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Project title: "Promotion of the effective management of a network of MPAs in the largest southern Atlantic coral reef complex: the Abrolhos Bank, Brazil."

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Summary

The project "Promotion of the effective management of a network of MPAs in the largest southern Atlantic coral reef complex: the Abrolhos Bank, Brazil" focused on the two main Marine Protected Areas (MPAs) in the Abrolhos Bank: the Abrolhos Marine National Park (AMNP) and the Corumbau Extractive Reserve (CER). The goal was to strengthen the implementation of an effective network of MPAs as a tool to conserve the region's unique biodiversity and reverse the ongoing decline of its fisheries resources. Through this project, Conservation International (CI) and in-country partners accomplished the following main results: (1) enhanced MPAs and buffer zones management effectiveness by expanding and advancing a biological monitoring program; (2) provided a baseline for fisheries management in the buffer zones, multiple-use and proximities of no-take areas; and (3) increased stakeholder awareness about the importance of MPAs for the sustainable management of local fisheries. This report contains a detailed presentation of the project's results.

Promotion of the effective management of a network of MPAs in the largest southern Atlantic coral reef complex: the Abrolhos Bank, Brazil

FINAL REPORT TO NOAA
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Contents

1. Project site: The Abrolhos Bank, Bahia State, Brazil

The Abrolhos Bank is a coral reef hotspot located in the Southwestern Atlantic Ocean (Werner et al. 2000, Moura 2003), along the coast of Brazil. The Brazilian reefs are small, comprising of only 5% of Western Atlantic reefs, but with high endemism levels (20% in reef fishes and ~50% in reef corals). The endemic-species/area ratios of the Southwestern Atlantic reefs are three to four times higher than those of the Caribbean (Moura 2003). Abrolhos is f a mosaic of marine and coastal ecosystems that encompass the highest biodiversity in the South Atlantic, the largest reefs of the Brazilian coast, as well as several endemic and red-listed marine species (Werner et al. 2000).

The Bank‘s MPAs encompass multiple types of protected areas, from no-take reserves such as the Abrolhos Marine National Park and the Itacolomis Marine Protected Area (a no-take marine reserve within the Marine Extractive Reserve of Corumbau) to multiple-use marine reserves, including the State Environmental Protection Area of Ponta da Baleia and the great part of the Marine Extractive Reserve of Corumbau (MERC) (**Figure 1**).

The Abrolhos Marine National Park (AMNP) was created in 1983 and is managed by the Brazilian Environmental Agency (ICMBio; formerly IBAMA), covering 88,240 ha. AMNP is divided in two separate portions – the Timbebas Reefs (11,100 ha) and the Archipelago and Parcel of Abrolhos (77,150 ha), located 45 miles off Caravelas, Bahia State. MERC was created in 2000 and covers 89,525 ha, being co-managed by ICMBio and a deliberative board composed by members of local communities and NGOs. MERC’s goal is to improve community livelihoods by fostering sustainable use and fisheries management. Although MERC is a multiple-use MPA, it’s management plan considers several no-take zones, the larger being the Itacolomis Marine Protected Area, covering approximately 20% of MERC’s reefs.

Abrolhos harbors the most diverse and important coral reefs in the South Atlantic. The unique reef type, locally known as “chapeirão”, consists of mushroom-shaped pinnacles built predominantly by Brazilian-endemic species, covered with fans of fire coral and round knobs of brain corals, also unique to

the Abrolhos Bank. All the commercially valuable species of reef fish in the South Atlantic can be found in the archipelago's surroundings, including red-listed large predatory fish such as the goliath grouper (*Epinephelus itajara*), the cubera snapper (*Lutjanus cyanopterus*), and the mutton snapper (*Lutjanus analis*). Between July and November, Abrolhos is visited by Humpback whales. Abrolhos is the only area in the South Atlantic to which the whales go in order to mate and give birth during the Antarctic winters. Key threatened bird species occur in the region, including the tropicbird *Phaeton aethereus* and the Royal tern, *Thalasseus maximus*. Three red-listed marine turtles are also present in the region, including the green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), and loggerhead (*Caretta caretta*). All this rich biodiversity is found in the no-take areas (Itacolomis and the Park), but these areas alone are not enough for the long-term conservation of this unique marine realm.

Most recommendations for biodiversity conservation and maximization of fisheries yields suggest that an optimum of 30–50% of the total management area be set aside in no-take reserves (Roberts et al. 2002, Halpern & Warner 2003). This reserve size allows populations to remain large enough to produce sufficient offspring for maintaining species stability and fisheries needs, while simultaneously leaving enough area open for fishermen to have sustainable catches (National Research Council 2001). As the State Environmental Protection Area of Ponta da Baleia has never been implemented, the actual Abrolhos MPA network covers only 4% of the Abrolhos Bank - clearly not enough to achieve the multiple goals expected from a MPA network. An optimized expansion of the Abrolhos network, although depending on several factors that lie outside the scope of the present project, also depend on assessing and monitoring the state of the ecosystems, generating a better baseline assessment of the fisheries along the unprotected areas, and especially on creating awareness on the importance and immense potential of MPAs. In the following sections we present a detailed presentation of the project's results, contributing to the ***promotion of the effective management of a network of MPAs in the Abrolhos Bank***.

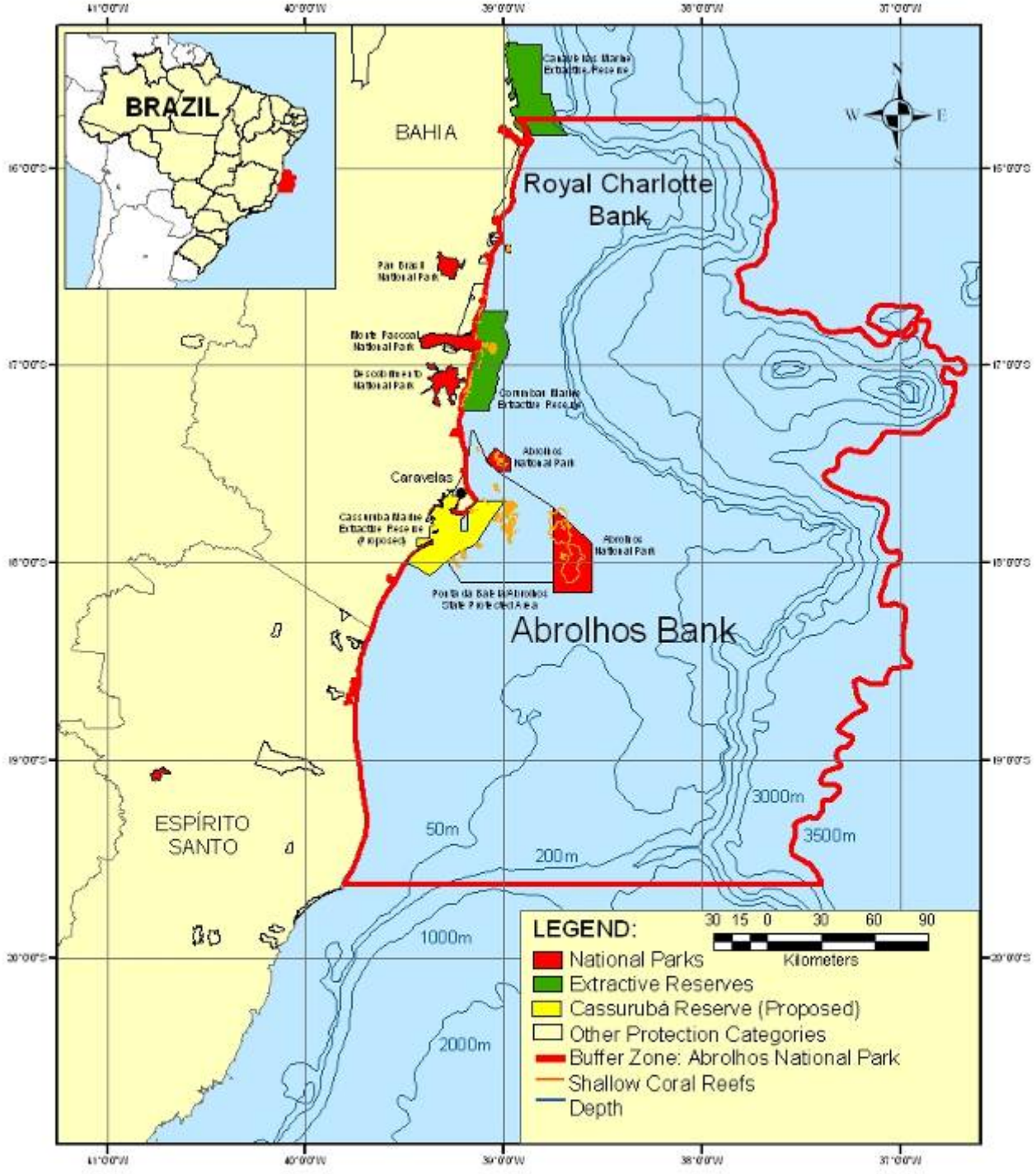

Figure 1. The Abrolhos Bank and its location within the tropical South-West Atlantic (Brazil), showing depth contours, State boundaries, existing (Abrolhos National Marine Park, Ponta da Baleia State Protected Area, Corumbau Extractive Reserve) and proposed (Cassurubá Extractive Reserve) Marine Protected Aareas (MPAs), proposed Buffer Zone, protected areas on land, and distribution of shallow reefs.

2. Research and monitoring

Several institutions have been monitoring the Abrolhos reefs with different protocols and independent structure. Besides providing a synthesis of the dynamics of fish assemblages subjected to different management regimes (Francini-Filho & Moura 2008 – Appendix 1), the project focused on promoting a dialog among the institutions that have been monitoring the Abrolhos reefs. An alliance of institutions was formed in order to evaluate sampling design and monitoring protocols, also involving the Brazilian Environmental Agency, IBAMA (currently ICMBio). The different monitoring approaches that have been undertaken in the region include CI's protocols, the AGRRA (employed between 2000 and 2002) and Reef Check coordinated by the Federal University of Pernambuco in 2000 and 2004). Although a joint sampling design and protocol was not agreed, the project triggered a more intense cooperation in terms of sampling design, infrastructure, logistics, and communication of results, maximizing both financial and human resources.

2.1 - Dynamics of fish assemblages subjected to different management regimes

Since 2001, CI and partners have been collecting biological data on the status of fish populations and benthic communities in the Abrolhos reserves and proximities. During the course of the project, a synthesis of the results of this monitoring program, from 2001 to 2005, was produced (Francini-Filho & Moura 2008 – Appendix 1).

Main findings

Main results of this study, *in press* in *Aquatic Conservation*, include: **(1)** Biomass of commercially important fishes was higher in the older no-take reserve, and biomass of black grouper, *Mycteroperca bonaci*, increased by 30-fold inside the no-take reserves during the study period, remaining consistently low elsewhere; **(2)** A single herbivore, the parrotfish *Scarus trispinosus*, dominated fish assemblages (28.3% of total biomass). Biomass of this species increased in 2002 within MERC (inside and outside no-take zones, soon after

establishment of a no-take zones and banning of parrotfish fishery in multiple-use zone. This increase was followed by a decline from 2003 onwards, after increased poaching and reopening of the parrotfish fishery; **(3)** Fleshy algae cover was high on some reefs (>50%) and inversely related to coral cover, probably due to overfishing of herbivores; **(4)** Fish biomass increased in 2002 along the entire region. This increase was stronger in sites closer to deeper reefs, where fish biomass was up to 30-times higher than shallow reefs: movements of fishes from deeper to shallower areas may have played a role; **(5)** Despite some positive signs, the effective use of MPAs in the Abrolhos Bank is still dependent on a larger network with adequate enforcement and including several critical unprotected habitats such as deep reefs and mangroves.

2.2 - Comparisons of protocols for sampling reef fish and benthic assemblages

In order to assess and understand methodological biases, cost-benefit issues, and the specific questions that each coral reef monitoring approach is able to address in Abrolhos, we developed comparisons among two of the most widely-used reef survey methods (AGGRA and Reef Check), and the methods previously used by CI-Brazil and partners in Abrolhos (**Table 1**). Comparisons of protocols for sampling reef fish and benthic assemblages were done in the Abrolhos Archipelago area (surveyed between March 04 and 11, 2006), in cooperation with scientists from the Federal University of Bahia - UFBA (team led by Dr. Ruy K. P. Kikuchi). Scientists from the Federal University of Pernambuco – UFPE (led by Dr. Beatrice Ferreira) could not participate in the joint field campaign, but two pre-sampling meetings and one post-sampling meeting were carried out with both team leaders and the project coordinator (Dr. Rodrigo Moura, from CI-Brazil).

Interaction between the lead project scientists was carried out as separate encounters during three major scientific meetings: XII COLACMAR (Latin American Marine Sciences Congress – Florianópolis, April 2007), XVII EBI (Brasilian Ichthyology Meeting - Itajaí, February 2007), and I SENAPE (National Symposium of Fisheries Statistics – Brasília, August 2007). During XII

COLACMAR, Dr. Beatrice Ferreira (Federal University of Pernambuco) convened a thematic symposium about coral reef science and conservation, with participation of other team members from Conservation International (CI-Brasil) and Federal University of Bahia (UFBA). During XVII EBI, Dr. Ferreira and the project coordinator convened a workshop about MPAS, with participation of managers and/or scientists working on six different Brazilian units, including Abrolhos.

Table 1. Methods used for sampling reef fish and benthic assemblages in the Abrolhos Archipelago and corresponding sampling effort.

Method	Sampling Unit	Number of Replicates
Fish assemblages		
Atlantic and Gulf Rapid Reef Assessment (AGGRA)	30 x 2 m linear transect + roving diver survey	10
Reef Check	20 x 5 m linear transect	10
Stationary Visual Census	Stratified (4m and 2m radius) stationary plot	15
Benthic assemblages		
Atlantic and Gulf Rapid Reef Assessment (AGGRA)	30 x 2 m linear transect and 25 cm^2 quadrat	10
Reef Check	20 m point-intercept line with 40 points	10

Main findings

Considering the 17 most abundant fish species in Abrolhos, stationary visual census was the most precise method, presenting the lowest Coefficient of Variation (CV) in abundance estimates of 11 species (64.71%). AGGRA protocol was more precise for the remaining species, and Reef Check was the least precise of the three methods, for all species (**Table 2**).

A Multidimensional Scaling (MDS) ordination of the mean densities of the 17 most abundant fish species sampled in each method (**Figure 2**) didn't reveal any consistent differences among estimates produced by the three different

methods. In addition, analyses of similarity (ANOSIN) corroborate the high similarity in the estimates produced by the different methods ($P > 0.01$; $R = 0.059$). Overall, the three different methods provide a similar depiction of the reef fish community structure.

Table 2 – Mean and Coefficient of Variation (CV) of the densities of the 17 most abundant fish species sampled by the three different methods.

	AGRRA		STATIONARY		REEF CHECK	
Species	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
*Malacoctenus sp.**	0.0267	0.19	0.0219	0.17	0.0085	0.41
*Parablennius sp. **	0.0270	0.18	0.0207	0.15	0.0190	0.32
*Stegastes spp.**	0.1377	0.10	0.2632	0.13	0.0340	0.32
Anisotremus virginicus	0.0513	0.18	0.0376	0.20	0.0295	0.23
Chaetodon striatus	0.0440	0.18	0.0234	0.14	0.0300	0.33
Haemulon parra	0.0590	0.51	0.1175	0.33	0.2545	0.78
Haemulon plumieri	0.0667	0.27	0.0804	0.30	0.0525	0.32
Abudefduf saxatilis	0.1733	0.19	0.1125	0.13	0.1335	0.20
Acanthurus bahianus	0.0803	0.22	0.0334	0.14	0.0235	0.22
Acanthurus chirurgus	0.0630	0.32	0.0149	0.27	0.0140	0.36
Acanthurus coeruleus	0.0327	0.21	0.0725	0.23	0.0355	0.35
Haemulon aurolineatum	0.4917	0.20	0.3152	0.24	0.3135	0.48
Ocyurus chrysurus	0.0477	0.31	0.0618	0.25	0.0255	0.25
*Scarus trispinosus**	0.0203	0.32	0.0194	0.27	0.0195	0.57
*Scarus zelindae**	0.0180	0.27	0.0117	0.25	0.0130	0.31
*Sparisoma axillare**	0.0237	0.19	0.0361	0.21	0.0055	0.38
Halichoeres poeyi	0.2407	0.18	0.0891	0.14	0.0845	0.34

* species endemic to Brazilian Reefs

Cost-benefit analyzes (**Table 3**) were premised on the direct relationship between the time spent censusing fish and the financial cost of the entire operation. Results indicated that stationary census demanded less set up time, less censusing time, and less staff for set up and execution (**Table 3**). Moreover, the need for the identification of *a priori* list of the species presented at each site increases the total time required for data collection in two or three days.

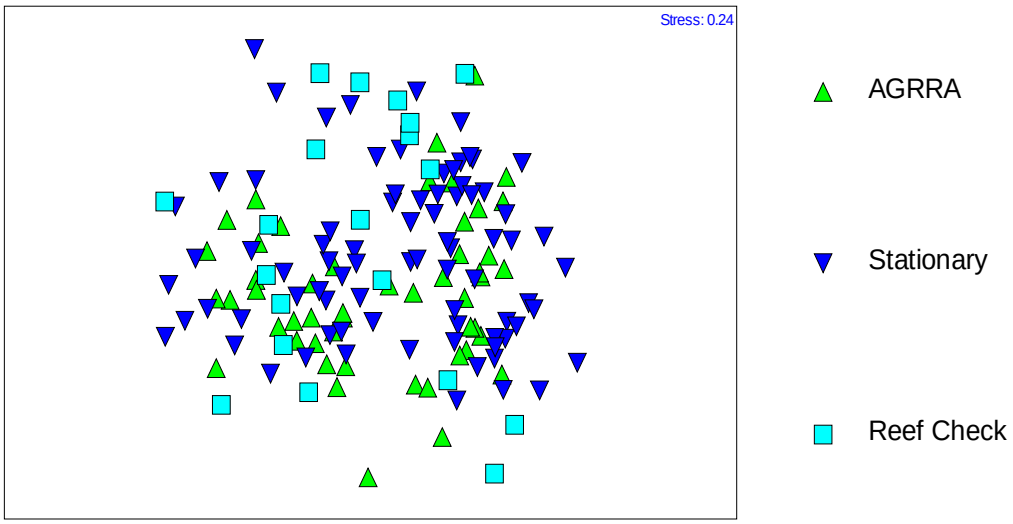

Figure 2 – Non-metric multidimensional scaling ordination of the mean densities of the 17 most abundant fish species sampled in each method.

Table 3. Variables used to estimate the costs of each method.

Protocols	Requires species list	Sampled Area	Taxonomic Refinement	Number of Divers	Set up Time	Censusing Time	Total Time
AGRRA	yes	60 m^2	Ecological and Taxonomic Groups	2	3-8 min.	15-20 min	18-28 min.
Stationary Censuses	no	50,2 m^2	Species	1	1-2 min.	5 min.	6-7 min.
Reef Check	no	100 m^2	Families	2	3-8 min.	8-12 min.	11-20 min.

Although a common sampling protocol was not achieved, as initially expected, the biases of each methodological approach are now more broadly understood, and allow for more reliable comparisons of results. A paper discussing the experience and the results is now under preparation, and will hopefully assist managers in the interpretation of reef monitoring results. Despite the challenges of maintaining long-term monitoring programs under a scenario of scarce resources, a greater integration between the groups that intermittently monitor the region is now achieved, including shared field logistics and infrastructure.

3 - Effective management

Careful consideration of the effects on allocation of resources among users, displacement of fishing activity, requirements for surveys and stock assessment for the most important target species, and assessment of

monitoring and enforcement costs should all be considered in future MPA options and design. Thus, considering that no-take marine reserves should be integrated with existing management measures, as part of a coherent ecosystem-based approach to fisheries management, we carried on a baseline assessment of the fishing activities around Abrolhos' MPAs. The baseline information we present herein may now help decision makers to understand the areas and species under pressure by fisheries, in order to make an informed proposal for the expansion of the current MPA network and boundaries, as well to propose alternative methods or areas for fishing.

Besides the interviews with vessels operating around the two no-take reserves we also conducted interviews with fishermen at the main landing sites, to collect information on the total capture and obtain basic biological data on the main target species. These activities were also key opportunities to increase awareness and support for MPAS and fisheries management around MPAS. In addition to the present Technical Report, we emphasize that the project's results were presented in all fishing villages targeted by the project, greatly strengthening the relationship between managers, researchers and local fishermen. Both approaches represent the seeds for an informed fisheries management policy for the region, reducing pressures and conflicts.

3.1 - Fisheries landings

Landings' data were obtained in the four main coastal municipalities near MPAs: Caravelas, Alcobaça, Prado and Nova Viçosa. A total of 1,362 reef fisheries landings were monitored since May 2006: 453 (33.3%) in Caravelas, 346 (25.4%) in Alcobaça, and 563 (41.3%) in Prado.

Fisheries were classified in three main categories: **(1)** Subsistence (targeted exclusively for direct consumption, without commercial purpose, motorized boats are not used); **(2)** Artisanal (captures partially or totally commercialized, small/ medium-size motorized boats, fishing artifacts are rudimentary and confectioned by fishermen who own the boat or work in partnership with the owner); and **(3)** Semi-industrial (fleet comprised by large motorized boats equipped with mechanic system to operate fishing gear, GPS

devices and radio-transmitters, majority of boats belong to companies operating in the coast of more than one State).

Fleet characteristics for each site is summarized in **Table 4**. Although there are several overlaps in terms of the fishing grounds, there are several distinctions in terms of fisheries types, gear, depth range and duration of operations. Existing MPAs affect communities differently, especially because they were set near the artisanal fleets' fishing grounds and far from the semi-industrial fisheries ranges. We predict that new MPAS in deeper zones, for example, will affect (negatively) mostly semi-industrial fleets. Specific strategies for the establishment and implementation of new MPAs must be developed considering the different needs and characteristics of the publics to be affected, positively or negatively, by such new units and/or fisheries regulations around existing MPAs. As we will emphasize in the forthcoming section concerning the spatial distribution of fisheries, there is a great complexity involved in the development of a fisheries management program for the Bank as a whole, requiring the development of mechanisms facilitating inter-agency cooperation.

Table 4 – Summary of fishing fleet characteristics by region monitored.

	Caravelas	**Alcobaça**	**Prado**
Fisheries types	Subsistence and Artisanal	Semi-industrial	Semi-industrial
Main fishery	Shrimp otter-trawl	Hook-and-line	Hook-and-line and longlines
Fishing gear	Hook-and-line, harpoon and gill net	gill net, harpoon, longlines (bottom and surface) and hook-and-line	harpoon, gill net, longlines (bottom and surface) and hook-and-line
Number of boats (n)	200	250	150
Boats size (m)	5.5 to 9	5.5 to 9	5.5 to 9
Crew (n)	1 to 4	3 to 11	3 to 14
Load capacity (t)	0.7 to 2	0.7 to 2	0.7 to 2
Mean fishing time (days)	1.3	12.1	14.46
Depth range of operations (m)	13 to 21	15 to 640	31 to 500
Main Targets	Shrimp (Penaidae), Lutjanidae (snappers) and Serranidae (groupers)	Lobster, Lutjanidae (snappers) and Serranidae (groupers)	Lobster, Coryphaenidae (dolphinfish), Lutjanidae (snappers) and Serranidae (groupers)

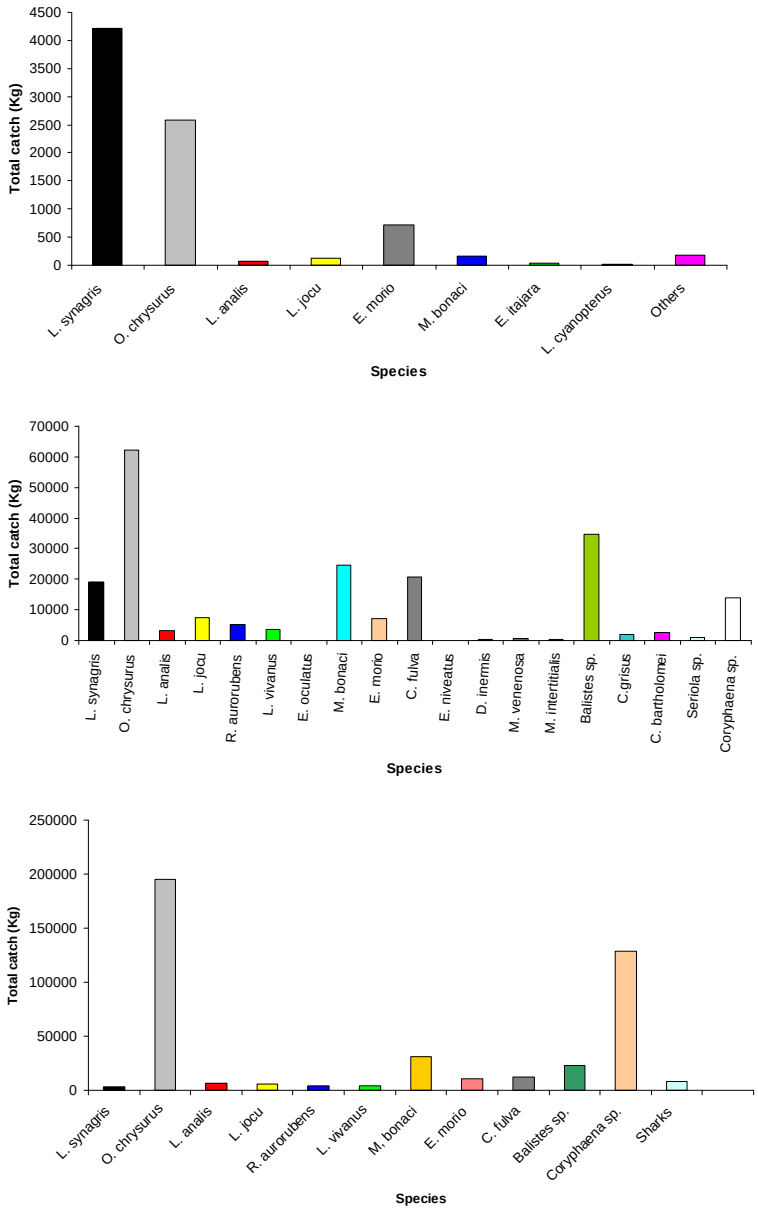

Figure 3 – Total catch of main fish species landed during the study period in Caravelas (a), Alcobaça (b) e Prado (c).

In general, Lutjanidae and Serranidae species were the main targets of the reef fisheries at all monitored sites (**Figures 3 and 4**), especially *Lutjanus synagris*, *Ocyurus chrysurus* (Lutjanidade), *Mycteroperca bonaci*, *Epinephelus morio* and *Cephalopholis fulva* (Serranidae). Lutjanids and serranids represent the most important reef fisheries resources in the tropical West Atlantic (Allen, 1985), also playing a major role as predators in reef ecosystems.

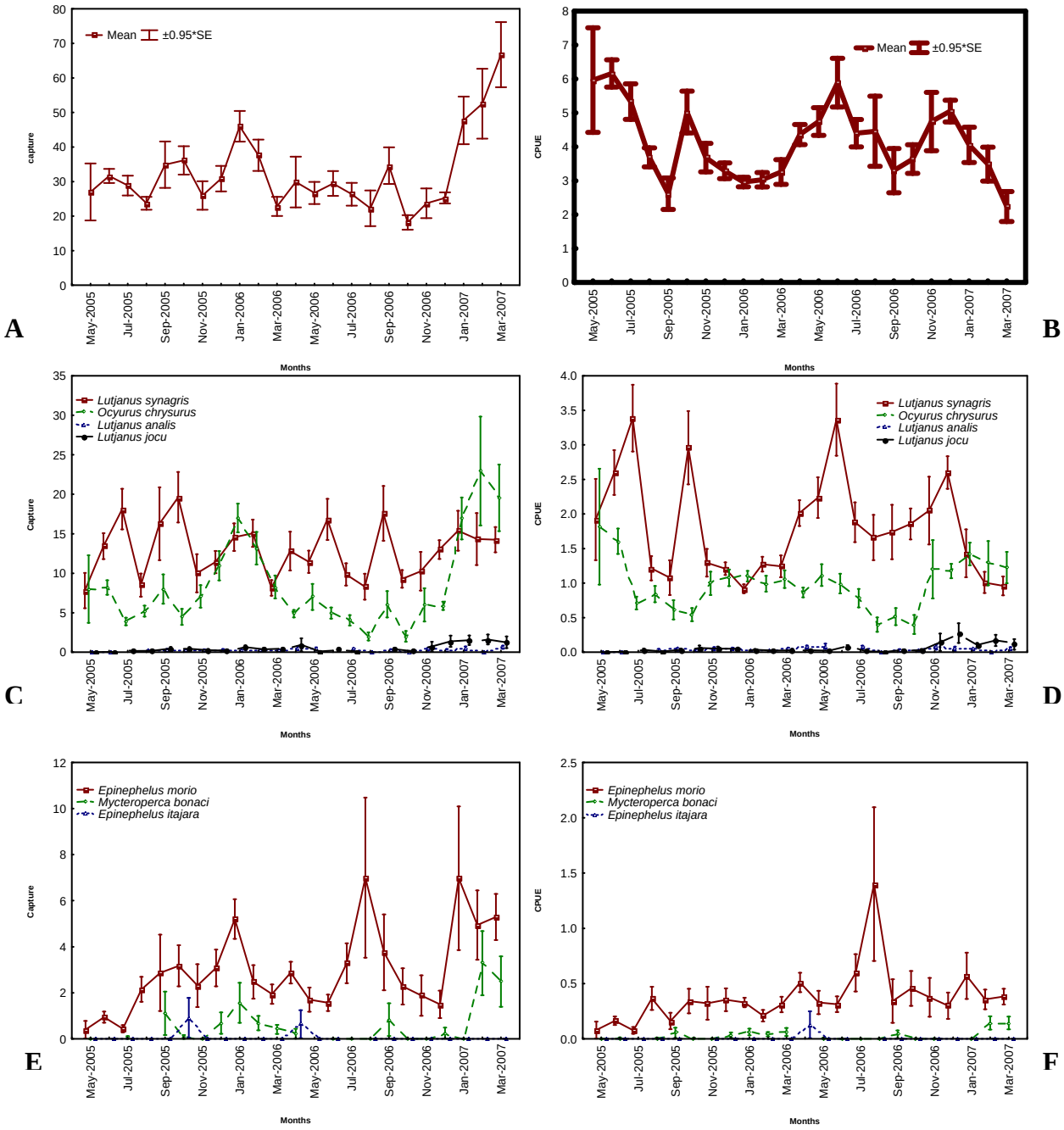

Figure 4. (A) Total snapper and grouper landings sampled at all three municipalities (Prado, Alcobaça and Caravelas); **(B)** Catches per Unit of Effort (CPUE) of snappers and groupers at all three municipalities; **(C)** Total landings (kg) of the most representative snappers sampled at all three municipalities; **(D)** Catches per Unit of Effort (CPUE) of the main snapper species disembarked at all three municipalities; **(E)** Total landings (kg) of the most representative groupers sampled at all three municipalities; **(F)** Catches per Unit of Effort (CPUE) of the main grouper species landed at all three municipalities.

Due to several similarities regarding fishing grounds and gear, as well as the long-lived and large-sized nature of the species, these resources are

frequently referred collectively as the “snapper–grouper complex” (e.g. Coleman et al 2000, Gobert et al. 2005). Following the worldwide trends of marine fisheries (Pauly et al., 2005), several, if not most snapper-grouper fisheries are sharply declining or collapsing, including those that are the most intensively researched and managed. Due to the concentrated nature of the reproductive events of several species, spawning aggregations of snappers and groupers are disappearing even before scientists and managers realize their existence (e.g. Colin et al., 2003).

Signs of overfishing were identified for all studied species in the snapper-grouper complex, some of them already collapsed in the Abrolhos Bank (e.g. *L. cyanopterus*, *L. analis*, *M. venenosa* and *E. itajara*). In the course of the present study[1] we found that several species of commercially important reef fishes in the snapper-grouper complex spawn in the equivalent northern hemisphere spawning seasons, and also have similar sizes at maturity. These include the snappers *Lutjanus synagris*, *L. jocu*, *Ocyurus chrysurus* and *Rhomboplites aurorubens*, and the groupers *Cephalopholis fulva*, *Mycteroperca bonaci* and *Epinephelus morio*. With the exception of *R. aurorubens*, snappers tend to spawn in the spring and groupers tend to spawn from the winter to spring.

Thus, banning and/or restricting captures in specific (spawning) seasons may be a potential management strategy for the Abrolhos Bank snapper-grouper fisheries, at least in multiple-use MPAS and near no-take zones. We propose breaking the management inertia with a combination of catch and effort limitations within and outside Marine Protected Areas, coping with the region’s size and characteristics, taking advantage of the MPA network as a governance framework for fisheries management.

[1] Specific results concerning reef fish reproduction are out of the scope of the present project and will not be presented herein.

3.2 – Characteristics and spatial distribution of fisheries

Spatial information and characteristics of fishing vessels were collected during seven E-W transects from the shore to the shelf break, between January and March 2007, resulting in 71 interviews with captains or crew members, and 27 additional sightings of fishing vessels (no interviews, only spatial information) (**Tables 5 and 6; Figures 5 and 6**) The Humpback Whale Institute, a partner institution which was carrying cetacean research in the southern portion of the Bank during the study period, also participated in the survey (with a simplified protocol), reporting 54 sightings of fishing vessels in that area (**Figure 6**).

Table 5. Number of fishing vessels interviewed at sea and the respective origin landing port. BA= Bahia State; ES= Espírito Santo State.

Landing Port (City/State)	N. of Vessels (Interviews)	Landing Port (City/State)	N. of Vessels (Interviews)
Conceição da Barra - ES	12	Cabrália – BA	3
Vitória – ES	12	Mucuri – BA	3
Alcobaça – BA	6	Corumbau – BA	2
Porto Seguro – BA	6	Guaiú – ES	2
Barra Nova – BA	5	Belmonte – BA	1
Caravelas (Barra) - BA	4	Campo Grande - ES	1
Nova Viçosa – BA	4	Piúma – ES	2
Prado – BA	4	Vila Velha – ES	1

Table 6. Fishing gears used by the vessels interviewed at sea.

Fishing Gear	Frequency (%)
Trawl	24
Net	18
Line	18
Long Line	10
Long Line/Line	8
Net/Line	7
Dive	4
Trawl/Line	3
Trawl/Net	3
Long Line/Net	1
Line/Dive	1
Line/Trawl/Net	1

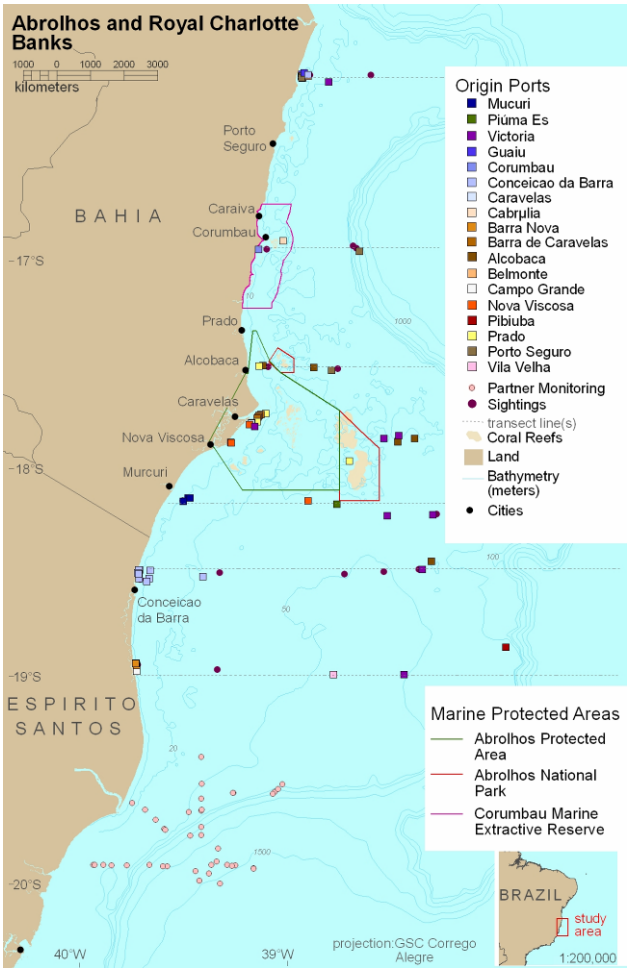

Figure 5. Locations of fishing vessels operating in the Abrolhos Bank, along the seven transects held on summer 2007. Boat trips and their respective ports of origin are described in the legend ("Sightings" indicates boats observed but with no port of origin identification).

Notice concentration of effort around the Abrolhos National Park, and one illegal fishing operation.

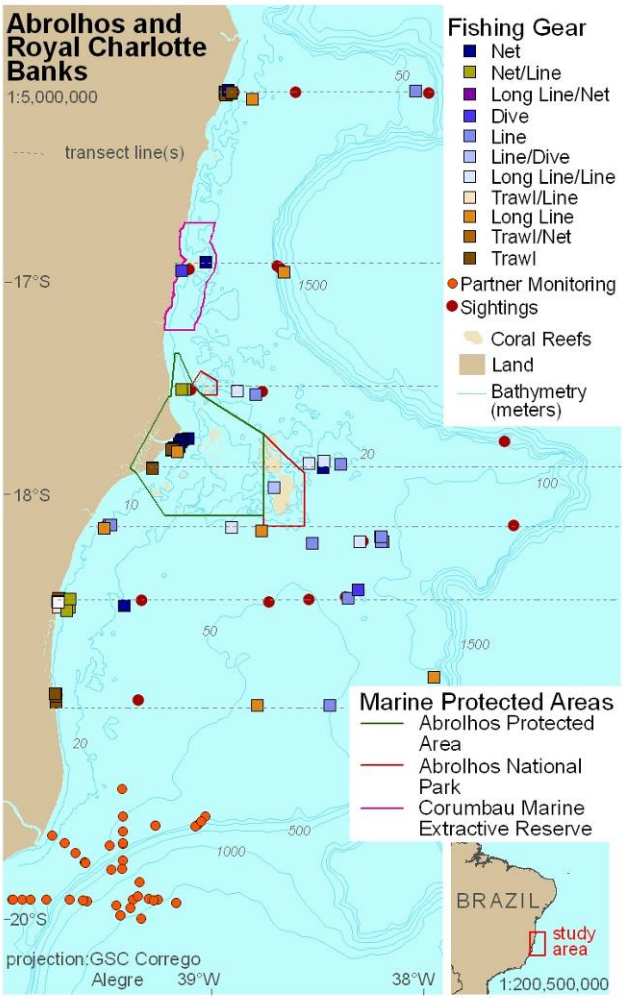

Figure 6. Locations of fishing vessels operating in the Abrolhos Bank, along the seven transects held on summer 2007. Boat trips and their respective gears are described in the legend ("Sightings" indicates boats observed but with no gear identification).

3.3 Main findings and future directions

One of the most relevant findings within this component of the project is the fact that fishing grounds around the Bank's MPAS (all within Bahia State) are shared by fleets from two different Brazilian States. Considering only data from the interviews at sea, we found vessels from both Bahia (58%) and Espírito Santo State (42%), from 18 different municipalities (**Figures 5 and 6**), with use of several fishing gears and combination of different fishing gears (**Table 6**). These results are already introduced into a GIS database and demonstrate the great complexity involved in the development of a fisheries management program for the Abrolhos Bank, requiring the development of a strong inter-State cooperation among agencies - which is now still incipient.

It is clear from the project's results and other recent and ongoing studies that managing fisheries only within the existing MPA network will not reverse the current decline trends observed in Abrolhos and the central Brazilian coast as a whole, specially because the larger specimens and higher captures are being reached far off the limits of these MPAs (see depth ranges in **Table 4).** No existing MPA reaches habitats deeper than 20 m, and no estuaries are inside their limits. However, the existence of a legal framework for establishing at least a pilot management plan for the snapper-grouper fisheries within the multiple-use Corumbau Extractive Reserve, within the larger unimplemented MPA (Ponta da Baleia Abrolhos State protected Area), and also in the (proposed) Buffer Zone around the Abrolhos National Park (with limited but with some jurisdiction from the MPA's authorities and council), provides a favorable starting point for the implementation of fisheries regulations within larger and more meaningful biological and significant socio-economic spatial scales. Although the scientific knowledge and the existing databases need to be amplified, the current state of knowledge about the fisheries, the species pool present in the fisheries (Moura & Francini-Filho 2006, Moura & Lindeman 2007), the habitat use of the main species and their spawning seasons, are enough to propose initial measures to start reversing the decline observed in the last two or three decades.

4 - Capacity Building and Communication

The capacity building and communication strategy employed along the project emphasized the participation of local communities, through the opening of several communication channels and venues. We were premised on the fact that raising stakeholder awareness and building their capacity increases support for MPAs and for the sustainable use of resources in the adjacent open-access areas. Accordingly, the main target audiences for the awareness activities were schoolteachers, because of the multiplicative effect they have on students, and also the local fishing communities, which depend and use the local natural resources.

Three main components were devised and implemented within the project's capacity building and communication strategy: **(1)** Production and dissemination of communication materials about the region's fishing legislation, MPA boundaries and regulations; **(2)** Promotion of meetings with fishing communities in the municipalities around MPAs, to share information about the MPAs regulations, boundaries and benefits; **(3)** Involvement of schoolteachers in field trips to visit the Abrolhos Marine National Park.

4.1 - Production and dissemination of communication materials

Contents of the communication materials were focused on the region's unique biodiversity, fishing legislation, MPA boundaries and regulations. After consulting with fishermen about their expectation and needs, large and permanent signs (panels) were placed in three major landing sites, informing not only about MPAs and legislation, but already providing a space to place weather forecast updates and general information of communitarian interest (meetings, parties, etc.). The three large signs (110 x 160 cm) that were installed also have a space for printed news (there are no newspapers in the region) and weather forecast, and are placed in strategic points that are assessed daily by several fishermen (**Figure 7**).

Figure 7. General layout (above) and the actual panels installed in public places frequented by fishermen (below).

4.2 Promotion of meetings with fishing communities around MPAs

In order to share information about the MPAs regulations, boundaries and benefits, as well as to hear expectations and needs from the community, several meetings were promoted with the fishing communities of the municipalities around MPAs.

During September 2007, two formal meetings (30-40 people each) and a series of smaller informal meetings (household or neighborhood level) were promoted with fishermen from the three most important fishing ports in the municipality of Caravelas (Barra de Caravelas, Ponta de Areia and Centro), in order to share information about captures (catch per unit effort), size, and reproductive periods of the main target species. In January and February 2008, we scaled-up the initiative and promoted additional meetings in the municipalities of Nova Viçosa, Alcobaça, and Prado, including the Corumbau Marine Extractive Reserve, directly involving about 200 fishermen and four fishing associations/guilds (*Colônias dos Pescadores* in Portuguese) (**Figure 8**). In all meetings, involving scientists from Federal University of Bahia, State University of Bahia, State University of Maringá, and CI-Brazil, fishermen were very concerned about the information provided, such as the large reproductive size/age of their main targets, and the captures concentrated into reproductive periods when fishes form spawning aggregations. Despite the concerns, these information-sharing exercises helped to strengthen the relationship between researchers and the fishing community. Moreover, they also increased the awareness about the urgent need to implement changes in fishing techniques, fishing areas, and implement an overall fisheries management strategy in the Abrolhos Bank. The challenge, however, is coupling more restrictive regulations with the overall poverty and exclusion context in which fishermen are immersed.

In most instances (with the exception of some communities such as those within Corumbau Marine Extractive Reserve), these meetings represented the first contact of the fishermen with researchers, and the joint

discussion of problems and potential solutions. The concept of “no-take reserves”, previously not well known by these communities, has today a broader understanding and support, as these areas are now starting to be seen as “fish repositories”.

Figure 8. Meetings between scientists and fishermen, focused on the discussion of the current state of fisheries and potential management strategies.

Despite such immense challenges, it is noteworthy that communication efforts are influencing people to communicate and organize themselves. For instance, a substantial amount of the fishing community has recently requested the creation of another Extractive Reserve in Bank, the Cassurubá Extractive Reserve (CER), located in the estuaries of the municipalities of Caravelas and Nova Viçosa (see **Figure 1**). Once declared by the Brazilian Government, this 1,000 km^2 managed area will protect the most important mangroves and shrimp grounds in the Bank. CI-Brazil and local partners are very committed to this initiative, and have supported the technical studies and the public hearings for the creation of the reserve along 2007 (**Figure 9).** The CER proposal can be considered one of the most important and concrete results of this project and associated initiatives.

Figure 9. Public hearings for the creation of the Cassurubá Marine Extractive Reserve in the municipalities of Caravelas and Nova Viçosa.

4.3 Involvement of schoolteachers and fishermen

In April 2006, 42 school teachers (24 women and 18 men, 20-45 years old) from the four main municipalities neighboring the Abrolhos MPAs (Caravelas, Alcobaça, Prado and Nova Viçosa) benefited from a capacity building and communication initiative (*Professores no Parque* – Teachers in the Park). During an entire week they participated in several activities such as lectures about relevant ecological themes and environmental education practices, group dynamics, interpretative trails, and also took a basic diving course (**Figure 10**). In the subsequent weekend, all teachers visited the Abrolhos Marine National Park for the first time (**Figure 10**).

In order to estimate the multiplier effect of the teachers on students, in August and-September 2006, all schools were visited and the teachers interviewed. As a result of this follow-up initiative, 30 small projects were conducted by the teachers and students, encompassing different environmental issues, such as garbage, water quality and beach conservation (**Table 7**).

Figure 10 – Different aspects of the schoolteachers' training. Clockwise from the upper left: 1) formal classes about the regions reefs; 2) diving course; 3) group activities in the park's visitors' center; 3) visit to the islands.

Table 7 – Summary of the small projects developed by teachers and students who received training during the project

Project Name	Students Age (years)	n° of students	Teachers	Objetive
"People with a heart don't toss garbage on the floor"	12 - 17	150	1	Awareness about solid waste problems.
"Rubbish in the basket, Why?"	8 - 10	32	1	
"Rubbish in the basket: Community Conscience"	7 - 8	25	1	
"Building partners to defend the environment"	09 - 11	40	1	Social Responsibility and Environmental Awareness.
"S.O.S. Planet Earth"	07 - 14	130	2	
"Conscious Mind, Different Environment"	09 - 16	250	1	
"Care about the Planet, save the life"	11 - 17	355	2	
"Open your Eyes 2006"	10 - 50	*250 - **1000	1	
"Vegetable Garden at School"	14 - 18	52	1	
"Vegetable Garden – A Place of Ideas"	12 - 20	*400 - **1300	1	Social Responsibility and Environmental Awareness. Students appreciating organic food and its importance.
"Vegetable Garden at School"	8	31	1	
"Vegetable Garden"	08 - 10	300	1	
"Water, a fargile and vital cycle"	11 - 20	300	2	Social Responsibility and Environmental Awareness about the importance of Fresh Water
"Barrinha River Project"	11 - 13	83	1	Social Responsibility and Environmental awareness showing the importance of a small creek, the Barrinha River
"Consumer awareness – capacity building for teachers"		60 - 80	2	Capacity building and awareness about natural resource sustainability .
"ABC of the beach"	5 e 6	21	1	Teach to read and write using words from the environment, specially the beach.
"Children of charcoal"			1	Survey and Awareness about children working with charcoal.

Besides the aforementioned activities with schoolteachers and students, a complimentary outreach initiative, also targeted at schoolteachers and students, was proposed and is being funded by the Brazilian Ministry of Science and Technology (December 2006-December 2008). This project, entitled “Abra os Olhos para a Ciência” (Open your Eyes to Science) is a continuity effort that arose from the NOAA project. Since July 2007, a group of 80 teachers and 20 students are being engaged in activities in the Abrolhos Park Visitors’ Center (Figure 6), and in the field (coastal plains, estuary, and Abrolhos archipelago).

It is worth mentioning that approximately 80% of all teachers had never been to the park before the program *Professores no Parque* was established. Taking schoolteachers in field trips to visit the MPAs, especially the Abrolhos Marine National Park, is a permanent challenge due to financial and logistic limitations. However, it is being shown as the most rewarding strategy to raise local awareness about the region’s biodiversity, and about the benefits of the MPAs for conservation and welfare. We were able to start a broad initiative with the NOAA grant in 2005-2006, and to successfully fundraise for two more years (2007-2008). The environmental agency responsible for the MPAs management lack resources to adequately maintain its basic functions, and it is likely that NGOs and other agencies will need to keep on supporting such activities, at least for some more years.

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5 - Constraints

Three major (and related) factors constrained the project’s initially proposed activities and overall chronogram. First, the former manager of Abrolhos National Park, who was part of the team that conceived the project,

was changed for another officer. Although the new park manager absorbed the project's aims and understood its seminal importance for a longer-term MPA strategy for the entire Bank, it took some additional time till the two teams fully achieve coordination.

Another constrain was related to the chronic malfunctioning of the Abrolhos National Marine Park boat (RV Benedito), and the need to use rented boats for the field operations. Finally, the project was affected by a complete restructuring of Brazils Federal Environmental System. The Ministry of Environment now heads two main different agencies: IBAMA (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis), which is now mainly devoted to environmental licensing, and the recently created ICMBio (*Instituto Chico Mendes de Conservação da Biodiversidade*), devoted specifically to protected areas. These factors resulted in several operational difficulties, overcame by the expansion of the project's timeline.

6- Project products and outcomes

Besides the overarching monitoring framework used by CI to measure the achievement of high-level objectives in a consistent way across regions, we monitored the achievement of the project's goal and objectives by using a series of indicators, as follows:

6.1 - Sampling Design and Monitoring Protocol

Indicators: Greater integration between the three groups that have intermittently monitored the region was achieved, including shared field logistics and infrastructure. A common sampling protocol was not reached as expected. However, and relevantly, biases of each method are now more broadly understood and will allow more reliable comparisons of results. A broad diagnostics of the current state and dynamics of Abrolhos' reefs is concluded.

6.2 – Fisheries Inventory

Indicators: Types of fisheries, fleet characteristics, effort and main fishing grounds around the Abrolhos' Bank MPAs are already described. Diversity and basic biological parameters (e.g. size at maturity, spawning seasons) from the main target species is already assessed. Results are presented and discussed with fishermen from all municipalities around the MPAs. An analysis report is not yet produced, but will be released in Portuguese, in the mid-term (2008-2009), containing a synthesis of the most relevant findings and and recommendations for management.

6.3 - Map of fisheries in Abrolhos

Indicators: Distribution of vessels and fisheries around the Abrolhos Park and Corumbau Reserve is assessed, and data is incorporated into a GIS database containing information such as origin, type of vessel, equipment and target species. Results are presented and discussed with fishermen from all municipalities around the MPAs. The map of fisheries is complimentary to the analysis report. An unexpected high frequency of boats from Espírito Santo State operating around the MPAs in Bahia State adds complexity for managing the region's fisheries and requires the development of a strong inter-agency cooperation.

6.4 - Communications products

Indicators: The outreach strategy was one of the most successful components of the project, and is being continued through follow-up projects and aggregation of new partners. Communication needs were discussed with the community and delivered not only to provide information about MPAs, but also to provide useful communication channels within the community.

6.5 - Mid-term and Final Technical and Financial Reports

Indicators: All required mid-term Technical and Financial Reports are delivered to NOAA.

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