding aggregations, breeding of fish and lobster juveniles. Areas of importance cultural: Places of cultural importance (indigenous payments).

In general, the odC selected represent either span the "elderly" biodiversity for the bay at different levels of biological organization and geographic scales, therefore that provides a strategy of conservation ecologically further comprehensive, according to it pose poiani et to. (2000). The ID of only eight odC is important, already that develop feasible conservation strategies and actions for the site with the largest number, would result difficult of drive; without embargo, No HE has to ignore that this selection has to be an iterative process over time, so it should continue to evaluate the bay, and in the extent that it was filled the empty of information (in the behavior of the ecological processes of the site and its threats) will have the possibility of changing objects so much for new strategies of action, as for the new threats either even if the conservation scenario changes definitively. Likewise, develop new biological and ecological research, environmental monitoring, among others, would be an important tool for the continuation of the present design.

Viability

Find the viability of the odC for the establishment of an AMP is a process of great importance, in he which HE determines the ability of a species, community either system ecological of to persist by generations during a period certain, ensuring that in the chosen site they are as functional as possible and that they have the probability of stay in the time (groves et to the., 2000). The assessment final for the odC in the bay He showed a VjG Well to the Add the results partial of the objects regard to the three criteria qualifiers; however, it presented the exception of the object of "areas with the presence of Great Hammerhead (Sphyrna mokarran) where said value was poor, that is to say that its Restoration is difficult and requires immediate intervention on the part of man that could disappear in the area (Table 3).

Table 3. Matrix of qualification of viability for objects of conservation versus the attributes ecological of size, condition and landscape context, with its hierarchical value (Vj) and weighting (p), value hierarchical general (VjG) of viability and qualification global of the health of the biodiversity for bay Cupica

Object of conservation	Size		Condition		Context		Value hierarchical general
	VJ	P	VJ	P	VJ	P	
Coral formations	Good	**1**	Regular	1	Good	**1**	Good
phanerogam meadows	Good	**1**	Good	1	Good	**1**	Good
sandy beaches	Regular	**1**	Good	1	Good	**1**	Good
rocky coastline	Regular	**1**	Good	1	Good	**1**	Good
mangrove forest	Good	**1**	Good	1	Good	**1**	Good
Sites with Crocodylus acutus	Poor	**0.75**	Poor	0.75	Regular	**0.75**	Poor
Sea turtle feeding	Good	**0.75**	Regular	0.75	Good	**0.75**	Good
Sites of importance for birds	Good	**0.75**	Good	0.75	Good	**0.75**	Good

***Qualification global of the health of the biodiversity

In general the bay presents a level GOOD of viability, that it can translate in a good "state of health of the biodiversity" (TNC, 2000b), it that it corroborates with the results of the monitoring obtained by INVEMAR (1988, 1992, 2004) referring to the effects produced by the coal port facilities (Puerto Bolivar) about the ecosystems marine representative of the area, to the equal that the registered specifically by Díaz et al. (2000) for coral formations and Díaz et al. (2003) for pastures marines. Of agreement with poiani and richter (1999), the health of the biodiversity is a extent general of the functionality to level of landscape either place, of mode that HE can show off that in the conditions current bay Cupica presents a good ability for maintain healthy OdCs as well as support key ecological processes within of their natural ranges of variability in the long term.

Category of driving

In the last years, to through of the coordination of the UAESPNN he country it was tipped over toward he strengthening of the System National of Areas protected (SINAP). During this process, a technical proposal has been generated on the new possible management categories (Sguerra, 2005), based on various technical documents (Biocolombia, 2000; Fandiño-Lozano, 2001; 2004; Andrade, 2005) in which it is done a revision to background of the current categories, with base in it willing in the decree 622 of 1977, which establishes the general regulations to be taken into account for the Declaration of areas with relevant values for the national patrimony.

According to the ecological conditions defined for Cupica Bay from of the analysis of viability, HE determined that he aim major of the area is contribute to the conservation of the ecosystems marine and coastal and their species associates, guaranteeing the naturalness and the essential ecological processes that are presented there. However, if either a protected area is declared in order to fundamentally and preferentially achieve a specific conservation objective, it can help simultaneously and in a complementary to the achievement of several general conservation objectives (Sguerra, 2005). Therefore, two secondary objectives were established: (1) maintain the populations of species migratory (turtles and birds marine and shirts) that it was associated to the place for purposes for feeding, resting and reproduction, as well as endangered species Great Hammerhead (Sphyrna mokarran) and (2) guarantee essential environmental goods and services for the benefit of the community in the zone of influence, which for this case are the communities natives.

Once the central objective has been determined and since the area includes a portion Marine, his statement, driving, administration and control relapses about ambit of the management National (MAVDT and UAESPNN), by it so much, the category of driving that better it adapts is the of Park National Natural (PNN), equivalent to the category II of the Union International for the Conservation of the Nature (IUCN) (Davey, 1998). In this, it allows some types of activities and indirect uses according to what was proposed by Sguerra (2005) and No result incompatible with the presence of a guard either booking indigenous inside of their limits, whenever the pertinent studies are carried out to jointly reach the good driving of the area, such and as it Explains in the normativity of the country to through of the decree 622 of 1977. Other authors have proposed this area as a Life Refuge category. Wilderness

of a regional nature (Biocolombia, 2000), as an area for the conservation of avifauna associate to wetlands coastal of the choco (Chestnut, 2001), area of importance international for the conservation of birds (AICA) (Franco-Amaya and Bravo, 2005), zone of preservation of mangrove swamp (Sánchez-Páez et to,. 1997; CORPOGUAJIRA, 2003) and as place priority of conservation for forests floodable of the plains marine (Fandino-Lozano and Wyngaarden, 2005), the which it focused mostly to ecosystems emerged.

Since the proposal of this MPA category was defined based on criteria ecological, is necessary he development of studies multidisciplinary that HE order to inquire further into the economic, political and socio-cultural aspects related with the bay, that to his time allow the implementation efficient of the AMP. This proposal of PNN increase in a 3% for pastures marine and a 2% for forest of mangrove swamp the representativeness of the total coverage in the Colombian continental Pacific of these ecosystems inside the SPNN (Table 3).

Intangible zones

For the scenery of "better solution" HE got three zones intangibles (Figure 3). said zones are the result of the group of 583 UP located to the northeast, west and south of the bay, the which fulfilled, in his most, with the goal of conservation (30%) for each of the objects in the smallest possible surface. Likewise, the scenario the "solution added" selected UP that result selected between 131 to 300 times, is say, that appear almost always in the solution for achieve with the goals preset by it that it converts in units irreplaceable, alluding this to the great importance ecological contained inside of each a of they; No however, although some of are UP are not found in the proposal of intangible zones (Figure 4), they are considered as an important result in future decision-making processes, by being able to use them as negotiation items. Consequently, the designation of these intangible zones within the AMP they will allow to maintain the foreign environment to the slightest alteration human, to end that the conditions natural it keeps to perpetuity (Swar, 2005).

Only the OdCs for sandy beaches and rocky coastlines did not meet the established goals (Table 4), because the area of influence of the facilities port gender a high cost (threat), affecting the selection of UP forthcoming to said infrastructures. However, the selected scenario included the largest area possible of these objects within the intangible zones. On the other hand, the food object of sea turtles exceeded the goal, since in the compaction process of MARXAN were selected UPs that adjoin other objects, which necessarily should have be selected for reach the goals of conservation of the the rest OdC .

The importance of guarantee the representativeness of the 30% of the different guys of marine and coastal habitats of Bahía Cupica through these protection zones strict, will allow benefit the survival and development of the different phases of the cycle of life of many species, since the strong link between reefs is recognized coral reefs and adjacent nursery areas, such as seagrasses and mangroves (Nagelkerken et al., 2000). Recent exercises such as the Great Barrier Reef of Australia and the United Kingdom have increased the protection zones by percentage strict (no take zones), where for the first, in 2004 the Australian government approved a new legislation in which the area was increased from 4.5% to 33% (MPA News, 2004), and the second, proposes to cover a percentage of 30% in all regions biogeographic and guys of habitat (Roberts et to the., 2003a; MPA News, 2005). At the moment when comparing the coverage of OdC within intangible zones of the current SPNN we can find, for example, that in the PNN Corales del Rosario and San Bernardo where present two intangible areas (Isla Rosario and Isla Tesoro), the coverage of formations corallines No achieves he 3.5% of the surface total inside of the AMP (Alonso, 2005); of the same manner HE present percentages minors to the 10% in objects as the grasslands of sea grasses and mangroves in intangible zones within the PNN Tayrona, PNN Old Providence McBean Lagoon and PNN Corales del Rosario and San Bernardo, so are figures they look like be very little for guarantee the resilience of these habitats to the natural and anthropic impacts and guarantee its viability in the long term (Bohnsack, nineteen ninety six; Schmidt, 1997; Robert and Hawkins, 2000; NRC, 2001; Leslie et al ., 2003; Roberts et al ., 2003a, 2003b, 2003c; Loos, 2006).

The lack of specific information on the uses and activities in the bay does not allowed the delimitation of others zones of driving possible inside of the category of PNN under the framework of current regulations (Decree 662 of 1977), so it must be carry out a characterization and diagnosis of these in the future. In accordance with Alonso (2005), the internal zoning of an MPA and its terrestrial counterparts present differences, given that he concept of "use public" this widely extended in he sea and includes non-consumptive and consumptive uses (socioeconomic activities) that, difference of the component land, HE refers mostly to the "harvest of estate" without modification considerable of habitat (to exception of those Arts of fishing destructive and No selective). By it, the zoning in

the current AMP shall be revised in order to establish zones with different types of restriction and gradation of use of the resources; management differences for consumptive areas such as fishing (sports, commercial, artisanal, and drag), and recreation; and not consumptive like diving apnea (or "snorkeling"), water sports, bathing areas, among others.

CONCLUSIONS AND RECOMMENDATIONS

In general terms, Cupica Bay is considered one of the areas natural habitats with the greatest diversity and heterogeneity in Colombia. This not only HE determined in the present investigation, but by different proposals of conservation that various authors have done for the area. However, Cupica Bay currently does not have no figure of protection or conservation for its ecosystems, for which reason is necessary implement strategies of conservation in the short term, being the creation of an MPA the best instrument to increase the representativeness of biodiversity in this sector of the Colombian Pacific and avoid his deterioration in the future.

There is little research available on the study of communities and the distribution space of the most of species registered in the books reds of Colombia for the area, it which gender nails limitations during the development of the design and he use of the SSD; For this reason, it is recommended to start assessment studies and current status of the threatened species in the bay.

The present design is based on the evaluation of ecological criteria, without embargo for the later route of declaration and implementation of the MPA, HE requires of the evaluation of social, economic and political-administrative criteria within the framework of a participatory process with all the actors involved or "stakeholders".

MARXAN has been used mostly for the selection of sites candidates to be marine protected areas, especially marine reserves, it also turned out to be a good tool to support internal zoning allowing the identification of intangible zones or "no take" allowing multiple scenarios to be generated.

HE considers the category of driving further adequate for the area of study is PNN, without embargo by be a of the further strict inside of the SINAP, the presence in Cupica Bay of the infrastructure of the Puerto Bolívar coal port and some settlements of Emberá communities leads to taking special measures of management, being necessary the participation of these actors from the beginning of the process of declaration; as well as the zoning with which a gradation of uses is proposed and guarantee the fulfillment of the conservation objectives, in addition to the definition of a buffer zone.

THANKS

The authors thank the Institute of Marine and Coastal Research "José Benito Vives De Adréis"- CORPOCHOCÓ for the support provided in carrying out this study, to COLCIENCIAS for the resources granted to carry out this investigation inside of the frame of the project "Design of a Grid of Areas marine protected for the north of the Colombian continental Pacific" code No. 210509-16822, as well as the advisory technique and financial of the NGO international as environmental Defense and The Nature Conservancy –TNC. In addition, to the equipment technical of the UAESPNN. A sincere gratitude to Paula TO. Castle, biologist Marine, by his advisory during he development of this investigation. Finally, to the evaluators for their valuable comments for the manuscript improvement.

BIBLIOGRAPHY

- Abadía, G. 1995. Crocodylus acutus (Cuvier 1807) in Cupica Bay. Crocodile Specialist Group Newsletter, 4 (1): 9 p.m.
- Airame, S., JE Dugan, K.D. Lafferty, h. Leslie, GIVES McArdle and R. Warner. 2003. applying ecological criteria to marine reserve design: A case study from the California Channel Islands. echo. Appl., 13 (1): 170-184.
- Alonso, D. 2005. Planning model of a representative system of marine protected areas for the Colombian Pacific. M.Sc. Thesis, University of Las Palmas de La Gran Canaria, Las Palmas de La Great Canary, Spain. 135 p.
- Alonso, D., c. Osorio, F. Navarrete, and m. Londono. 2004. Model of development sustainable for the archipelagos of Our Lady of the Rosary and of San Bernardo. Executive summary (Resolution 0456 of 2003). INVEMAR-MAVDT-UAESPNN-CARDIQUE-EPA CARTAGENA, Santa Marta. 90 p.
- Alonso, D., g. busily and d. Rozo. 2005. Analysis of empty of representativeness of the biodiversity in protected marine areas of the Colombian

continental Pacific. Proc. Gulf Caribbean. Fish. Inst., 58: 317-324.

- Alonso, D., Ramírez, LF, Segura-Quintero, C. and P. Castillo-Torres. 2007. Ecoregional Planning for the conservation of the biodiversity in if you Marine coastal of the Peaceful continental Colombian. Report technical final. INVEMAR-TNC. holy Martha, 94 p.
- Alonso, D., c. Segura-Quintero, Q. Castillo-Torres, and J. Gerhantz-Wall. 2008. progress in he design of a Network of Marine Protected Areas: Conservation Strategy for the Northern Pacific Continental Colombian. Bull. Invest. Mar. Cost., 37 (1): 129-156.
- Anderson, M., P. Comer, D. Grossman, C. Groves, K. Poiani, M. Reid, R. Schneider, B. Vickery, and A. Weakley. 1999. Guidelines for representing ecological communities in ecoregional conservation plans. The Nature Conservancy, Arlington, USA 74 p.
- Andrade, G. 2005. Proposal of categories for the National System of Protected Areas of Colombia. Ministry of Environment, Housing and Territorial Development- Special Administrative Unit of the System of parks Nationals natural, Bogota. 73 p.
- Ardila, N., GR Navas, and J. Reyes. (Eds.). 2002. Red book of marine invertebrates of Colombia. Series Red Books of Threatened Species of Colombia. INVEMAR, Ministry of the Environment, Bogota.180 p.
- Areces, JA, J. Gerhartz, H. Alidina, R. Duttit, and C. Martínez. 2003. Validation of the marine areas system protected areas (SAMP) by analyzing gaps in their representativeness. IDO-CNAP-environmental Defense-WWF. Summary report final technical, Center National of Areas protected, The Havana. 25 p.m.
- Ball, I. and HP Possingham. 2000. Marine reserve design using spatially explicit annealing. A manual prepared for the Great Barrier Reef Marine Park Authority. Univ. of Queensland, Brisbane, Australia. 69 p.
- Biocolombia. 2000. Design of strategies, mechanisms and instruments required for the implementation of the National System of Protected Natural Areas. Special Administrative Unit of the parks Nationals natural of Colombia Bogota. 225 p.
- Bohnsack, HA nineteen ninety six. Maintenance and recovery of reef fishery productivity. 283-313. In: Polunin, NVC and
- CM Roberts (Eds.). management of reef fisheries. Chapmann and Hall, London. 477 p.
- Brune, L., Q. Townsley, R. Pomeroy and R. Pollnac. 2000. socioeconomic manual for coral reef management.
- global coral reef monitoring network. Australian Institute Mar. Sci. Townsville, Australia. 251p.
- Bustamante, RH, P. Martínez, F. Rivera, R. Bensted-Smith, and L. Vinueza. 1999. A proposal for the initial zoning scheme of the Galapagos marine reserve. Charles Darwin Research station Technical report, Galapagos. 89 p.
- Carr, MH, JE Neigel, HA you are, S. andelman, RR Warner, and JL largier. 2003. compare marine and terrestrial ecosystems: Implications for the design of coastal marine book. echo. Appl., 13 (1): 90–107.
- Chestnut, g. 2001. Assessment of the avifauna associate to wetlands of the choco with purposes of conservation.
- Chronicle Forest and of the Half Atmosphere. National University of Colombian, 16 (1): 5-33.
- Castaño-Mora, OV (Ed.). 2002. Red book of reptiles of Colombia. The Species Red Book Series Threatened from Colombia. Institute of Natural Sciences-National University of Colombia, Ministry of Half Environment, Conservation International-Colombia, Bogota. 160 p.
- Ceballos-Fonseca, C. 2004. Distribution of nesting beaches and feeding areas of sea turtles and their threats in the Colombian Pacific. Bull. Invest. Mar. Cost., 33: 79-99.
- CORPOGUAJIRA. 2003. Current status of mangroves, use and zoning in the department of The Choco. Corporation autonomous region of The Choco, Riohacha. 125 p.
- DANE. 2005. Department National of Statistics. http://www.dane.gov.co/censo/files/presultados.pdf.
- 02/07.
- Davey, AG 1998. National System Planning for Protected Areas. IUCN, Gland, Switzerland and Cambridge. 71 p. Diaz, JM, LM Neighborhoods, MH blind them, J. Garzon-Ferreira, J. Geister, m. Lopez-Victoria, GH ospina, F.

- Parra-Velandia, J. Finch, b. Vargas-Angel, F. shoe and S. Zea. 2000. Areas corallines of Colombia. INVEMAR, Series Publications Specials no. 5, holy Martha. 176 p.
- Díaz, JM, LM Barrios and DI Gómez-López (Eds.). 2003. The seagrass meadows in Colombia: structure and distribution of a strategic ecosystem. INVEMAR, Special Publications Series No. 10, holy Martha. 159 p.
- Fandiño-Lozano, M. 2001. Evaluation of a system of conservation area categories in force in Colombia. Rev. Atmosphere and development, Bogota. 9:55-74.
- Fandiño-Lozano, M. 2004. System of Categories of Conservation Areas. Special Administrative Unit of the System of parks Nationals natural, Bogota. 37 p.
- Fandino-Lozano, m. and W. go Wyngaarden. 2005. Priorities of conservation biological for Colombia. Cluster BOW, Bogota. 188 p.
- Franco-Mayan, A.M and GA Bravo. 2005. Areas important for the conservation of the birds in Colombia. 117-
- 281. In: Boyla, K. and A. Estrada (Eds.). Important areas for the conservation of birds in the Andes tropical: sites priority for the conservation of the biodiversity. BirdLife International and International Conservation. Series of Conservation of BirdLife No. 14, Quito.
- Friendlander, A., J. Salader, R. Appeldoorn, P. Usseglio, C. McCormick, S. Bejarano, and A. Mitchell-Chui. 2003. Designing effective marine protected areas in Seaflower Biosphere Reserve, Colombia. Based on biological and sociological information. Conservation Biol., 17 (6): 1769-1784.
- Garzón-Ferreira, J. 1989. Contribution to the knowledge of the ichthyofauna of Cupica Bay, department of El Chocó, Colombia. trianea On Scient. Techn., 3:149-172.
- Groves, CB, L. Valutis, D. Vosick, B. Neely, K. Wheaton, J. Touval, and B. Runnels. 2000. Design of a geography of the hope: manual for the planning of the conservation ecoregional. The Nature Conservancy, Vol I and II, Arlington, USA 215 p. halfpenny, h. and CM Roberts. In press. Designing to networks of marine book for Northwestern Europe.echo. Appl.
- INVEMAR. 1988. Diagnosis current of the communities marine of the bay cupica, analysis of effects real for the construction and operation of port facilities. Final report. INVEMAR, Santa Martha. 156 p.
- INVEMAR. 1992. Initial description of marine ecosystem monitoring units in Cupica Bay. Determination of the area of influence of Puerto Bolívar outside Cupica Bay. Final report, INVEMAR, holy Martha. 67 p.
- INVEMAR. 2004. Monitoring of representative ecosystems of Cupica Bay. Final report, INVEMAR, holy Martha. 137 p.
- INVEMAR. 2007. Design of a grid of areas marine protected for he north of the Peaceful continental Colombian. Report technical final, INVEMAR-COLCIENCIAS-UAESPNN- CORPOGUAJIRA-CORPAMAG- ENVIRONMENTAL DEFENSE-TNC, holy Martha. 16 p.
- INVEMAR-UAESPNN-TNC. 2008. Analysis of empty and proposal of the system representative of areas marine protected for Colombia. Final technical report, holy Martha. 64 p.
- Leslie, H., m. ruckelshaus, YO. Ball, S. Andelman and h. possingham. 2003. using sitting algorithms in the design of marine reserve networks. echo. Appl., 13(1):185-198.
- Loos, SA 2006. Exploration of MARXAN for utility in Marine Protected Area zoning. M.Sc. Thesis, Univ. of Victory, Canada. 199 p.
- Mejía, L. and A. Acero P. (Eds.). 2002. Red book of marine fish from Colombia. The Red Book series Endangered Species of Colombia. INVEMAR, Institute of Sciences natural University national of Colombia, Ministry of the Environment Atmosphere, Bogota. 174 p.
- MPA News. 2004. Australian parliament passes Re-Zoning Bill for great barrier reef, Creating World's largest book System. International News and analysis on Marine protected areas, 5: 10.
- MPA News. 2005. Scientists: UK Should Set Aside 30% of Waters as No-Take Reserves. International News and analysis on Marine protected areas, 6 (7): 4.
- Nagelkerken, YO., m. Dorenbosch, WCEP Verberk, c. of the Moriniere, and g. go right Velde. 2000. Importance of shallow-water biotopes of a Caribbean bay for juvenile coral reef fishes: Patterns in biotope association, community structure and spatial distribution. Sea. echo. Program Be., 202: 175–192.

- RF, MA O'Connell and DM Murphy. 1997. The science of preservation planning. Habitat preservation under the endangered species. Act. Island Press, Washington. 246 p.
- NRC. 2001. Marine protected areas: Tools for sustaining ocean ecosystems. National Research Council.
- National Academic, Washington. 272 p.
- Poiani, K. and DB Richter. 1999. Landscapes functional and the conservation of the biodiversity. documents Working Paper for Conservation Science, No. 1. Conservation Science Division. The Nature Conservancy, Herdon, USA 12 p.m.
- Poiani, K., b. Richter, m. anderson and h. Richter. 2000. biodiversity preservation at multiple scales. BioScience, 50(2):133-146.
- Prada, MC 2004. Large and multiple use MPA: Experiences about zoning process within the San Andres Archipelago. Report technical internal, CORALINA, Saint Andrew Archipelago. 59 p.
- Renjifo, LM, AM Franco-Maya, JD Amaya-Espinel, GH Kattan, and B. Lopez-Lanús (Eds.). 2002. Book red bird of Colombia. Series of red books on endangered species in Colombia. Institute of Investigation of Biological Resources Alexander von Humboldt and Ministry of the Environment, Bogota. 562 p.
- Roberts, CM, and JP Hawkins. 2000. Fully Protected Marine Reserves: A Guide. Seas campaign in WWF Hazard, Washington and Environment Department, University of York, Heslington York, Kingdom United. 141 p.
- Roberts, CM, FR Gell, and JP Hawkins. 2003a. Protecting nationally important marine areas in the Irish Sea Pilot projects region. environmental department, University of York, York, UK 133 p.
- Roberts, CM., S. Andelman, G. Branch, R. Bustamante, JC Castilla, D. Dugan, B. Halpern, K. Lafferty, H. Leslie, J. Lubchenco, d. mcardle, h. Posingham, m. ruckelshaus and R. Warner. 2003b. ecological criteria for evaluating candidate sites for marine reserves. echo. Appl., 13(1):199-214.
- Roberts, CM., G. Branch, RH Bustamante, JC Castilla, J. Dugan, BS Halpern, K. Lafferty, H. Leslie, J. Lubchenco, D. McArdle, M. Ruckelshaus, and R. Warner. 2003c. Application of ecological criteria in selecting marine reserves and developing reserve networks. echo. Appl., 13 (1): 215-228.
- Rodríguez, M. 2000. Status and distribution of Crocodylia in Colombia. Ministry of Environment, Bogota. 71 p.
- Rodriguez, m. 2002. crocodylus acutus . 41. In: chestnut-mulberry, O.V. (Ed.). Book red of reptiles of Colombia. Red books of threatened species of Colombia. Institute of Natural Sciences-University National of Colombia, Ministry of the Environment, Conservation International-Colombia, Bogota. 160 p.
- Hall, S., EITHER. Aburto-Oropeza, g. Walls, YO. Vine, JC Barrier and P.K. Dayton. 2002. General models for designing networks of marine reserves. Science, 298: 1991-1993.
- Psalm, VR, JR Clark, and AND. siirila. 2000. Marine and coastal protected area: TO guide for planners and managers.
- IUCN, Washington. 371 p.
- Sánchez-Páez, H., R. Álvarez-León, F. Pinto-Nolla, AS Sánchez-Alférez, JC Pinto-Renjifo, I. García-Hansen and MT Acosta-Peñaloza. 1997. Diagnosis and preliminary zoning of the Pacific mangroves. of Colombia. Proj. P.S. 171/91 Rev.2 (F) Phase YO. Conservation and driving for he use multiple of the mangroves of Colombia, Min. Environment/ITTO, Bogota. 511 p.
- schmidt, KF 1997. no-take areas spark fisheries debate. Science, 277: 489-491.
- Sguerra, S. (Ed.). 2005. The system national of Areas Protected Natural from Colombia – SINAP. Proposal Technique. November version of 2005, Bogota. 65 p.
- Solano, EITHER. 1994. corals, formations reefs and whitening of 1987 in bay cupica (Guajira, Colombia). an. Inst. Mar. Punta bitin, 23:149-163.
- TNC. 2000th. Scheme of the 5 S for the conservation of sites: manual of planning for the conservation of sites and the measurement of success in conservation. The Nature conservation, 1:62 p.
- TNC. 2000b. Workbook for the conservation of sites and measures of conservation success (PCS_ v2i.exe). The Nature Conservation. http://conserveonline.org/coldocs/2000/1/PCS_v2 i.exe/ librarydocument_view. 06/09.
- Turpie, JK, YOU Beckley, and YE Katua. 2000. Biogeography and the selection of priority areas for preservation of South African coastal fishes. Biol Cons., 92: 59-72.

- Vergara-Gonzalez, O. 1986. Guajiros. 12-29. In: Correa, F. and A. Pachón (Eds.). Introduction to Colombia Amerindian. Institute Colombian of Anthropology, Bogota. 49 p.m.
- Ward, TJ, MA Vanderklift, AO Nicholls and RA Kenchington. 1999. selecting marine book using habitats and species assemblies ace surrogate for biological diversity. echo. Appl., 9: 691-698.