

EXPEDITION REPORT

Expedition dates: 1 - 27 March 2009

Report published: July 2010

Diving the Caribbean to safeguard
the coral reef of the Cayos Cochinos
marine protected area, Honduras.



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**Authors:
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HCRF**

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**Kathy Wilden & Matthias Hammer (editor)
Biosphere Expeditions**

ABSTRACT

The Cayos Cochinos Natural Monument, located off the coast of Honduras in the Caribbean Sea, was declared a protected area by the Honduran government in 1992 and in 2003 was awarded the status of a Marine Nature Monument. The Cayos Cochinos Natural Monument is an important and protected part of the Meso-American barrier reef and the world's second largest barrier reef system, which has been identified by the Smithsonian Institute, The Nature Conservancy, the World Wildlife Fund and the World Bank as one of the key sections of the barrier reef system to preserve. In 2004 the first management plan was published and new zoning and connected regulations were approved. This was updated by the 2008 - 2012 management plan, which was also based on the important monitoring findings provided by these joint Biosphere Expeditions and Honduras Coral Reef Fund expeditions. This report summarises the findings of the third survey of this long-term monitoring programme, which was conducted from 1 - 27 March 2009.

Reef Check is the methodology selected for this survey involving volunteer divers, as it was designed to assess the health of coral reefs and because it is also quite different from other monitoring protocols in that it focuses on the abundance of particular coral reef organisms that best reflect the condition of the ecosystem and that are easily recognizable to the general public. This study also includes a comparative Reef Check analysis over 4 years.

From the beginning of the monitoring efforts in 2006 to date, we have observed a gradual decrease in the average abundance of big predators such as groupers. We have also observed a high average abundance of herbivore indicator species, showing a slight reduction in 2009. This reduction of predators and increase of herbivores could be the beginning of significant changes within the coral reef ecosystem, which we will have to continue monitoring to establish appropriate management measures.

It is important to note the increasing fishing pressure on commercial species such as *Ocyurus crysurus*, *Lutjanus cynagris*, *Haemulon plumieri* and *Mycteroperca bonaci*. The conch and lobster have also shown low abundances since monitoring began, these two invertebrates traditionally being the species of greatest exploitation in Honduras. However, our management efforts to reduce fishing pressure, especially the efforts of providing viable community economic alternatives as well as establishing temporary no fishing zones on spawning aggregation sites, are beginning to show positive results.

The sea urchin that feeds on algae was found to be abundant, especially at the El Avión site. The high sea urchin number at this site could indicate the beginning of a coral recovery.

Overall coral coverage is still low around Cayos Cochinos, but the reduction in bleached areas is significant. Nonetheless, we observed high levels of detrimental sedimentation originating from the mainland and the landslides on Cayo Mayor.

Our recommendations for future expedition work is continued monitoring of the effectiveness of management plan regulations, implementation of an environmental education programme, continued biological monitoring and initiation of a study to determinate the levels of fish extraction during the spawning aggregation periods.

RESUMEN

El Monumento Natural Cayos Cochinos, ubicado en la costa de Honduras en el Caribe, fue declarado área protegida por el gobierno hondureño en 1992 y en el 2003 fue premiada con el estatus de Monumento Natural Marino. El Monumento Natural Cayos Cochinos es una parte importante y protegida del Sistema Arrecifal Mesoamericano y es el segundo sistema arrecifal más grande. En el 2004 un plan de manejo fue publicado y nuevas zonificaciones y regulaciones fueron aprobadas.

El actual estudio fue iniciado en el 2006 por la Fundación Cayos Cochinos y Biosphere Expeditions con el propósito de establecer evidencia científica y evaluar la efectividad de las nuevas regulaciones en proteger los hábitats y especies que residen dentro del Monumento Natural Cayos Cochinos. Este reporte resume los resultados de la tercer inspección de este programa de monitoreo de largo plazo, que fue conducido del 1-27 marzo 2009

Reef Check es la metodología seleccionada para esta inspección que involucra buceadores voluntarios, ya que fue diseñada para evaluar la salud de los arrecifes coralinos y porque también es algo diferente de otros protocolos de monitoreo ya que este se enfoca en la abundancia de organismos particulares de los arrecifes coralinos que mejor reflejan la condición del ecosistema y que son fácil de reconocer por el público en general. El presente estudio realiza un análisis comparativo entre los 4 años de monitoreos, se analizaron los datos aplicando pruebas no paramétricas, ANOVA de múltiples variables mediante la prueba de Kruskal-Wallis, igualmente se aplican análisis de ANOVA de una vías y de dos vías.

Desde que se iniciaron los monitoreos se ha observado un descenso gradual de la abundancia promedio de depredadores grandes tales como groupers (Serranidae) esto podría ser debido a la extracción en el caso de meros o de las poblaciones presas, por otra parte se observa que el grupo de indicador de peces de mayor abundancia promedio son los herbívoros (Parrotfish) mostrando una ligera reducción en el 2009. Esta reducción de predadores y aumento de herbívoros podrían generar cambios significativos en los ensamblajes ecológicos dentro de los ecosistemas de arrecifes de coral, el cual será necesario seguir monitoreando para establecer medidas de manejo que permitan mejorar este equilibrio ecológico. Por otra parte si agregamos que existe una presión pesquera en especies de importancia comercial como *Ocyurus crysurus*, *Lutjanus cynagris*, *Haemulon plumieri* y *Mycteroperca bonaci* pertenecientes a los Snapper (Lutjanidae), Haemulidos, Serranidae siendo este último grupo de mayor vulnerabilidad a la pesca debido a que hay meses del año en las que se reproducen y su extracción se concentran en estas épocas. De más grande preocupación es la muy baja abundancia de caracol y langosta. Esto son dos de los más importantes y los invertebrados más sobre explotados en Honduras. El Erizo *Diadema* spp que se alimenta de algas fue encontrado en buena abundancia, especialmente en el sitio El Avión, el alto número de *Diadema* en este sitio podría indicar el comienzo de una recuperación, como ellos se van alimentando de las algas hacen espacio para el crecimiento del nuevo coral. La cobertura coralina es aun baja en la región. La reducción en la extensión del blanqueamiento y daño coralino es alentadora. Sin embargo, donde específicas incidencias fueron registradas, eran más severas, sugiriendo una fuente mas localizada de daño como el sedimento o deslaves de las islas locales.

Los esfuerzos por reducir los impactos de la sobre extracción de los recursos y el desequilibrio ambiental en los ensamblajes de organismos arrecifales se esta comenzando a observar con la recuperación muy lenta de los recursos, uno de estos esfuerzos es a través de la implementación de alternativas económicas comunitarios lo cual poco a poco se esta reduciendo la presión pesquera por las comunidades locales y de influencia. Otro esfuerzo planteado en el plan de manejo 2008-2012 es la implementación de zonas de no pesca temporales en los sitios de agregación reproductiva.

Se recomienda dar seguimiento de las regulaciones establecidas en el plan de manejo, implementar un Programa de Educación Ambiental, continuar con los monitoreos biológicos y del impacto de la operación turística la cual cada vez en aumento, así como determinar las capturas pesqueras versus el número de turistas, y la extracción de peces en periodo de reproducción. Se recomienda continuar con el monitoreo para evaluar el impacto en los ecosistemas de los programas de televisión Realities Show, las actividades de turismo científico.

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Please note: Each expedition report is written as a stand-alone document that can be read without having to refer back to previous reports. As such, much of this and the following sections, which remain valid and relevant, is a repetition from previous reports, copied here to provide the reader with an uninterrupted flow of argument and rationale.

1. Expedition Review

K. Wilden & M. Hammer (editor)
Biosphere Expeditions

1.1. Background

Biosphere Expeditions runs wildlife conservation research expeditions to all corners of the Earth. Projects are not tours, photographic safaris or excursions, but genuine research expeditions placing ordinary people with no research experience alongside scientists who are at the forefront of conservation work. Expeditions are open to all and there are no special skills (biological or otherwise) required to join. Expedition team members are people from all walks of life and of all ages, looking for an adventure with a conscience and a sense of purpose. More information about Biosphere Expeditions and its research expeditions can be found at www.biosphere-expeditions.org.

This expedition report deals with an expedition to the world's second largest reef system in the middle of the Cayos Cochinos Natural Monument in the Caribbean Sea, off the coast of Honduras, which ran from 1 to 27 March 2009. The purpose of the survey programme was to provide data on the current biological status of the reefs and islands and of population levels of protected species within the marine protected area. All this as part of an international coral reef research programme, called the Reef Check monitoring programme.

1.2. Research area

The Cayos Cochinos are a group of two small islands (Cochino Pequeno and Cochino Grande) and 13 small coral cays situated 30 kilometres northeast of the town of La Ceiba on the northern shores of Honduras. In November 1993, a Presidential Decree designated the Cayos Cochinos a Natural Protected Area and the Honduras Coral Reef Fund (HCRF) as the managing agency responsible for the conservation of the islands. In August 1994 a second Presidential Decree, confirmed the protected status of the islands. In November 2003 a Legislative Decree declared a Marine Natural Monument. The protected area covers 460 km² and HCRF are responsible for its management.

The Cayos Cochinos form part of the world's second largest barrier reef system, known as the Meso-American Barrier Reef, and have been identified by the Smithsonian Institute, The Nature Conservancy, the World Wildlife Fund and the World Bank as one of the key sections of the barrier reef system to preserve. The reefs are the least disturbed ecosystems in the so-called Bay Islands Complex and have had a strong and active NGO working with local communities, private sector bodies and government organisations to help manage the reefs and their fisheries over the last 10 years.



Map of the study area. See also [Google Maps](#) for an internet-driven view of the study site.

1.3. Dates

The expeditions ran over a period of four weeks divided into two two-week slots, each composed of a team of international research assistants, scientists and an expedition leader. Slot dates were:

1 - 13 March | 15 - 27 March 2009.

Dates were chosen when survey conditions such as the clarity of water and therefore visibility were best.

1.4. Local conditions & support

Expedition base

The expedition team was based on the island of Cochino Pequeño at the scientific station of Cayos Cochinos. The Cayos Cochinos site and scientific station was set up by HCRF in 1994 and features spacious bungalow-style cabins, a fully equipped dive centre with compressors and equipment for hire, wet and dry labs, a computer and lecture room, common areas and a dining area. 4 – 8 team members shared a spacious bungalow-style cabin (2 – 4 persons to a room). Each cabin had a shower and toilet, a small kitchen cum lounge and a veranda overlooking the beach. A cook provided all meals and vegetarians and special diets were catered for.

Field communications

Each dive boat carried one radio for communication with other boats and with the scientific station. Mobile phones worked on the island and within a few kilometres out at sea, but very few European and North American providers seemed to have a roaming agreement with Honduran providers. There was e-mail and internet connection on the island for staff.

Transport, vehicles & research boats

Team members made their own way to the La Ceiba assembly point. From there all transport was provided for the expedition team and on the island a variety of HCRF boats were used to move to survey sites and back.

Medical support & insurance

The expedition leader was a trained divemaster and first aider, and the expedition carried a comprehensive medical kit. Further medical support was provided by a hospital and doctors within easy reach at La Ceiba. All dive boats carried safety equipment and oxygen. For urgent emergency cases there was a helicopter landing pad on Cochino Pequeño and a recompression chamber on nearby Roatan Island. All team members were required to carry adequate travel insurance covering emergency medical evacuation and repatriation.

There were some serious health incidences with several team members and the expedition leader contracting malaria. The disease was diagnosed after the expedition and all affected have made a full recovery at the time of writing.

Diving

The minimum requirement to take part in this expedition was a PADI Open Water or equivalent qualification. Team members who had not dived for twelve months prior to joining the expedition were required to complete a PADI Scuba Review before joining the expedition.

Standard PADI diving and safety protocols were followed.

Dive groups were divided into different teams, each working on specific task of the survey protocol. Divers were allocated to teams based on a mixture of personal preference, diving skills and knowledge of the species.

1.5. Local scientist

Marcio Aronne is a reef biologist and Reef Check trainer who has been working with HCRF since 1998. Marcio has worked with community development programmes, fish, reef, fisheries and spawning aggregation monitoring programmes in close cooperation with international institutions such as The Nature Conservancy, the World Wildlife Fund, Inter American Foundation and the Avina Foundation.

1.6. Expedition leader & chief scientist

Jon Shrives was born and educated on Jersey in the Channel Islands, where he developed a love of diving and marine biology from an early age. He graduated from Southampton University with a BSc in Biology, specializing in behavioural ecology, evolutionary ecology and marine tropical ecology. As part of his honours thesis research project, he travelled out to the remote Wakatobi islands of Sulawesi, Indonesia, and was bitten by the 'expedition bug' and diving science. Since then he has worked with several NGOs and ecotourism companies, teaching marine ecology and SCUBA diving. He has supervised several undergraduate research projects and led marine ecology programs in Indonesia, Honduras, Egypt and the UK. His experience varies from providing logistic management of a live-aboard research vessel, to completing baseline surveys for international organisations such as Reef Check and acting as head scientist to a team of five scientists and over a hundred volunteers in Honduras. Jon also recently became the UK's first Reef Check Course Director, instructing others how to teach Reef Check to divers.

1.7. Expedition team

The expedition team was recruited by Biosphere Expeditions and consisted of a mixture of all ages, nationalities and backgrounds. They were (with country of residence):

1 - 13 March 2009

Cornelia Beisel (Germany), Forrest Freymuth (USA), Janet Hoffberg (USA), Alan Hoffberg (USA), Susanne Lindner (Germany), Lee Mahoney (USA), Lynn Poser (USA), Nancy Sandler (USA), Michael Sandler (USA), Stephen Tredwell (UK).

15 - 27 March 2009

Cornelia Beisel (Germany), David Garbasz (USA), Gabriella Garbasz (USA), Mel Jewell (UK), Katja Koehler (Germany), Karin Lagergren (USA), Will Price (the Netherlands), Marie-claire ten Veldhuis (the Netherlands), Andrew Venus (UK), Cas Verhoeven (the Netherlands), Yvonne Ward (UK), Stuart Ward (UK).

Also throughout: trainee expedition leader Kai-Thorben Selm (Germany), Leslie Ruyle (USA) and Madeline Thebauld (Honduras).

1.8. Expedition Budget

Each team member paid towards expedition costs a contribution of £1260 per person per two week slot. The contribution covered accommodation and meals, supervision and induction, special non-personal diving and other equipment and air, and all transport from and to the team assembly point. It did not cover excess luggage charges, travel insurance, personal expenses like telephone bills, souvenirs etc., as well as visa and other travel expenses to and from the assembly point (e.g. international flights). Details on how this contribution was spent are given below.

Income	£
Expedition contributions	25,090
 Expenditure	
Accommodation and food includes all board & lodging	5,920
Transport includes fuel, boat maintenance, car transfers	1,586
Equipment and hardware includes research materials, research gear	240
Biosphere Expeditions staff includes salaries, travel and expenses to Cayos Cochinos	4,776
Local staff includes salaries, travel and expenses, Biosphere Expeditions tips, gifts	818
Administration includes registration fees, sundries, etc	281
Team recruitment Honduras as estimated % of PR costs for Biosphere Expeditions	4,230
 Income – Expenditure	 7,239
 Total percentage spent directly on project	 71%

1.9. Acknowledgements

This study was conducted by Biosphere Expeditions which runs wildlife conservation expeditions all over the globe. Without our expedition team members (who are listed above) who provided an expedition contribution and gave up their spare time to work as research assistants, none of this research would have been possible. The support team and staff (also mentioned above) were central to making it all work on the ground. Thank you to all of you, and the ones we have not managed to mention by name (you know who you are) for making it all come true. Biosphere Expeditions would also like to thank members of the Friends of Biosphere Expeditions and donors, as well as Land Rover, Swarovski Optik, Motorola, Cotswold Outdoor, Globetrotter Ausrüstung and Snowgum for their sponsorship.

We would also like to thank the Honduras Coral Reef Fund (HCRF), the Honduras National Fisheries Department (DIGEPESCA), the Honduras Protected Areas Unit (DAPVS/ ICF), the Honduras Ministry of Defense (Naval Base), Secretaría de Recursos Naturales y Ambiente (SERNA), Honduras Tourism Board (IHT), Instituto de Conservación Forestal (ICF), Sociedad de Inversiones Ecológicas (SIEC), WWF, MARVIVA, USAID, The Nature Conservancy, the Smithsonian Institute, SAM - Meso-American Barrier Reef Project, as well as the United Nations Environment Programme (UNEP), the World Conservation Monitoring Centre (WCMC), the Marine Conservation Society (MCS), the International Coral Reef Action Network (ICRAN) and Operation Wallacea. We also thank local subsistence fishermen communities and local schools.

1.10. Further information & enquiries

More background information on Biosphere Expeditions in general and on this expedition in particular including pictures, diary excerpts and a copy of this report can be found on the Biosphere Expeditions website www.biosphere-expeditions.org.

Enquires should be addressed to Biosphere Expeditions at the address given below.

2. Reef Check Survey

Marcio Aronne, HCRF and Jonathan Shrides, Oxford University.

2.1. Introduction

Study site

The Marine Natural Monument Archipelago Cayos Cochinos (MNMACC) is located at latitude 15° 57' N and longitude 86° 30' W in the Caribbean. The MNMACC belongs to the Honduran Bay Islands Department and covers an area of 485.337 square km, consisting of a core area (Fig 2.1a) and a five nautical mile buffer zone (Fig 2.1b).

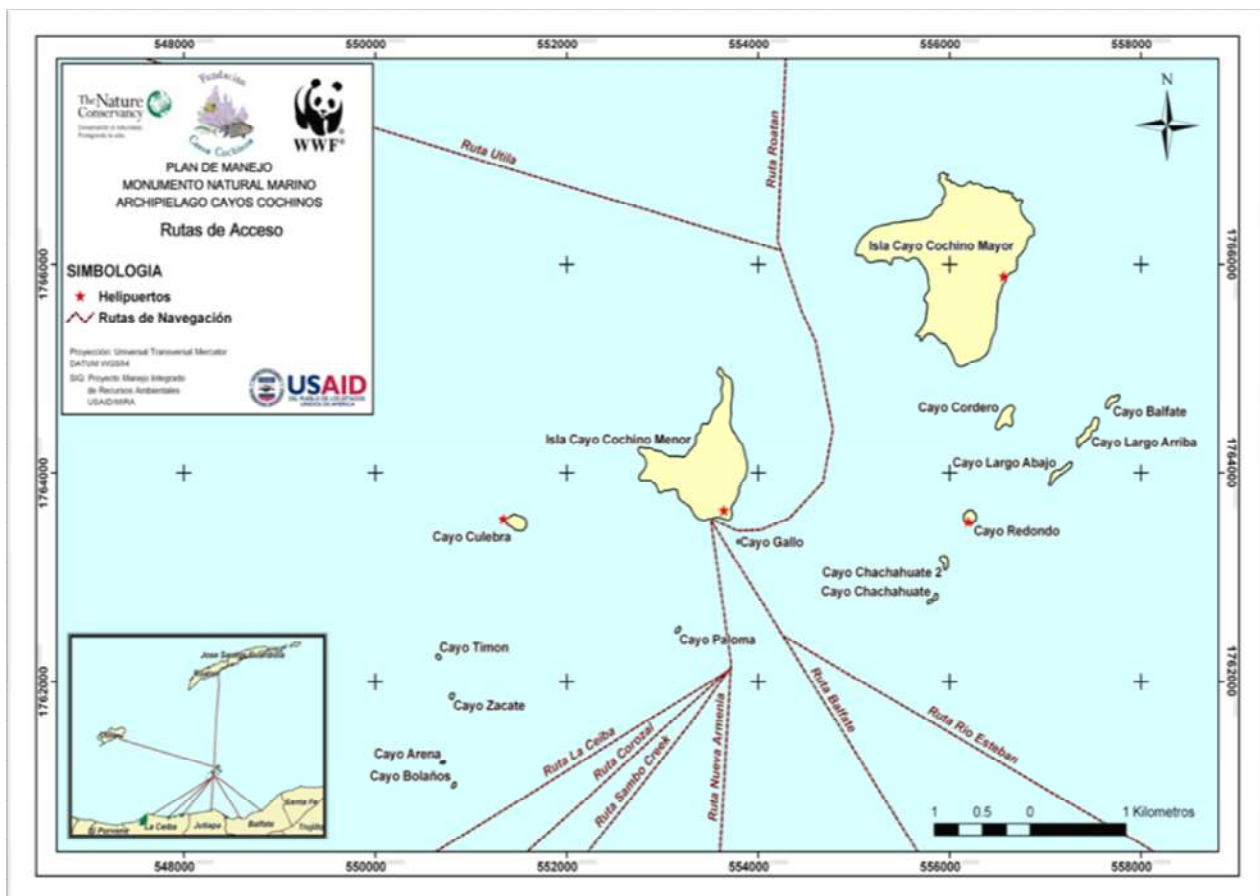


Figure 2.1a. Cayos Cochinos.

More recently a fishing buffer zone has been established south of the MNMACC up to the coast of mainland Honduras and extending three nautical miles beyond its eastern, western and northern limits (Fig 2.1b). Within this zone it is intended that industrial scale fishing will be banned, thus protecting the marine ecosystem beyond the boundaries of the MNMACC.

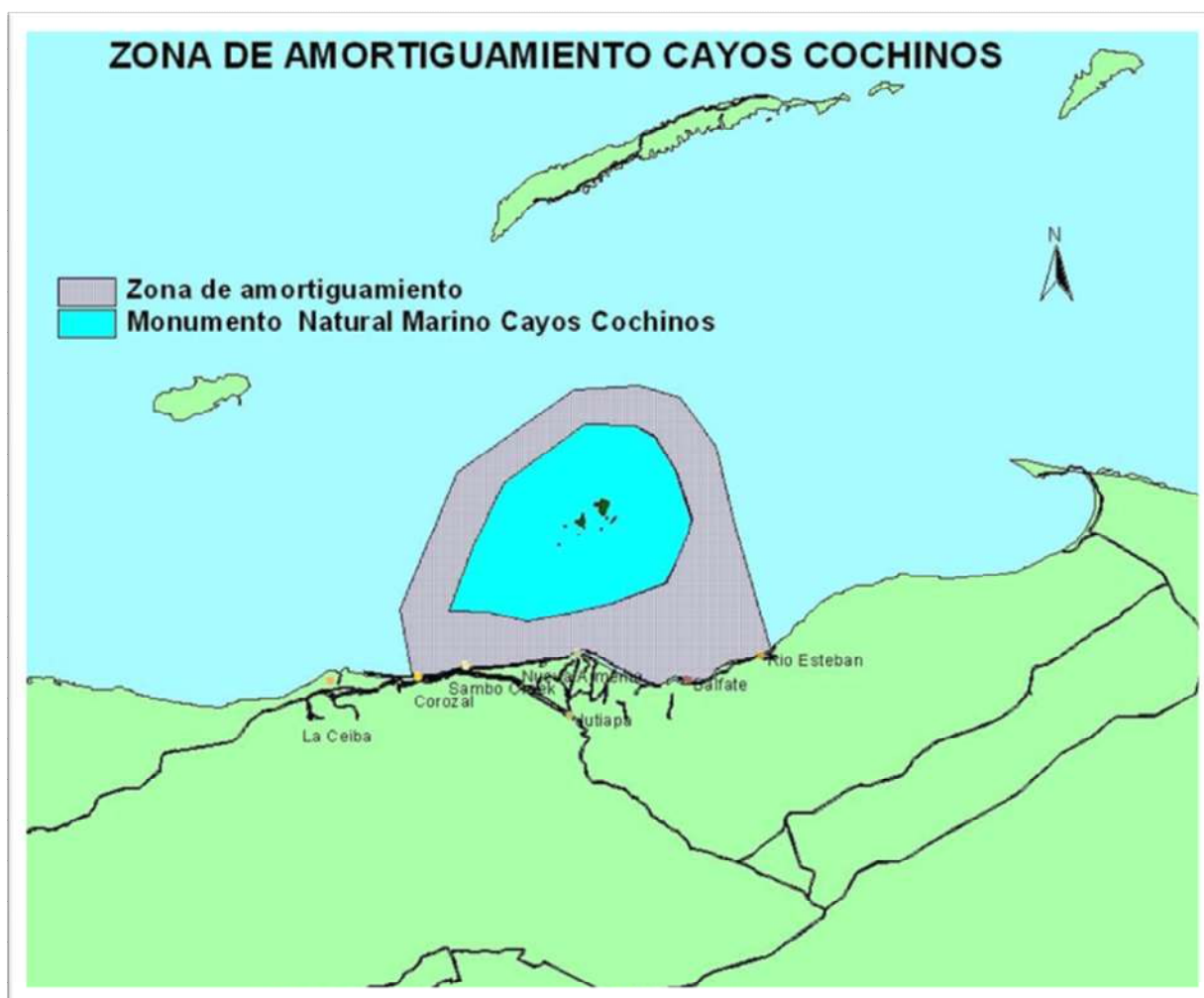


Figure 2.1b. Cayos Cochinos buffer zones.

The main areas influencing Cayos Cochinos from east to west are the city of La Ceiba (39.35 km); the Garífuna communities of Sambo Creek (25.83 km) and Nueva Armenia (18.53 km), which belong to the municipality of La Ceiba and Jutiapa in the Department of Atlántida; the Garífuna communities of Balfate (23.27 km) and Río Esteban (23.27 km), within the Department of Colón; and finally on the north side Roatan island (39.00 km) (Fig. 2.1c).

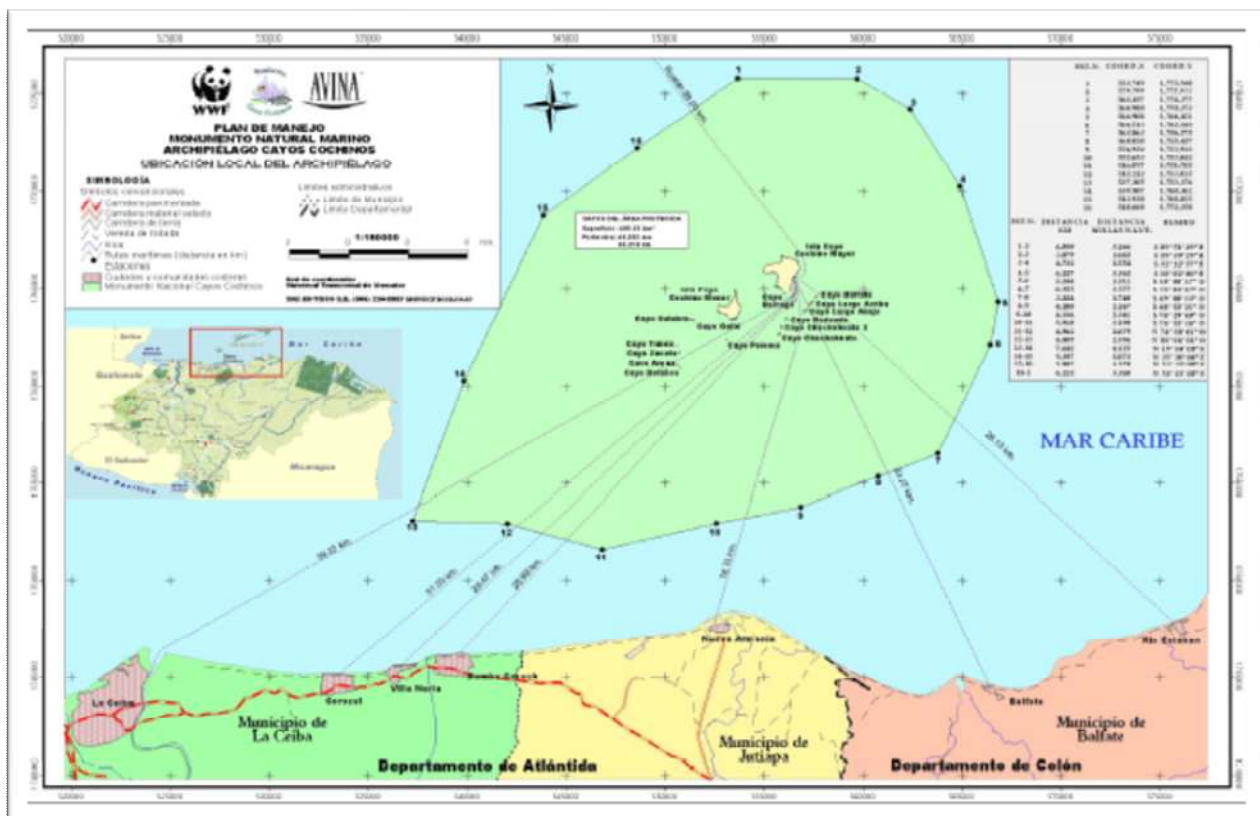


Figure 2.1c. Areas influencing Cayos Cochinos.

Type and structure of coral reefs at Cayos Cochinos

Given that part of the archipelago is inside the continental platform, the type of coral reefs present at Cayos Cochinos are barrier reefs. These develop only marginally into the deep sea, compared with further north where they extend further into the deeper sea to a depth of 25 metres. (CRPMS-MNMCC 2004).

The *Plan de Manejo del Monumento Natural Marino Archipiélago Cayos Cochinos* (CRPMS-MNMCC 2004) reported 66 hermatypic coral species, 44 octocoral and five antipatharia species. Guzmán (1998) identified the star corals of the *Montastraea* genus, brain corals of the *Diploria* genus and the *Colpophyllia natans* species as being the most common.

Conservation status

The results of monitoring carried out by the Mesoamerican Barrier Reef System Project (MBRS) between 2004 and 2005 (Garcia-Salgado et al. 2006) showed the coral reefs at Cayos Cochinos to be in good to excellent condition within the context of the Mesoamerican Barrier Reef, despite having been considerably affected in 1998 by bleaching and Hurricane Mitch (HCRF/TNC 2008).

The Garcia-Salgado et al. (2006) study also showed that hard coral coverage (24.9%) was higher than the regional average and that average death in colonies sampled (15.8%) was much lower than the regional average of 40.1%. The deep reef front showed a higher species richness than the shallow sites, but also a higher death percentage. Project MBRS did not monitor bleaching, but Shrives (2006) reported that the incidence of white band disease was low in Cayos Cochinos.

According to *Sistema Nacional de Areas Protegidas* (SINAPH), protected areas in Honduras must be evaluated every five years. This entails inspecting and modifying, where necessary, the protected area management plan. In 2004 a first management plan was created for the MNMACC, which was later modified for the period 2008-2012. This modification was made with the participation of all groups involved in resource management (Honduras Coral Reef Foundation/TNC 2008). One of the changes included in this management plan was how resource use is zoned, establishing two macrozones instead of three, a nuclear zone around the larger key and a restricted zone of public use. It is also established four temporary fishing zones at Pelican Point, Mariposales, La Grupera and Roatán Bank (Figure 2.1d) (Honduras Coral Reef Foundation/TNC 2008).

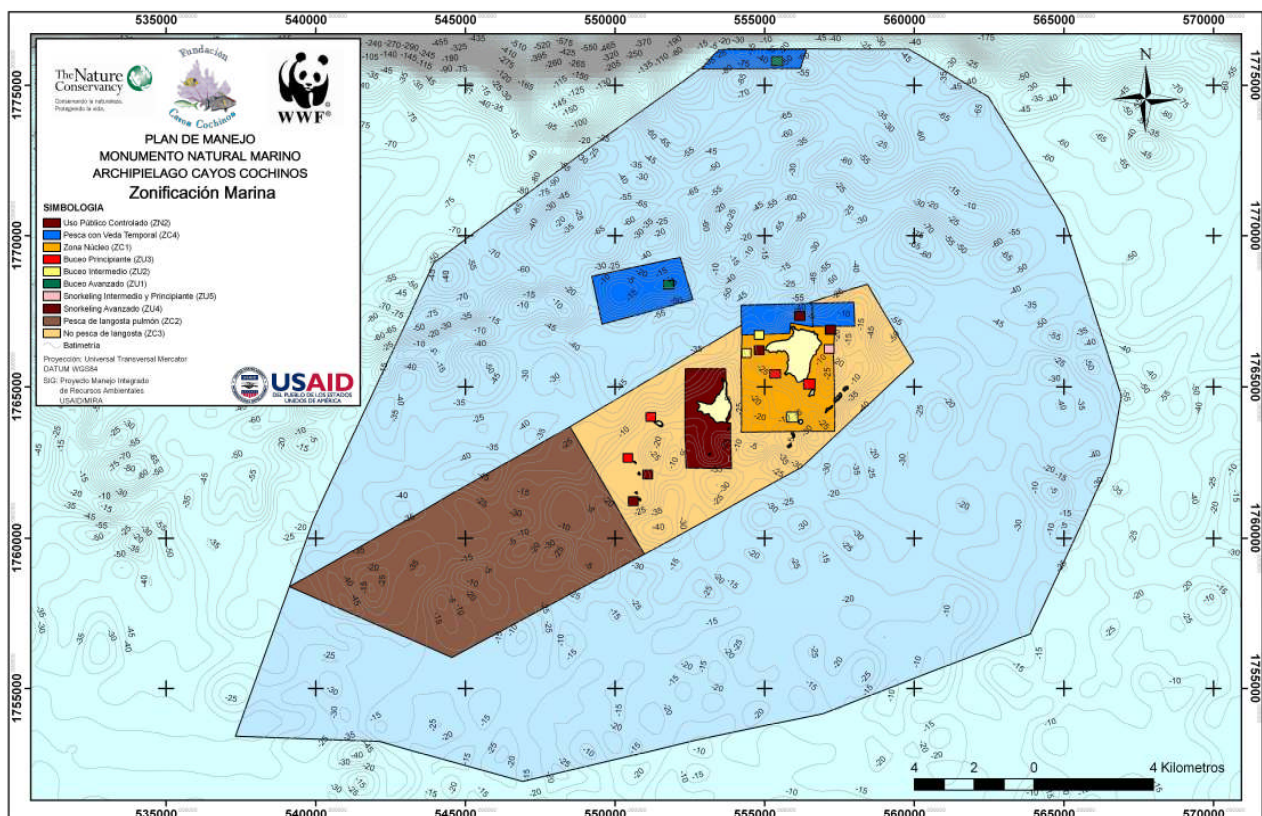


Figure 2.1d. Zoning of Cayos Cochinos

Honduras Coral Reef Foundation

The Honduras Coral Reef Foundation (HCRF) was founded in 1993 and is the non-governmental organization (NGO) officially responsible for the management and conservation of the MNMACC. The main tasks for HCRF are to enhance conservation and management activities; to enforce natural resource use regulations; to increase scientific station development; and to promote sustainable development options for local fishing communities. To achieve these objectives in the long term, HCRF has been supported mainly by AVINA/MARVIVA, the World Wildlife Fund (WWF), The Nature Conservancy (TNC), Operation Wallacea and Biosphere Expeditions amongst other international institutions. In 2004 HCRF, along with WWF and the support of Cayos Cochinos' local communities, published the first management plan for the area to further the conservation and protection of all natural resources. In the same year a sustainable development plan for tourism was created, thus giving HCRF the tools to measure the carrying capacity and public use of the whole area.

Biosphere Expeditions was first invited to help with the implementation of this plan in 2006. As part of the management plan several zones with different use regulations were established. In order to find out if these zones and their regulations have been effective for the conservation of natural resources, a long term monitoring programme of the reef's conditions needs to be conducted. The Reef Check methodology provides an easy protocol for this purpose that is replicated all over the world and allows for the use of volunteer divers (Hodgson et al. 2006).

Reef Check

Reef Check is the name of both the most widely used coral reef monitoring protocol and an international coral reef conservation program. The Reef Check programme brings together community groups, government departments, academics and other partners to fulfil its objectives. These include: educating the public about the coral reef crisis; creating a global network of volunteer teams to regularly monitor and report on reef health; scientifically investigating coral reef ecosystem processes; facilitating collaboration between academic institutions, NGOs, governments and the private sector; and stimulating local community action to protect remaining pristine reefs and rehabilitate damaged reefs worldwide (Hodgson 2000).

Reef Check was designed to assess the health of coral reefs and is quite different from other monitoring protocols. Since its inception Reef Check has focused on the abundance of particular coral reef organisms that best reflect the condition of the ecosystem and that are easily recognisable to the general public. Selection of these "indicator organisms" was based on their economic and ecological value, their sensitivity to human impacts and ease of identification. Sixteen global and eight regional indicator organisms serve as specific measures of human impacts on coral reefs. These indicators include a broad spectrum of fish, invertebrates and plants that indicate human activities such as fishing, collection or pollution. Some Reef Check indicator groups are individual species, whilst others are families (Hodgson et al. 2000).

For instance, in the Caribbean the Nassau grouper (*Epinephelus striatus*) is the most desired fish in the live food fish trade, whereas the trumpet triton (*Charonia variegata*) is collected for the aquarium trade. Both species are very distinctive organisms and excellent indicators of human predation. On reefs where these organisms are heavily exploited, their numbers are expected to be low compared to their abundance on unexploited reefs. (Hodgson and Liebeler 2002).

Reef Check teams collect four types of data: (1) a description of each reef site based on over 30 measures of environmental and socio-economic conditions and ratings of human impacts, (2) a measure of the percentage of the seabed covered by different substrate types, including live and dead coral, along four 20 m sections of a 100 m shallow reef transect, (3) invertebrate counts over four 20 m x 5 m belts along the transect and (4) fish counts up to 5 m above the same belt (Hodgson et al. 2006).

2.2. Methods

Site selection & sampling design

Reef Check's regional coordinator advised us on the site selections as well as other aspects of setting up our Reef Check team. All teams had a team scientist and a team leader trained by a Reef Check trainer.

The Reef Check protocol is designed to be as simple as possible so that untrained volunteer divers can participate. Practical team sizes are two, three, or four pairs of divers. However, larger or smaller groups are possible. Divers should be sufficiently experienced (>30 dives or equivalent experience) that they are able to perform simple activities underwater. It is the role of the team leader to decide if the team members are adequately qualified to undertake these activities.

Reef Check surveys can be carried out by snorkellers in shallow water (Hodgson et al. 2006). An ideal Reef Check team includes six members (three buddy pairs) plus support crew, each with different specialties and experience. In our case we selected a team of six members plus the team leader and the scientific leader of the expedition. Some adaptations to local conditions were made (i.e. substrate, underwater hand signals) for the team members.

Eight dive sites (Table & Figure 2.2a) within the different management zones inside the marine protected area were selected according to their level of use in relation to the regulations of the management plan. Selections were made so that over time the effectiveness of the recently established zoning and regulations can be monitored.

Table 2.2a. Dive sites and impact patterns.

Dive site name	Fishing allowed	Tourism impact (2006)	Tourism impact (2007)	Tourism impact (2008)	Tourism impact (2009)
Arena	Yes	Medium	Medium	Medium	Medium
Timón	Yes	Medium	High	Medium	High
El Avión	No	High	High	High	High
Pelican Point 0	No	Not surveyed	Not surveyed	Medium	Medium
Pelican Point 0.5	No	Not surveyed	Not surveyed	Not surveyed	Medium
Pelican Point 2	No	Medium	Medium	Medium	Medium
Dickie C (Pelican Point 2.5)	No	Medium	Medium	Medium	Medium
Pelican Point 4	No	Low	Low	Low	Medium
Jena's Cave	No	None	Not surveyed	Not surveyed	Not surveyed
Jena's Cove	No	None	Not surveyed	Not surveyed	Not surveyed
Pelican Point 1A	No	High	High	Not surveyed	Not surveyed
Pelican Point 1B	No	Medium	Not surveyed	Not surveyed	Not surveyed
Pelican Point 1C	No	Medium	Not surveyed	Not surveyed	Not surveyed
Pelican Point 3	No	Medium	High	Not surveyed	Not surveyed

All sites were recorded by Global Positioning System (GPS) coordinates for future comparative surveys. All positions were collected in degrees, minutes and seconds, NAD27 Central, in accordance with Reef Check methodology.

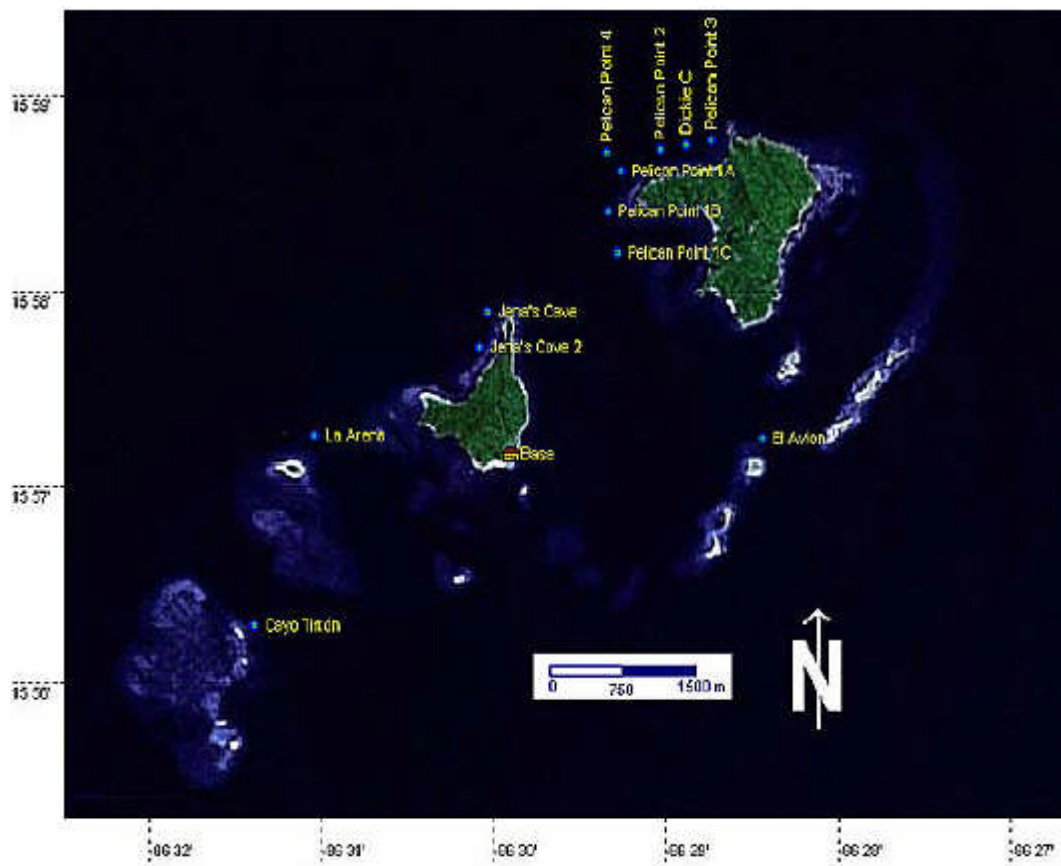


Figure 2.2a. Map of the study area. See also [Google Maps](#) for an internet-driven view of the study site.

Training of expedition team members

The first three days of each expedition slot were spent on land and in the water with training. Each group was prepared for its fieldwork, and received lectures on the research methods and goals over and above what is recommended by Reef Check. Open water dives were organized so that everyone could get comfortable in the water and put into action the fish, invertebrate and other ID skills taught before the actual survey work began.

Talks were organized to make team members familiar with the research and the area and to tell teams about species assemblages and their function in the ecosystem. Once the survey work started, the tasks of the expedition team as a whole were dive-based and consisted of several distinct underwater activities. Diving ability was assessed and team members were allocated to suitable tasks. Training in organism, substrate and disease identification skills was given using Reef Check teaching materials and special slide shows and discussion forums (Cubas et al. 2006).

Survey procedures & data collection

Data collection was based on methods described in Hodgson et al. (2006) with some minor adaptations to local conditions, such as designing a new set of hand signals to simplify underwater communication between team members (see appendix 1).

Data were recorded using underwater slates and then transferred at the end of the day onto one of the computers provided by HCRF using standard Reef Check Excel datasheets. These Excel sheets were then submitted to Reef Check.

2.3. Results

2.3.1. Fish

In four years of monitoring (Cubas, et al. 2006, Shrives et al. 2007, Shrives et al. 2008), a total of 3,261 fish were registered of which 32.97% (n=1,075) were parrotfish, followed by Haemulidae with 22.02% (n=718), snapper at 17.08% (n=557), butterflyfish at 12.91% (n=421), moray eel at 12.94% (n= 422), and groupers with 2.09% (n=68).

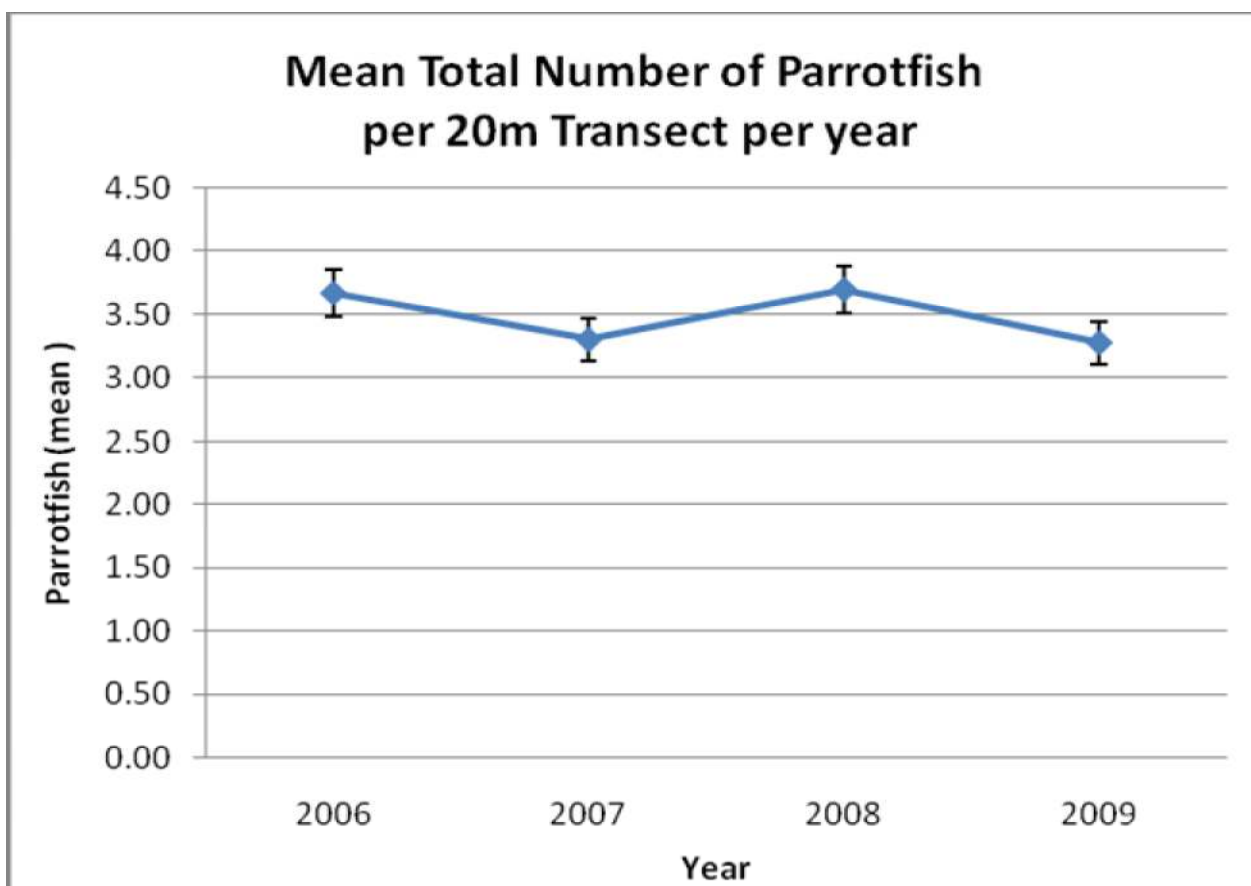


Figure 2.3.1a. Mean abundance of Parrotfish > 20 cm per 20 m transect (2006-2009) at Cayos Cochinos, Honduras.

The average abundance of parrotfish from 2006-2009 was 3.48 per 20 m transect (figure 2.3.1a). There has been no statistically significant shift in parrotfish populations in four years of monitoring at Cayos Cochinos ($P \geq 0.05$ (0.55) with a 95% confidence level),

The same applies to snapper (average abundance 1.48, $P=0.75$), Haemulidae (average abundance 1.94, $P=0.87$), moray eel (average abundance 0.02, $P=0.21$) and grouper (average abundance 0.16, $P=0.86$), all of which have been monitored for four years and show no statistically significant shift in populations over this time ($P \geq 0.05$ in all cases, with a 95% confidence level) (figures 2.3.1 b – e).

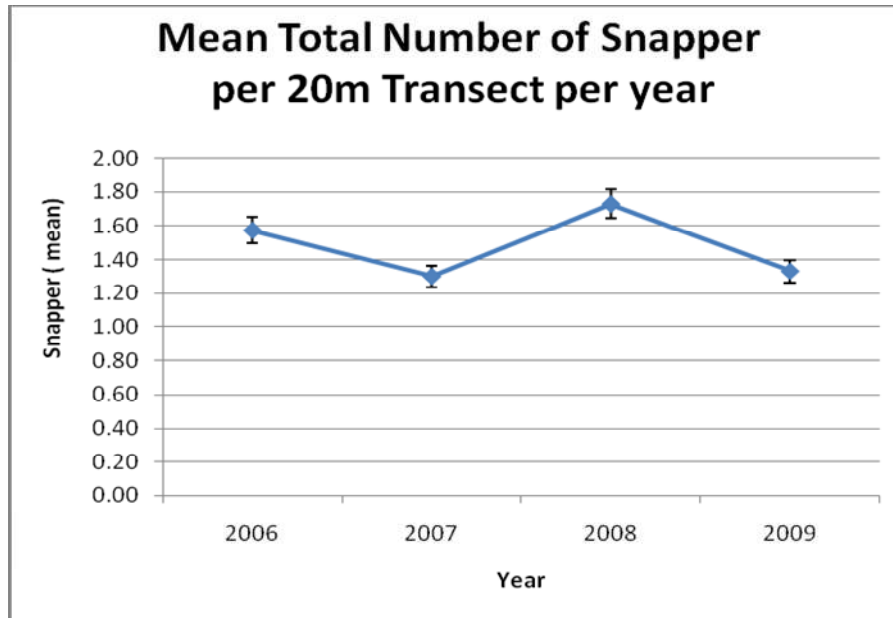


Figure 2.3.1b. Mean abundance of snapper per 20 m transect (2006-2009) on Cayos Cochinos, Honduras.

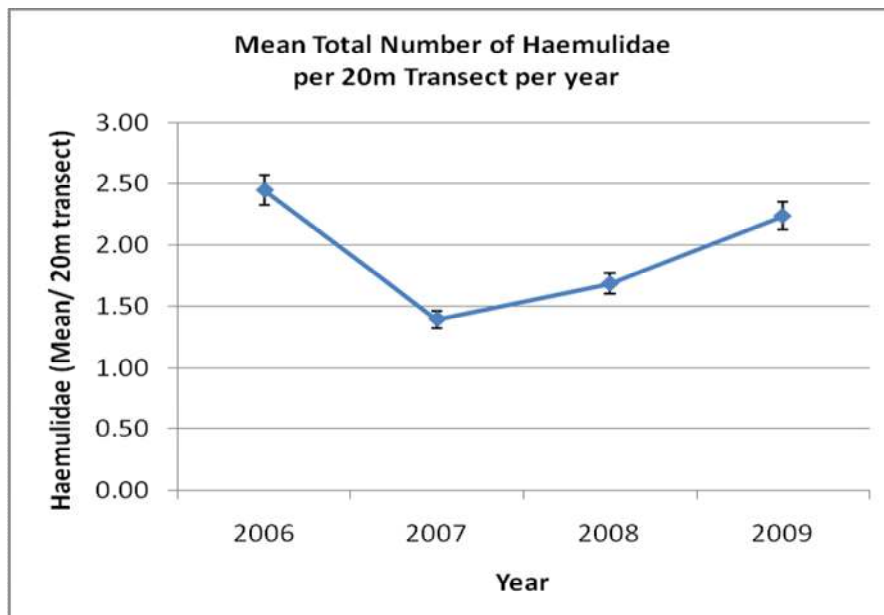


Figure 2.3.1c. Mean abundance of Haemulidae per 20 m transect (2006-2009) on Cayos Cochinos, Honduras.

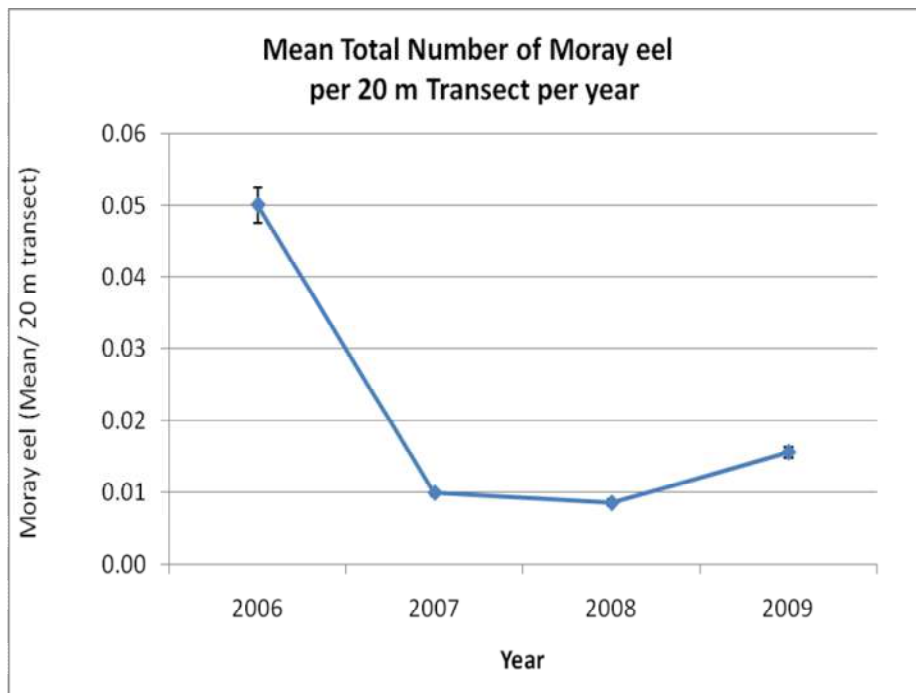


Figure 2.3.1d. Mean abundance of moray eel per 20 m transect (2006-2009) on Cayos Cochinos.

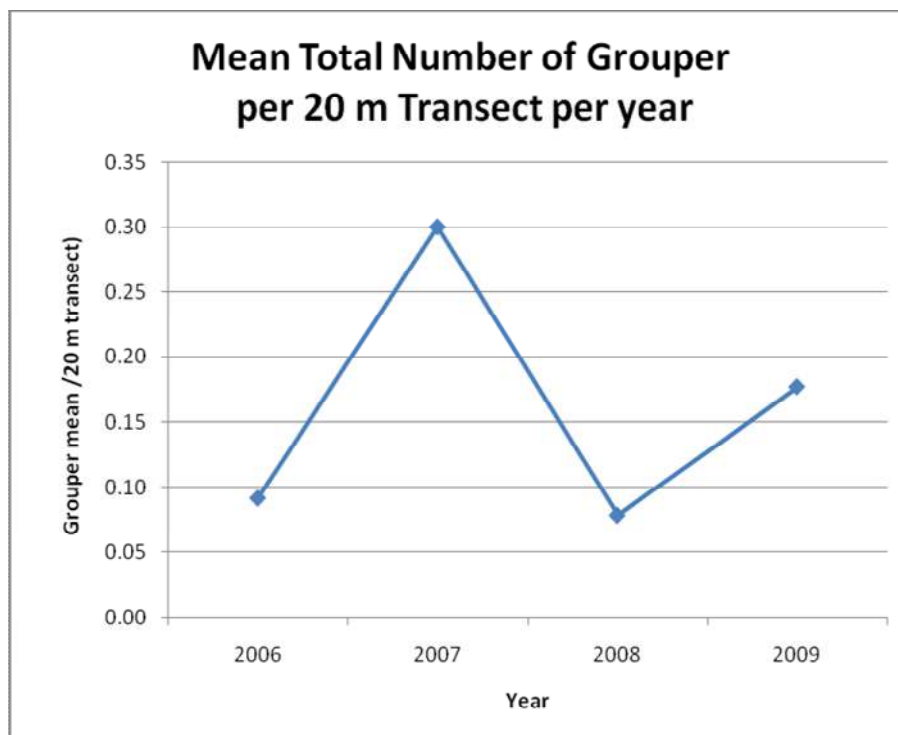


Figure 2.3.1e. Mean abundance of grouper per 20 m transect (2006-2009) on Cayos Cochinos, Honduras.

However, even though there is no statistically significant difference within each group over time, a multivariate analysis *between* the six groups of fish indicates a statistically significant difference between parrotfish and snapper ($P=0.03$, $P<0.05$ with a 95% confidence level).

The most abundant indicator group was parrotfish, which was found in largest numbers in 2009 at the Pelican 2.5 (Dickie C) site ($n=5$). The next most abundant site for parrotfish was Pelican 0.5 ($n=4.9$), while Cayo Timón had the least ($n=1.3$).

The second largest group of indicator fish was Haemulidae, which were most abundant at Pelican 0.5 ($n=4.1$) and Pelican 0 ($n=3.6$).

Groupers were most abundant at Pelican 2.5 (Dickie C), Pelican 0 and Pelican 0.5 ($n=0.3$) (see figure 2.3.1f).

A two-way ANOVA was performed to explore the interaction between categories of fish per site for 2009. There was no statistically significant difference ($P=0.899$) between the means ($P \geq 0.05$ with a 95% confidence level).

All these data are important, because it allows the management authority HCRF to analyse the abundance by species and fishing effort and adapt management strategies accordingly.

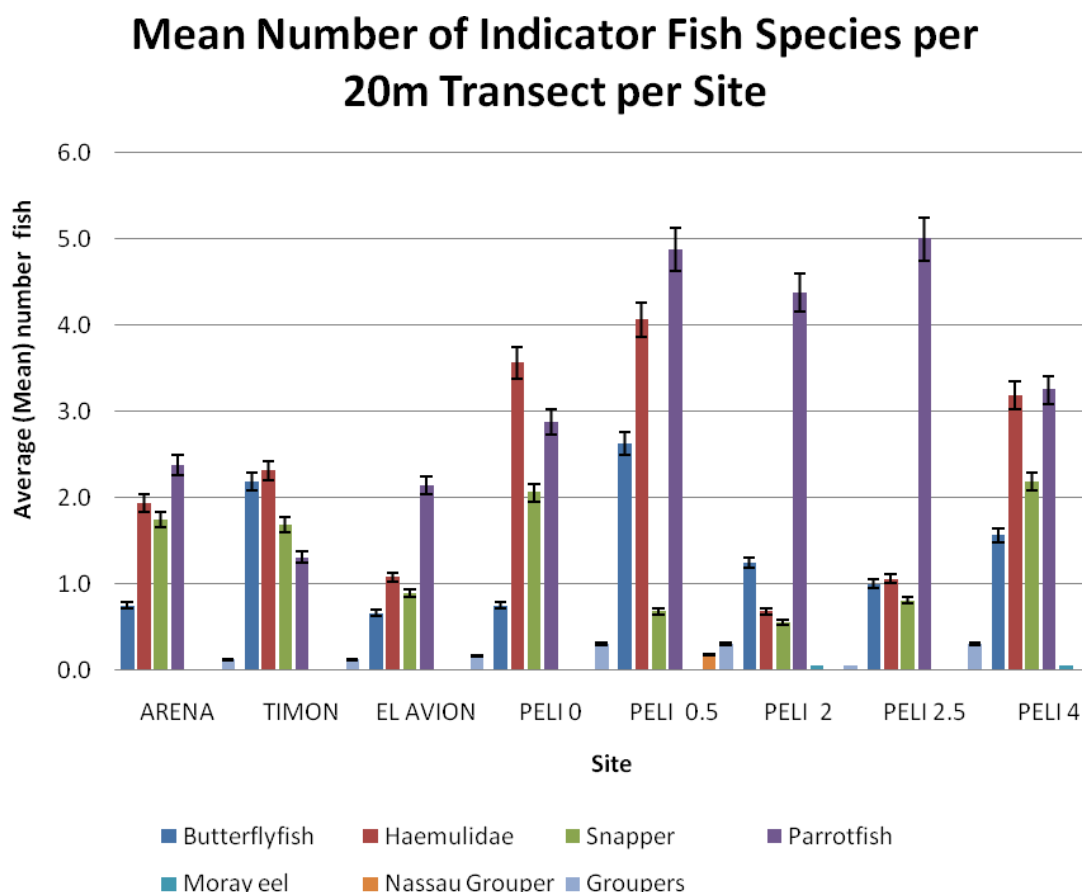


Figure 2.3.1f. A comparison between and within survey sites for average number of fish per category of indicator species seen on transects in 2009. Bars are ± 1 standard error.

A one-way ANOVA was performed on the indicator species observed within the zones where fishing is allowed and where fishing is not allowed. Parrotfish abundance is significantly different between fished and un-fished sites ($P < 0.05$), with none of the other categories of fish showing any difference. Snapper abundance is not statistically significantly different compared to other years of monitoring between fishing and non-fishing areas ($P > 0.05$). This also applies to other indicator fish species such as groupers (Table 2.3.1g).

Table 2.3.1g. Results of one-way ANOVA upon the categories of Reef Check fish indicator species, tested for differences in mean abundance between fished and non-fished sites.

Indicator species	<i>P</i> value 2009
Butterflyfish	0.586
Haemulidae	0.416
Snapper	0.568
Parrotfish	0.017
Moray eel	0.133
Groupers	0.543

2.3.2. Invertebrates

During the years of analysis (2006-2009) we observed a high abundance of *Diadema* sea urchins at El Avión (mean $n = 24.63$), when compared to the other sites. Abundance peaked in 2008 ($n = 56.44$) and was at its lowest in 2006 ($n = 4.8$). In 2009 abundance at this site was markedly lower than at the high 2008 level. However, we also observed lower abundances in 2009 at all the Pelican sites (Figure 2.3.2a).

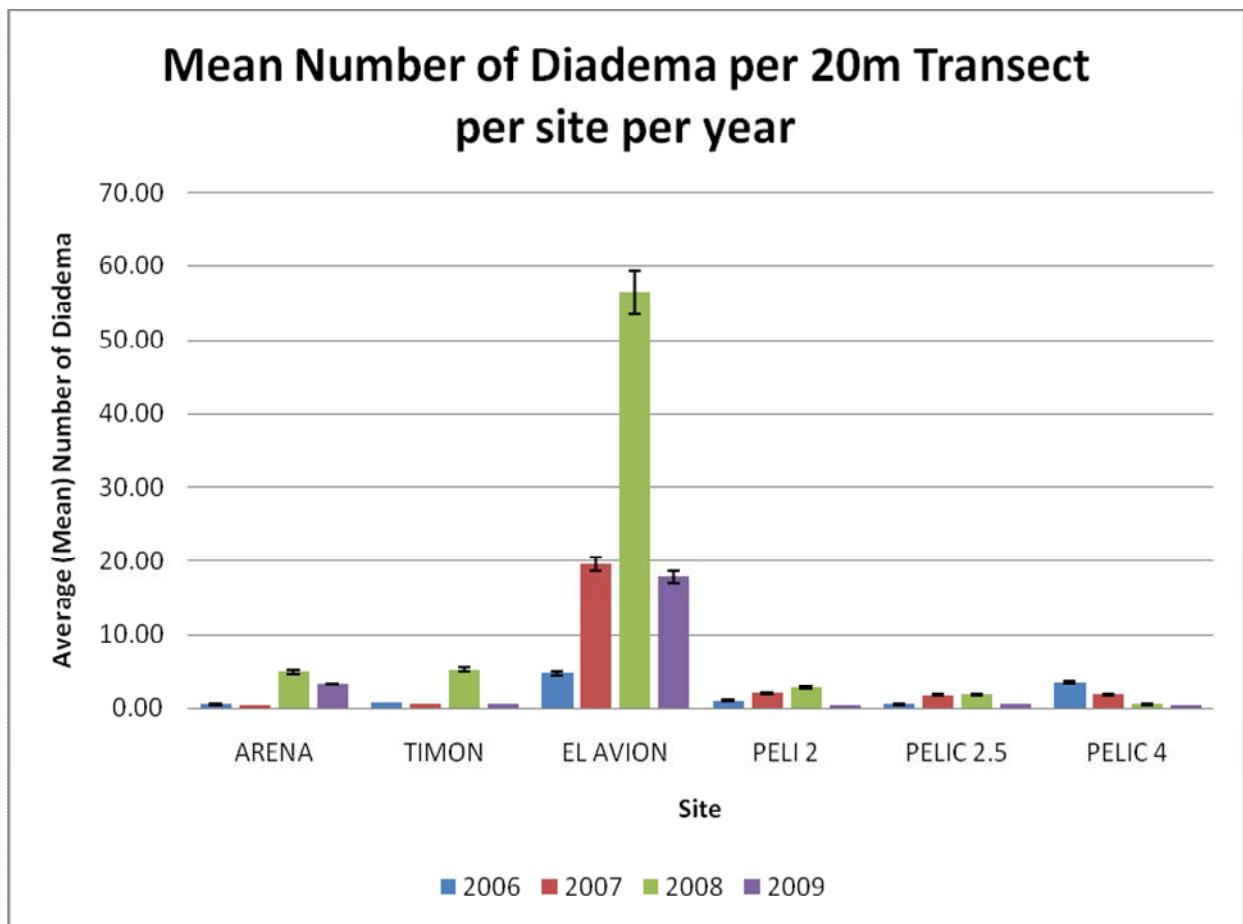


Figure 2.3.2a. Mean number of Diadema recorded at each site each year (2006-2009).
Bars are +/- 1 standard error.

A multivariate ANOVA analysis with the Kruskal-Wallis test shows $P=0.11$, and given that $P \geq 0.05$, there is no statistical difference between the means of El Avión and the rest of the sites with a 95.0% confidence level (Figure 2.3.2b).

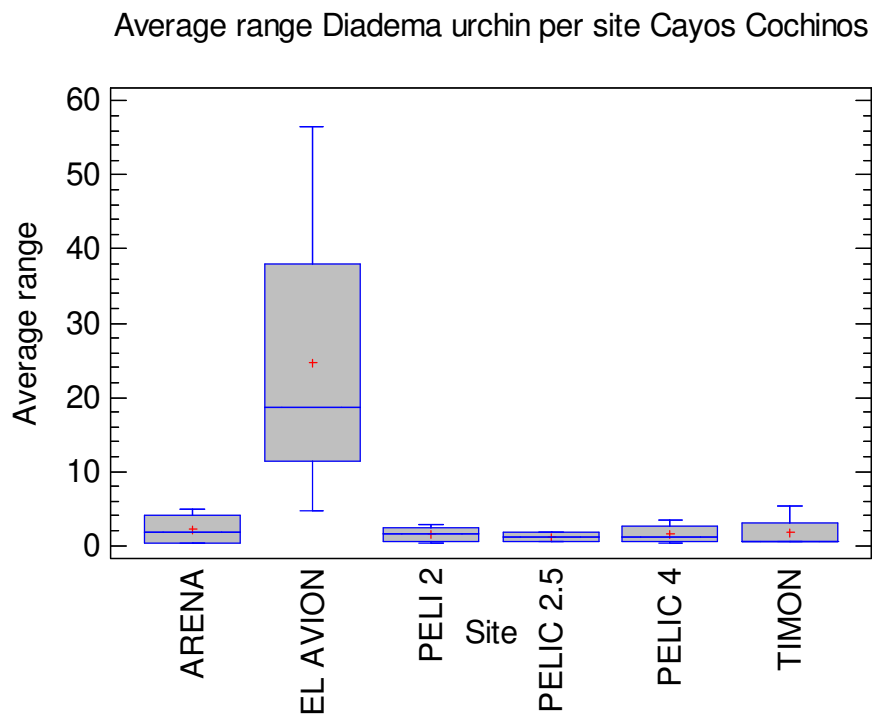


Figure 2.3.2b. The range of Diadema abundance at all sites over all surveyed years. Lines show medians and error bars show ± 1 standard error.

A comparison of the abundance of Gorgonia at the different sites over the monitoring period (2006-2009) shows a larger average abundance of Gorgonia at Pelican 4 compared to the other sites (mean=493.8, max=747.5 in 2008, min=350 in 2007). Sites with lower average abundances were Arena (mean=224.75) and El Avi3n (mean=123.62) (Figure 2.3.2c).

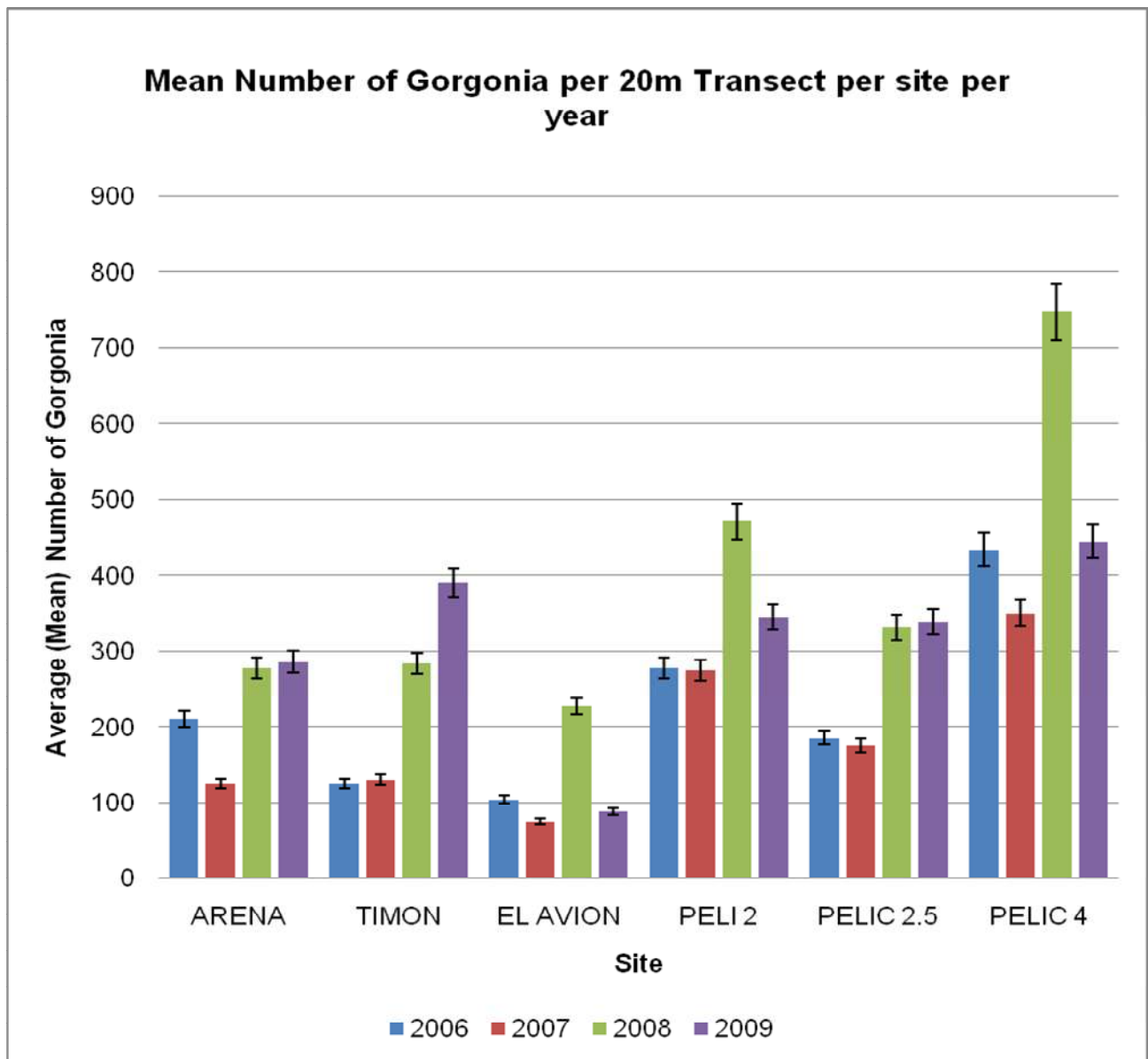


Figure 2.3.2c. Mean number of Gorgonia recorded at each site each year (2006-2009).
Bars are +/- 1 standard error.

A multivariate ANOVA Kruskal-Wallis test was used to determine the significance of the differences between Gorgonia abundances at the various sites. This shows a $P=0.01$ as $P<0.05$, meaning that there is a statistically significant difference with a 95.0% level of confidence between the medians of Pelican 4 compared to Timón and Pelican 2 (Figure 2.3.2d).

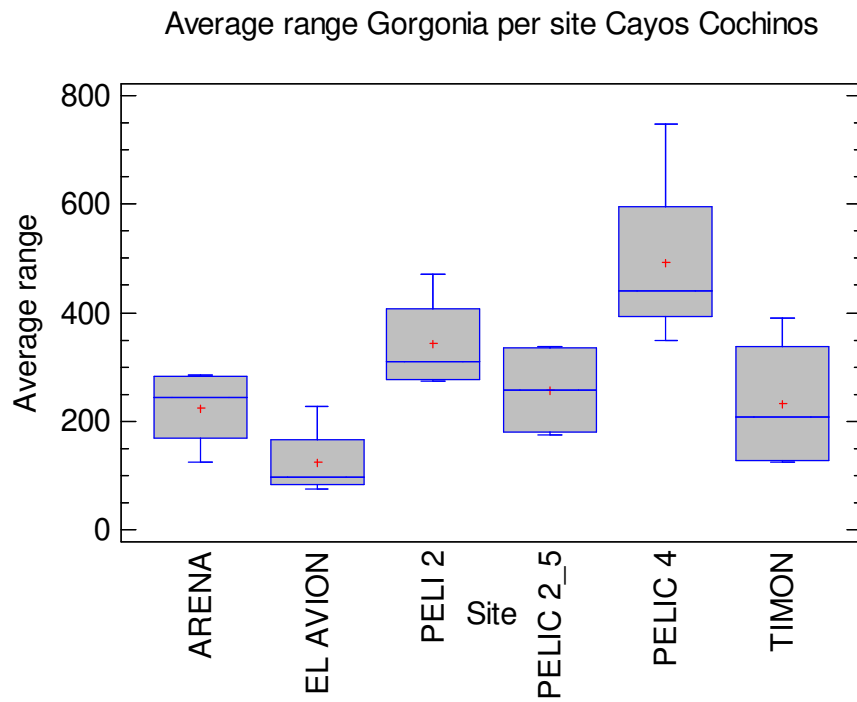


Figure 2.3.2d. The average range of Gorgonia abundance at all sites over all surveyed years. Lines show medians and error bars show ± 1 standard error

An ANOVA analysis of average abundance of invertebrate indicators per site in 2009 yielded a significance level of $P=0.669$ ($P \geq 0.05$ with a 95% level of confidence), indicating that there is no significant statistical difference between the indicator species of invertebrates at the different sites (Figure 2.3.2e).

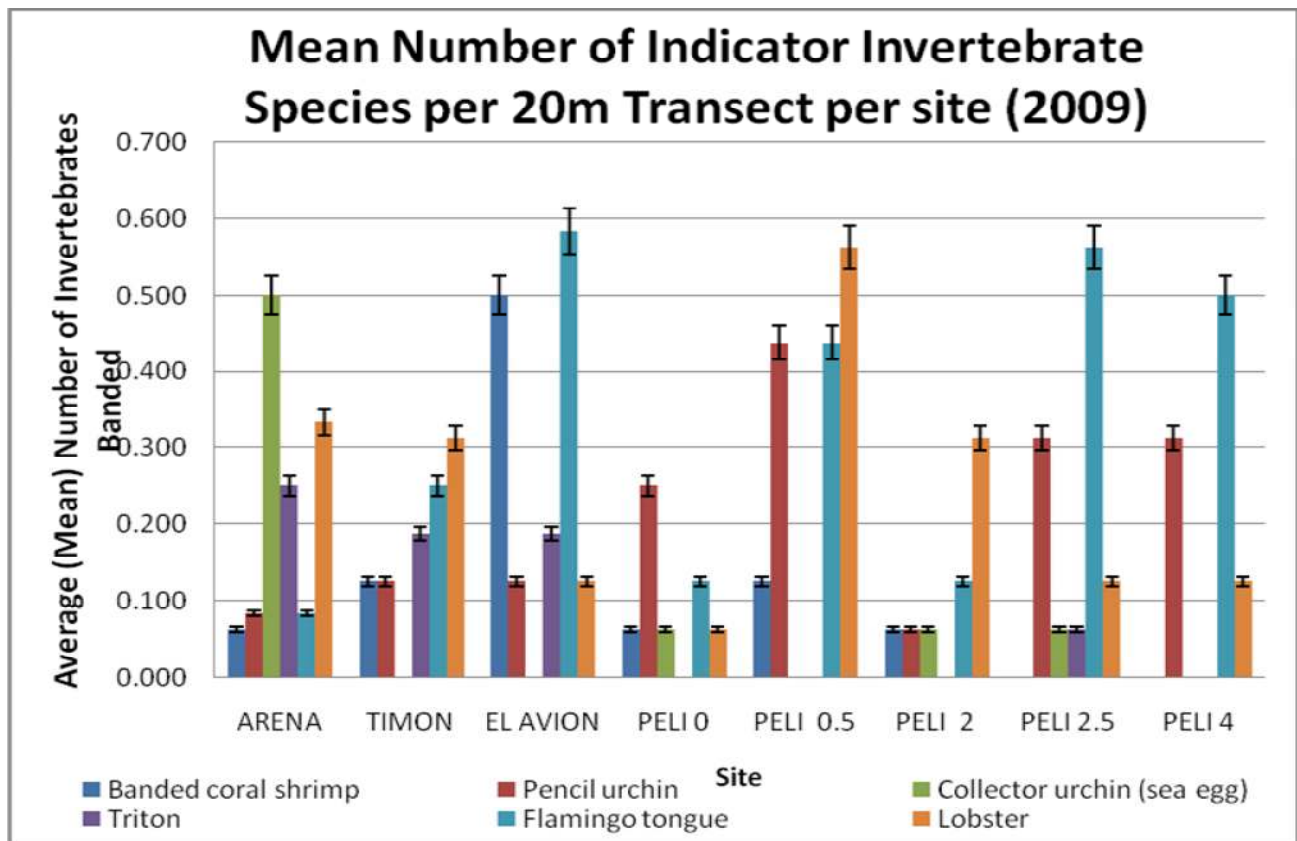


Figure 2.3.2e. Mean numbers of each invertebrate indicator species category in each site in 2009. Gorgonia and Diadema were excluded due to their comparatively high abundance and effect on scale. Bars indicate ± 1 standard error.

2.3.3. Substrate structure / benthic communities

An analysis of the substrate around Cayos Cochinos from 2006 to 2009 shows that significant changes in this period for hard coral (HC), nutrient indicator algae (NIA) and rock (RC). For HC the average percentage was 17.94% (max=23.78% in 2009 and min=7.37% in 2008) for NIA average was 16.48 % (max=20.42% in 2006 and min=13.10% in 2009), and for RC the average was 22.44% (max=39% in 2009 and min=7.82% in 2008) (Figure 2.3.3a).

Applying the ANOVA Kruskal-Wallis test to the data and comparing the means of the different substrate categories reveals a statistical difference between RC and HC with $P < 0.05$ ($P = 0.00019$). The other categories did not show any significant difference throughout the different years of monitoring (Figure 2.3.3b).

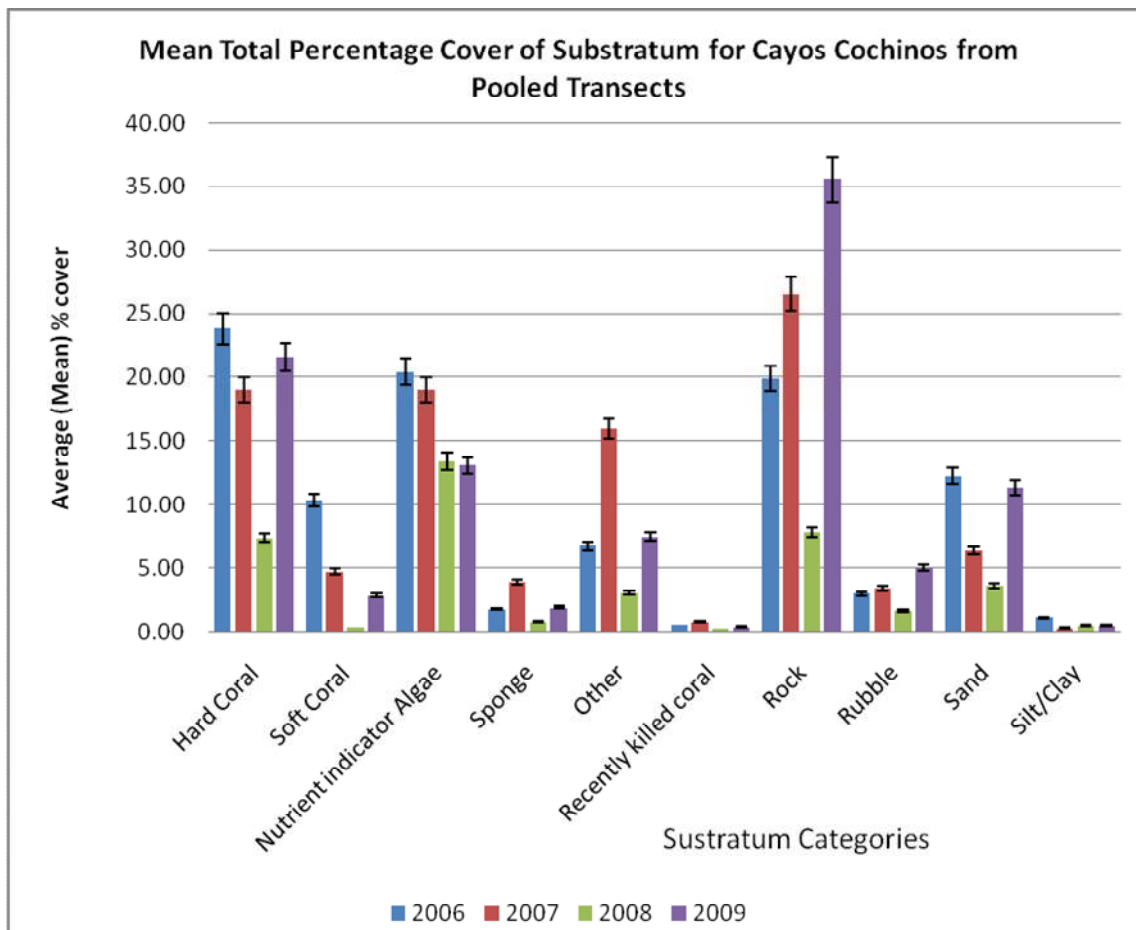


Figure 2.3.3a. Mean percentage cover of substrate categories from pooled data of all transects 2006-2009. Bars indicate ± 1 standard error.

Range average median comparison per categories cover sustratum Cayos Cochinos

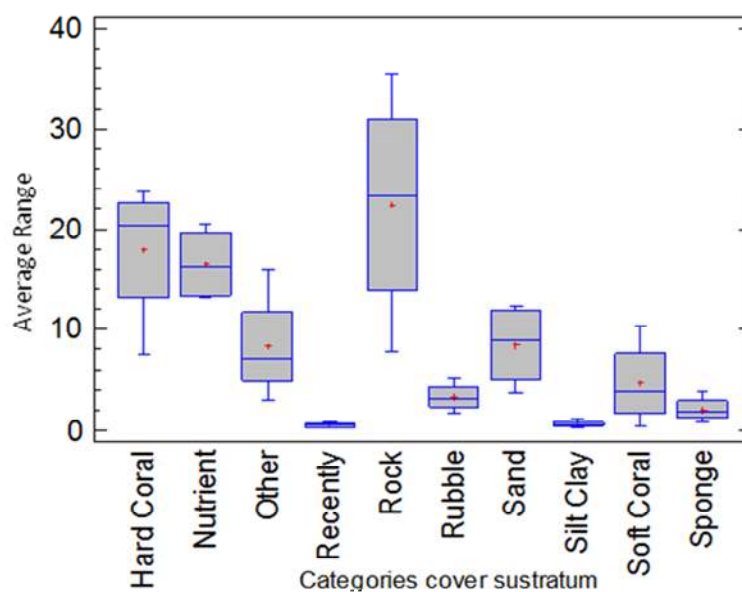


Figure 2.3.3b. The average range of coverage of substrate indicators. Data are pooled from all sites and all years (2006 – 2009). Lines show medians and error bars show ± 1 standard error.

The ANOVA analysis comparing the average cover of non-living substrate at the different sites in 2009 yields a significance level of $P=0.99$ ($P \geq 0.05$ with a 95% level of confidence), indicating no significant statistical difference between them (Figure 2.3.3c).

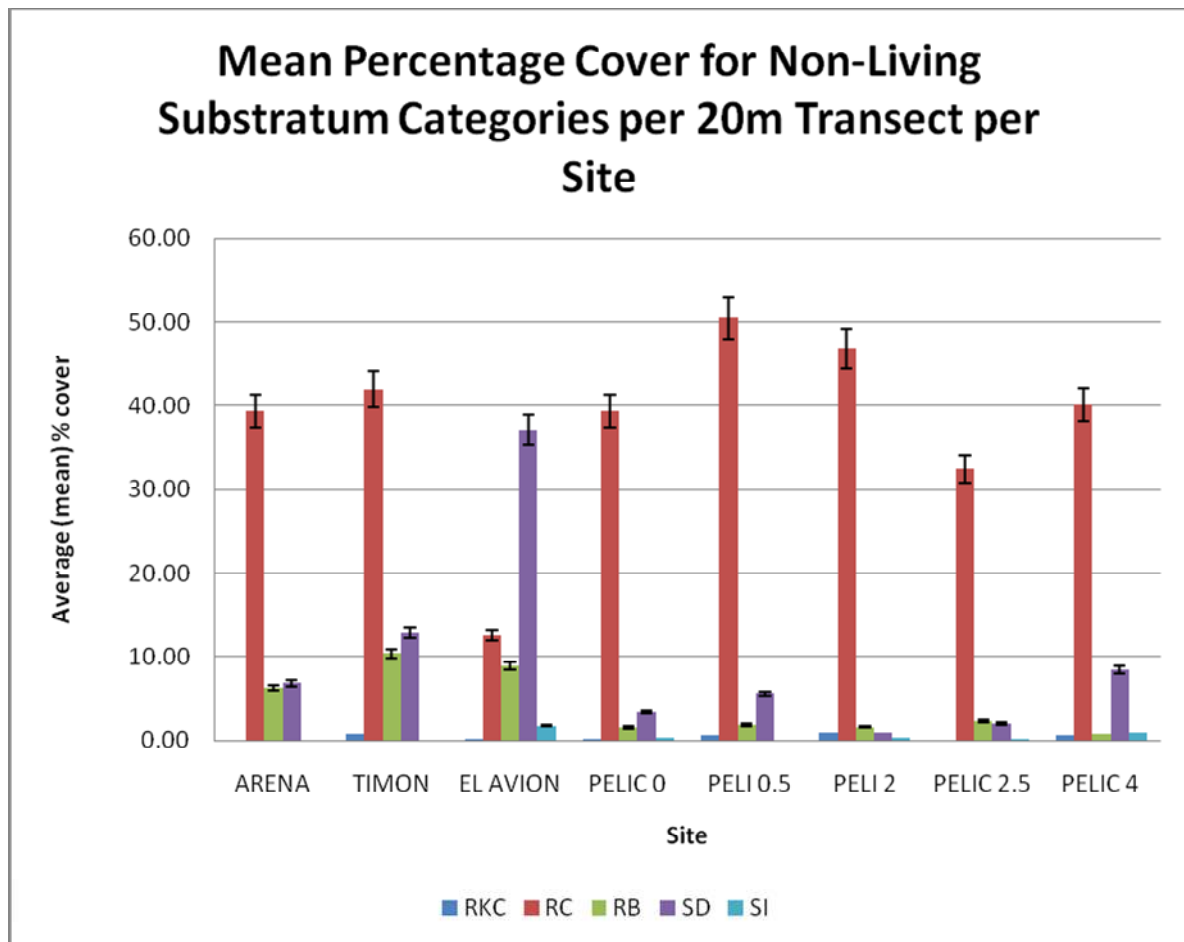


Figure 2.3.3c. Mean percentage cover of non-living substratum indicator categories at all Cayos Cochinos sites in 2009 . Bars indicate ± 1 standard error.
RKC = recently killed coral, RC = rock, RB = rubble, SD = sand, SI = silt.

The analysis comparing living substrate coverage between the different sites yields a significance level of $P=0.97$ ($P \geq 0.05$ with a 95% confidence level), indicating no statistical difference between them (Figure 2.3.3d).

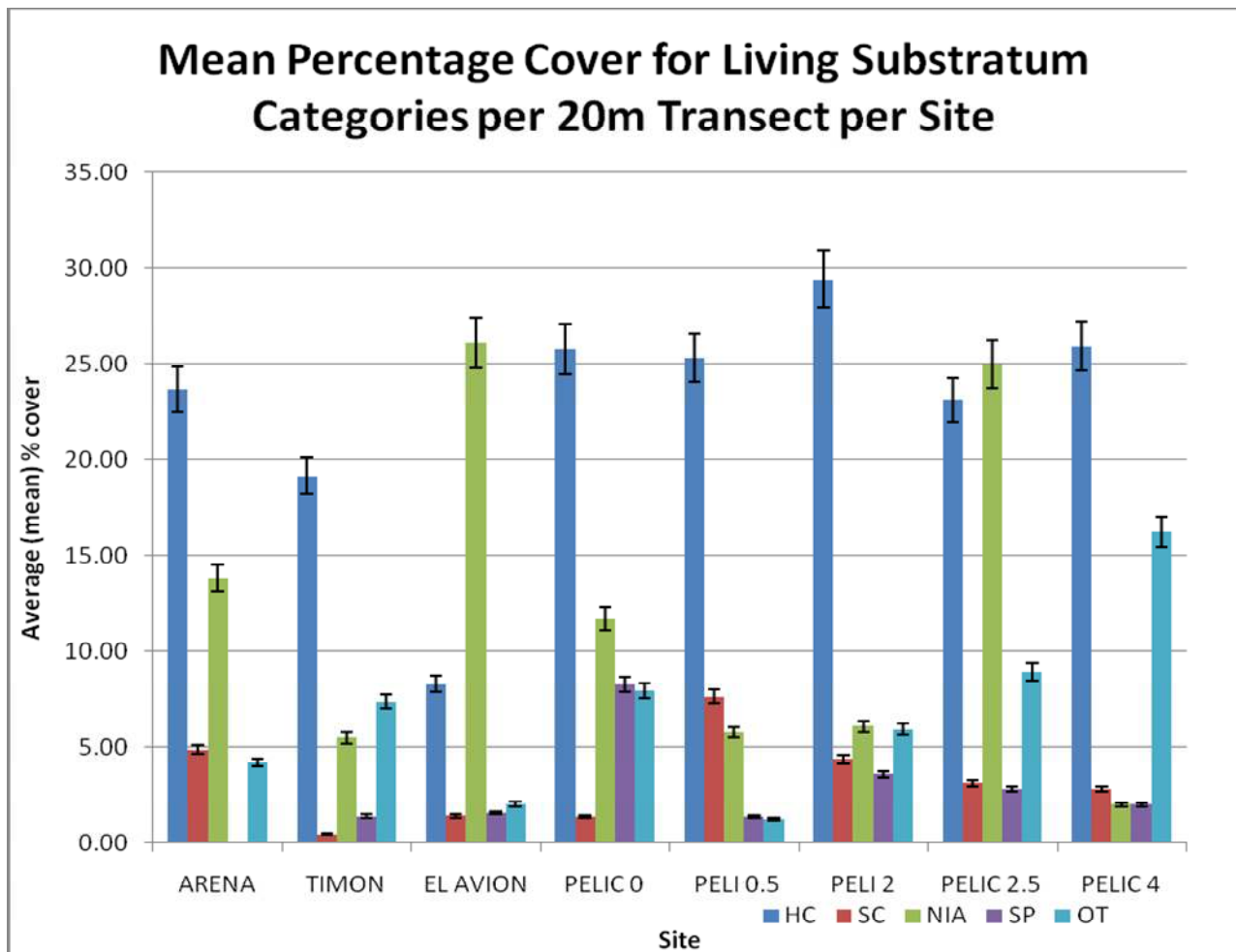


Figure 2.3.3d. Mean percentage cover for living substratum indicator categories at all Cayos Cochinos sites in 2009. Bars indicate ± 1 standard error. HC = hard coral, SC = soft coral, NIA = nutrient indicator algae, SP = sponge, OT = other.

Analysis of the five sites monitored from 2006-2009 (Pelican 4 was not monitored in 2006), El Avi3n had the lowest percentage coverage (mean=9%, min=6% in 2008, max.=12% in 2007), while the other sites had similar mean percentage coverages: Pelican 2 with 20%, Pelican 4 with 20%, Pelican 2.5 with 19%, and Tim3n with 17% (Figure 2.3.3e).

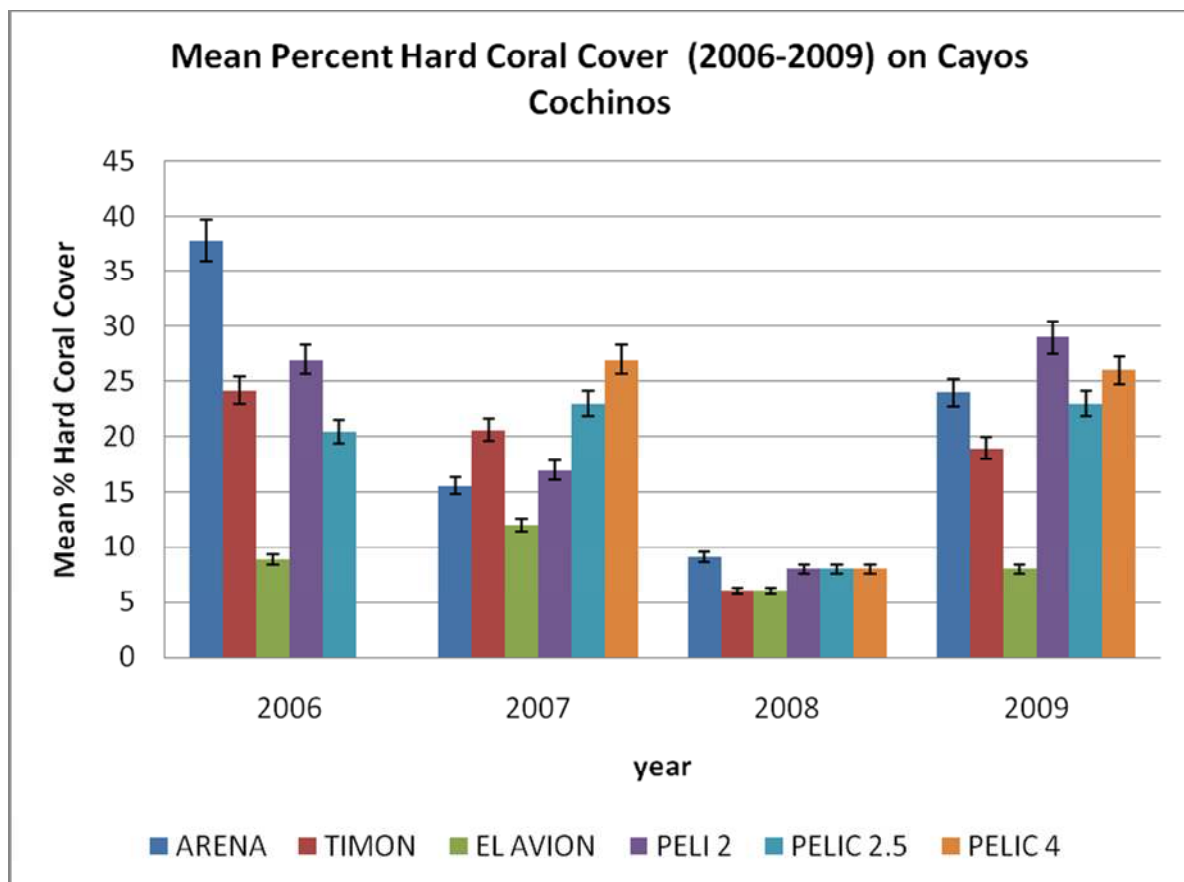


Figure 2.3.3e. Mean percentage cover of hard coral at all Cayos Cochinos sites from 2006- 2009. Bars indicate +/- 1 standard error.

A multivariate Kruskal-Wallis test was performed to examine the difference between percentage coverage of hard coral across all sites in 2008 versus all other years. The test yielded a significance level of $P=0.007$, indicating that coverage was significantly lower in 2008.

Average range Hard Coral per site (2006-2009) on Cayos Cochinos

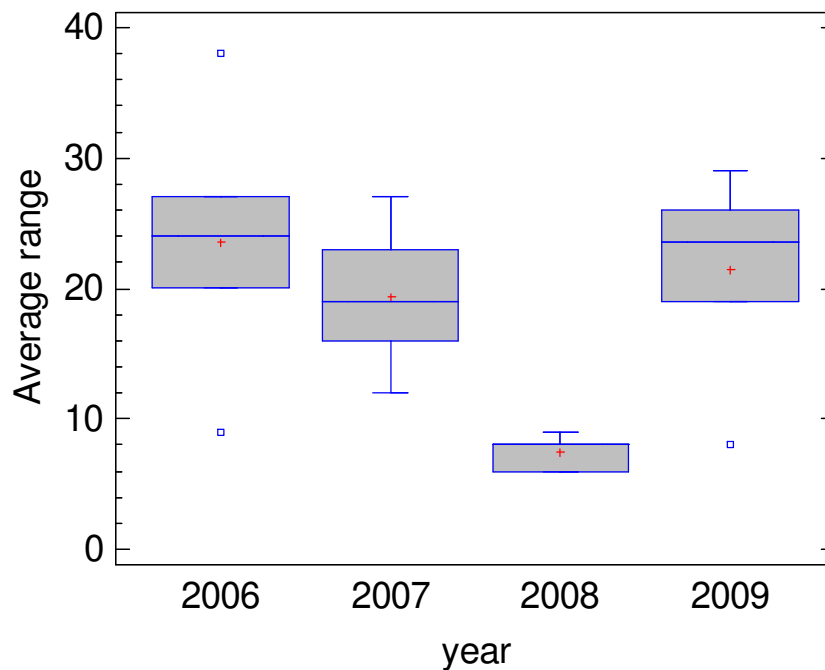


Figure 2.3.3f. The average range of percentage coverage of hard coral from 2006-2009. Data are pooled from all sites. Lines show medians and error bars show ± 1 standard error

2.3.4. Site condition and coral disease

Timon was the site most affected by coral bleaching from 2006-2009 (mean=21%, max.=27% in 2006, min=16% in 2007), followed by Pelican 2.5 (Dickie C) with an average 18% of bleached colonies (max.=25% in 2008, min=16% in 2006 & 2007) (Figure 2.3.4a).

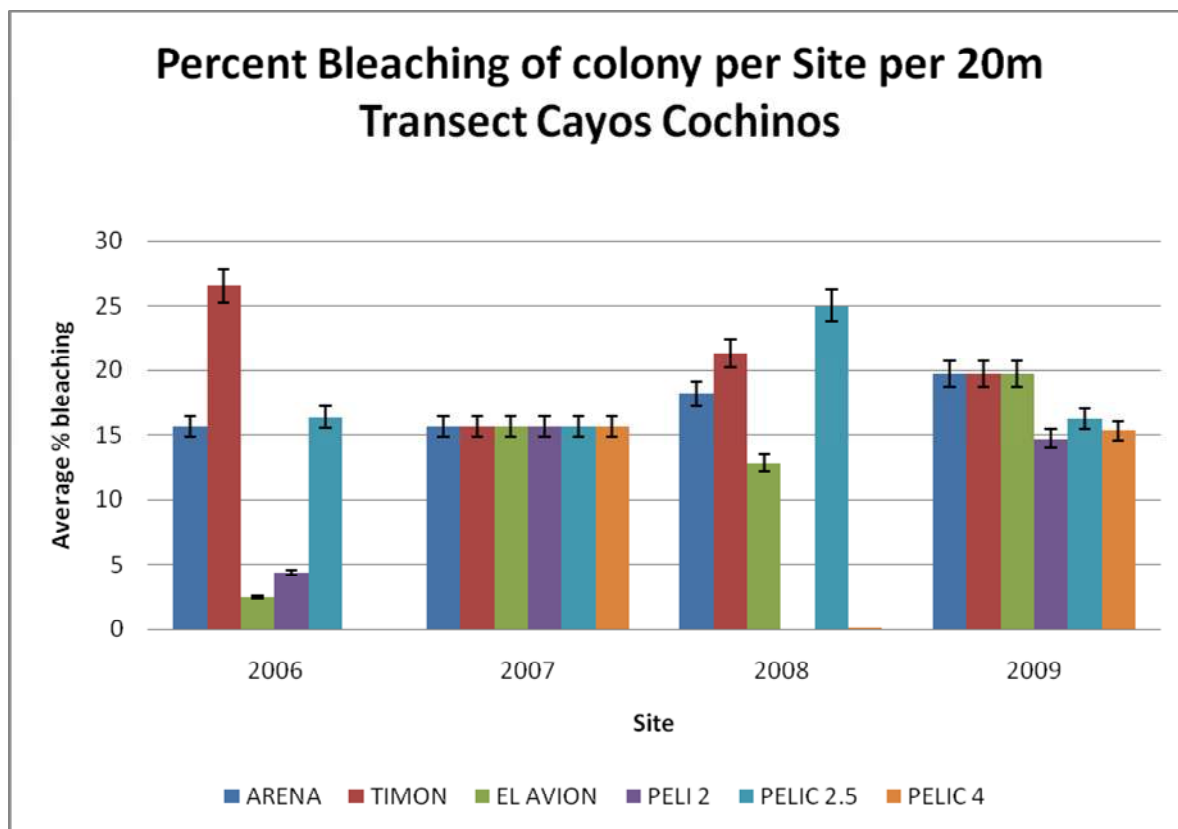


Figure 2.3.4a. Average percentage bleaching of colonies at all Cayos Cochinos sites for each year of monitoring (2006-2009). Bars indicate +/- 1 standard error.

A multivariate Kruskal-Wallis test between the means of Timón and all other sites yielded a significance value of $P=0.002$. Given that $P<0.05$, the difference is statistically significant with a 95% confidence level (Figure 2.3.4b).

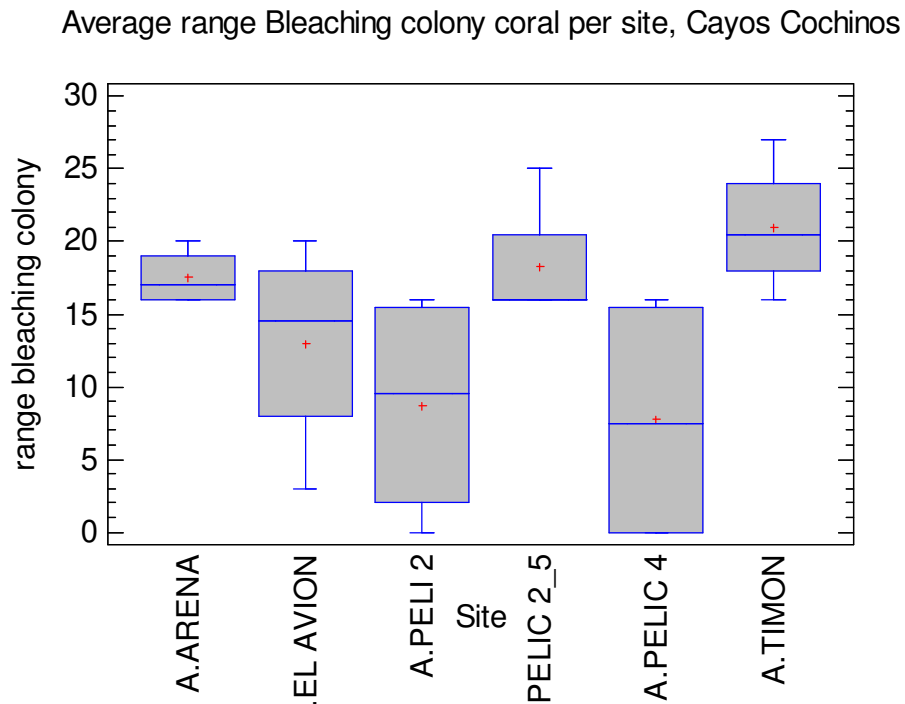


Figure 2.3.4b. The average range of percentage bleaching of coral colonies at all Cayos Cochinos sites. Data are pooled from all transects and all years (2006-2009). Lines show medians and error bars show ± 1 standard error.

The site with the highest average percentage of coral disease over the monitored period was El Avión with 1.5% (max=2.5% in 2006, min=0.25% in 2007), while Pelican 2 had the lowest average with 0.4% (max=1.18% in 2009, min=0% in 2006) (Figure 2.3.4c).

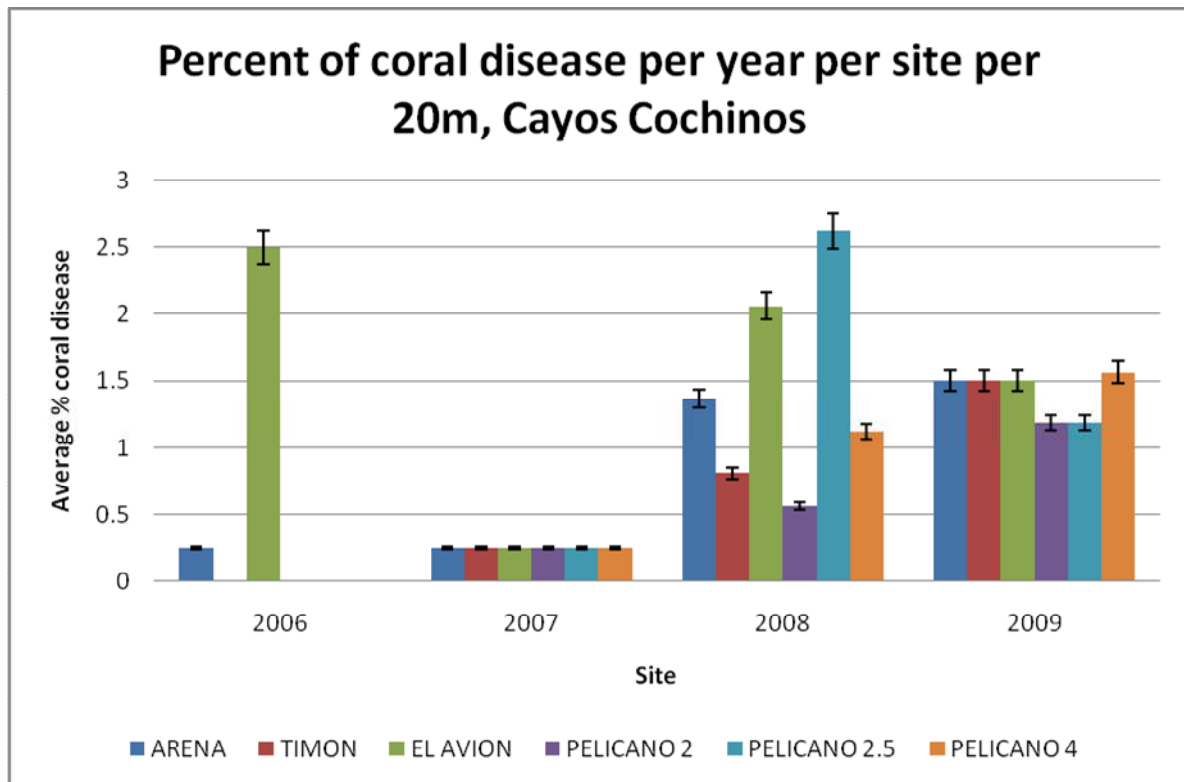


Figure 2.3.4c. Average percentage of diseased colonies at all Cayos Cochinos sites for each year of monitoring (2006-2009). Bars indicate +/- 1 standard error.

A multivariate Kruskal-Wallis test yielded a significance value of $P=0.6$. Given that $P>0.05$, there is no significant statistical difference between the means of El Avión and the rest of sites with a 95% confidence level (Figure 2.3.4d).

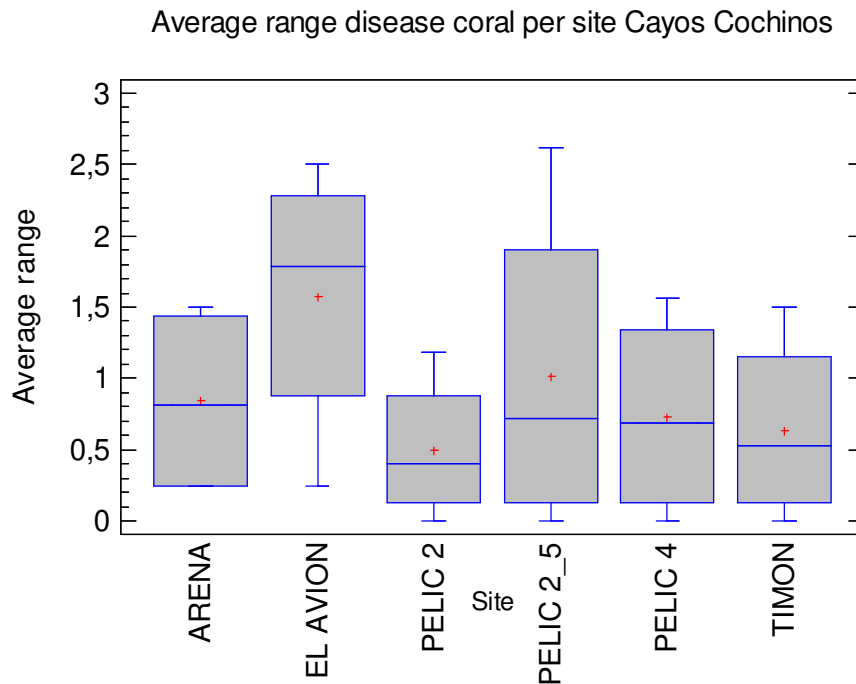


Figure 2.3.4 d. A comparison between range average medians diseased coral for pooled data of all transects, per year (2006-2009) per site.

2.3.5. Reef Check results & data submission

All survey data obtained served as a standard Reef Check survey. All data collected during the surveys were also submitted to Reef Check following their standard data submission protocol (Hodgson et al. 2004). These data will be analyzed by Reef Check and used to scientifically monitor, restore and maintain coral reef health. Please refer to www.reefcheck.org for further details.

2.4. Discussion

2.4.1. Fish

The reef fish in the Mesoamerican Barrier Reef System (MBRS) are important economic, social and ecological factors. The main threats to reef species are overfishing, habitat destruction, including effects on spawning and breeding sites (mangroves and seagrass), and pollution or modification of water quality by the effect of watershed runoff towards the coast (Garcia-Salgado et al. 2006). In the MBRS the most abundant families are Acanthuridae, Haemulidae, Lutjanidae and Scaridae (Garcia-Salgado et al. 2006), in Cayos Cochinos according Zaragoza (2008) the richest families are Serranidae, Labridae, Pomacentridae and Haemulidae.

According to the monitoring conducted by Biosphere Expeditions in Cayos Cochinos in comparison to previous years (Cubas 2006, Shrivives et al. 2007 and Shrivives et al. 2008) we observed a low average abundance of big predators such as grouper and moray eel (Figures 2.3.1d & e). This could be an effect of grouper overfishing or a lack of suitable habitat for moray eel. On the other hand, we also observed a slight reduction of herbivores (parrotfish), although they continue to be the fish indicator species of highest average abundance (Figures 2.3.1a-c). However, the ANOVA test in 2009 suggests that there is no significant difference between the parrotfish fishing and no-fishing areas ($P=0.017$, Table 2.3.1g). This trend was also observed by Shrivives et al. (2007) and Shrivives et al. (2008), which may indicate that there is no fishing pressure for these species and the catch is casual (Aronne, 2008).

Another species of commercial importance is the snapper. Here a slight decrease in average abundance in 2009 was observed compared to 2008. However, the ANOVA test between fishing areas and no-fishing areas in 2009 suggests a significant difference ($P = 0.568$, Table 2.3.1g). This is different from those described by Shrivives et al. (2007) who observed a reduction of fishing for these species. This reduction is probably due to several reasons. One of them is that fishing is changing over the season caused by differences in natural conditions of water, larval dispersal, migration, etc. (Cheung et al. 2008).

For Haemulidae an increase compared to the low values registered in 2007 was observed. However, the ANOVA test between fishing areas and non-fishing areas in 2009 suggests a significant difference ($P=0.416$, Table 2.3.1g). The Haemulidae are a group of commercially important fish, similar to snapper, and as such it is not surprising that their abundance is significantly different between fishing and non-fishing sites. This group is within the seven species of major fisheries in the area (see Table 2.4.1a).

Fisheries assessments on Cayos Cochinos have taken place since the 1990s. Figure 2.4.1a shows a comparison of fishing records from several publications on the different species of commercial interest reported on Cayos Cochinos (taken from Mug & Bolaños 2003).

Table 2.4.1a. Percentage composition of larger commercial value fish on Cayos Cochinos.

Nombre común	Nombre científico	Guzmán y Jácome (1998)	Gamboa (1997)	Medina, et al (2000)	Aronne (2008) ***	
		% Chachahuat, East End y Bolaños	% Chachahuat, East End y Bolaños	% Chachahuat, East End y Bolaños	% Nueva Armenia	% Chachahuat
Yalatel	<i>Ocyurus chrysurus</i>	53%	52%	43%	1%	25%
Ronco	<i>Haemulon plumieri</i>	15%	15%	15%		17%
Calale	<i>Lutjanus synagris</i>	6%	10%	25%	51%	29%
Pejepluma	<i>Calamus calamus</i>	7%	8%	7%		11%
Saraza	<i>Cephalopholis cruentata</i> *		5%	3%	3%	6%
Mantequilla	<i>C. fulva</i> **	4%	1%	1%		
Culila	<i>Caranx crysos</i>				13%	1%
Blanca	N/D				9%	
Corvina Blanca	<i>Cynoscion sp</i>				4%	
Macabi	<i>Albula vulpes</i>				3%	
Pez Sierra	<i>Scomberomorus regalis</i>				3%	
Palometa	<i>Trachinotus goodei</i>				1%	
Caulas	<i>Haemulon striatum</i>				1%	
Ronco Piedra	<i>Haemulon macrostomum</i>				1%	
	<i>Cephalopholis guttatus</i>					1%

* Previously known as *Epinephelus cruentatus*. ** Previously known as *Epinephelus fulvus*, *** Biosphere Expeditions report for year 2007.

It is clear that fishing on Cayos Cochinos is aimed at three families of fish, namely Lutjanidae, Haemulidae and Serranidae. This, according to Aronne (2008), is very similar to the observations of Guzmán and Jácome (1998) and Medina et al. (2000) and could indicate an imbalance in species composition and changes in ecosystem structure.

In addition Aronne (2008) asserts that the major fishing pressure on Cayos Cochinos is being exerted by two communities: Chachahuat and Nueva Armenia in three zones (north, centre and south) (Table 2.4.1b). According to Mug and Bolaños (2003) one of the reasons for fishing these groups of fish within the protected area and inside the influence zone is that they are rapidly growing species (in the case of the yellowtail and lane snappers).

HCRF has recently incorporated the *Manejo de las Pesquerías con un Enfoque de Ecosistemas* plan (Management of Fisheries Focused on Ecosystems), a new system which changes the order of priorities, focusing on the ecosystem instead of species (WWF 2006). Zaragoza (2008) evaluated the fishing areas of commercial importance on Cayos Cochinos, which were previously defined through a consultation process with the users and managers of the fishing resources. The sites selected were Roatán Bank, La Grupera, Mariposales, Salamandinga and Pelican Point. Zaragoza's (2008) study reports that Roatán Bank has the largest total reef fish biomass, followed by La Grupera and Mariposales, with Pelican Point and Salamandinga of lower biomass.

Table 2.4.1b. Average size (cm) of catch and Catch Per Unit Effort (CPUE, kg/boat/day), per community and fishing zone, number (N) of surveys and percentage (%) of fishing per zone and community.

Community	Zone	N	%	kg	Average size	Max. size (cm)	Min. size (cm)	Average CPUE*
Chachahuat	North	124	23	477	32	150	12	23.84
	Centre	96	18	250	27	120	15	12.48
	South	112	21	297	26	118	15	14.87
Total		332						17.07
Nueva Armenia	North	80	15	263	23	100	14	13.14
	Centre	37	7	175	23	175	14	8.74
	South	88	16	333	24	94	14	16.65
Total		205						12.84
Grand Total		537						

The present study shows a larger abundance of groupers at the four Pelican Point sites (0, 0.5 2.5 and 4) compared with El Avión, Timón and Arena. This is similar to what has been observed in previous years. Such high abundance at Pelican Point is possibly due to reproductive aggregation, based on data from five years of monitoring fishermen's reports (Aronne et al. 2009). Pelican 0 is one of the sites where there has been an increase in grouper abundance, a total of 37 individuals of *Mycteroperca bonaci* (black grouper) were recorded in February 2007 with lengths estimated at 71-90 cm. Likewise changes in colour and reproductive behaviour in this species have been observed. Different studies have described the reproductive behaviour of groupers and the change of colour, showing a bicolour phase white and dark brown (Shapiro 1987, Heyman et al. 2002, Claro and Lindeman 2003).

2.4.2. Invertebrates

El Avión had the largest number of sea urchins, which is consistent with observations of previous years, while abundance at other sites remained low. This low abundance is similar to the rest of the Caribbean, despite being considered organisms in a state of recovery after their sharp population declines in the 1980s (Wilkinson and Souter 2008).

In the present study the abundance of *Gorgonia* is similar to what was observed in 2006, where the highest abundance occurred at Pelican 4 and the lowest abundance at Arena and El Avión. Despite this relatively high abundance, the condition of the benthic hard coral substrate (Figure 2.3.3d) is not conducive to supporting a large population of fish, as also indicated by Zaragoza (2008) at Pelican. However, a more complex analysis of the data would have to be made to make this statement convincing.

The other categories of invertebrates, especially lobsters, which are a species of high economic importance, show low levels of abundance. These low levels are similar to those observed during previous years (Figure 2.3.2d). According to interviews carried out with local lobster fishermen, the low costs of lobster tails on the international market (\$7.8 per lobster tail) has caused a major extraction of this product in order to maintain profitability. Alternatively, in some cases the entire fishery has been abandoned in favour of other species such as giant clams, whose extraction is forbidden within the protected area (Francisco Solís, personal communication 2009). This increase of illegal fishing correlates with the threefold increase in the number of recorded violations in the last trimester (April – June 2009) (Aguilar 2009). This higher pressure can lead to a deterioration of the ecosystem due to overfishing.

2.4.3. Substrate structure / benthic communities

From the ANOVA analysis the rock (RC) substratum has the highest mean number observed over the four years of monitoring, especially in 2009 (Figure 2.3.3a & b), followed by the lowest hard coral cover recorded in 2008, possibly due to an error in data collection (Figure 2.3.3. d,e,f). This is in agreement with Zaragoza (2008) who associated the Pelican and Mariposales sites with low diversity and intermediate coverage of hermatypic coral when compared to those of Roatán Bank, which showed high diversity.

The average hard coral cover from 2006-2009 (excluding 2008 which contained an apparent error) was 21% shows a slight reduction in hard coral cover compared to that reported by García-Salgado et al. (2006) who registered 23.47%. In the assessment of health status in the MBRS, an average hard coral cover of 21% as reported in this study is still considered to be a good condition (20-30%) according Almada-Villela et al. (2003) and García-Salgado et al. (2006).

There is a third, significant substrate category on the ANOVA analysis, namely nutrient indicator algae (NIA), with an average percentage of 16.48%. In 2009 coverage was similar to 2008, especially at El Avión (Figure 2.3.3d). When this indicator was compared with the coverage of hard coral from previous years (Figure 2.3.3e), there is a slight reduction of NIA in relation to HC cover, which could be related to several factors such as the accumulation of sediments from coastal rivers or storm and hurricane activity (Shrives et al. 2007), with less intensity and force than the events that occurred between 2008-2009 to the events of 2006 -2007 (see http://es.wikipedia.org/wiki/Temporada_de_huracanes_en_el_Atlantico_de_2006).

2.4.4. Site condition and coral disease

Analysing all sites of 2006-2009, we note that the sites most affected by bleaching are Timón and Pelican 2.5 (Dickie C). 2006 and 2008 were the years when most bleaching events were reported (Figure 2.3.4a). After the significant bleaching events of 1995 and 1998, which strongly affected the coral reefs on Cayos Cochinos (Guzmán & Guevara 2008), the same phenomenon occurred again in 2005, affecting 40% of coral on the Meso-american reef (Wilkinson and Souter 2008).

In relation to coral death, Pelican 2.5 (Dickie C) registered a high percentage of coral mortality in 2008 (Figure 2.4.4b & c), which was likely linked to the bleaching events of 2006 or other events such as hurricane Felix in 2007. However, Timón did not register coral mortality after the 2006 bleaching event. Such inconsistencies between nearby sites underline the necessity of evaluating these sites on an ongoing basis to determine possible reef resilience.

2.4.5. Additional external factors affecting the area

HCRF is currently monitoring the short, medium and long-term impacts of tourism and the accomplishment of *Tourism Without a Trace* policies through the *Acceptable Change Limits within the Protected Marine Area* (Aronne 2009).

Thiebaud (2009) analysed tourism activities in Easter week 2009. She used indicators such as the presence of garbage at visited sites, the tourists' perceptions and level of satisfaction, and the impact of tourism on the ecosystem. In general tourists expressed a high level of satisfaction with the service offered by tour operators (81% were satisfied and 96% would consider coming back). Their impact on the ecosystem was, however, less favourable. Identified issues included the anchorage of many vessels in a small area, and the concentration of tourist numbers at the different sites, affecting not only the quality of their holiday experience, but also increasing the pressure on a sensitive ecosystem. Another negative impact that was identified was apparent disrespect on the part of the tour operators regarding following regulations concerning operating motorised canoes at high speeds within protected areas.

The HCRF has also evaluated activities related to all types of tourism to determine their impact on the reef ecosystem. Such studies have included monitoring the operations of reality TV shows from Spain and Italy, and observing the people in charge of diving operations.

As regards the impact of TV reality shows on the marine and coastal ecosystems, both reversible and irreversible effects have been observed. For example, at Cayo Paloma the nesting of birds was irreversibly impacted. Similarly, the nesting of sea turtles on various beaches was affected by the activities of the TV production workers, particularly by the constant use of canoes over the 2.5 months filming period (TNC/HCRF 2009). Studies have indicated that the presence of visitor, tourism infrastructure and even climate change have disrupted the nesting behavior of the sea turtles (Witherington, and Martin. 1999, Ga-Young and Eckert 2009, Hawkes et al. 2009). It is important to note that marine turtles, especially the Hawksbill turtle, are endangered and any disturbance is considered to be an irreversible damage to the populations (Meylan and Donnelly 1999).

HCRF in 1998 established a programme of sea turtle monitoring and research, which found changes in the number of turtles nesting in Cayos Cochinos (Aronne, in press). In the case of Cayo Paloma is not known whether the reduction of nesting is exclusively due to the presence of the TV production company or also influenced by other, external factors (for example nesting birds). It is, however, necessary to continue with the recommendations to restrict access to these sites during the nesting season (Aronne, in press).

2.5. Conclusions

The percentage coverage of dead and live coral (including *Gorgonia*) were fairly similar, suggesting that the substrate is able to support an absence of predator fish and an increase in herbivores. This balance is of great importance within the ecological assembly of the reef, giving it stability and suggesting a degree of robust health within the ecosystem. However, the evidence also indicates that the Cayos Cochinos coral reefs have suffered from moderate to high pressure by resource users, and high rates of sedimentation from coastal rivers.

In the last years we have observed that with the implementation of alternative community development projects oriented to developing tourism within the protected area, the pressure of extracting fishing resources has been slightly diminished. This is reflected by the increase in the catch of species of economical importance. However, the increase in tourism could have negative repercussions such as an increase in fishing efforts to supply food to the tourists. Further monitoring is needed to check this.

2.6. Review of previous recommendations and new recommendations

Since the start of expeditions in 2006 Biosphere Expeditions' support to HCRF has been crucial in guiding HCRF's efforts to manage the protected area. This became evident during the review process of the management plan 2004-2009, highlighting the need to redirect management efforts in particular to reduce the impact of sedimentation from the mainland. Another recommendation emerging from previous Biosphere Expeditions reports was to establish a programme monitoring the impact of tourism on coral reefs, in addition to defining more clearly the sites not intended for fishing.

Several of these recommendations were incorporated into the management plan currently in force (2008-2012). Recently, and with the support of organisations such as The Nature Conservancy, monitoring efforts have been increased and a surveillance programme increasing patrols has been implemented and enforced, especially in the no-fishing zones, as well as sites protected by national bans such as spiny lobster sites. Closer ties with agribusinesses in the area to make them aware of the problems associated with the release of nutrients and sediments into the sea have been built. However, this effort has not been successful so far, probably due to the lack of a concurrent environmental education programme and the lack of environmental education and awareness in business decision-makers. HCRF is also constantly monitoring the health status of coral reefs and associated ecosystems, as well as fish catches & landings. Local communities have consistently validated stocks and HCRF has evaluated the impacts of tourism under the policies on the Limits of Acceptable Change.

Recently HCRF has initiated an environmental education programme with the long-term goal to increase resource use awareness by promoting direct participation and involvement of different stakeholders in environmental issues in the protected area. One of the challenges in the short and medium-term is the management and evaluation of the buffer zone to determine the degree of connectivity between coastal ecosystems and coral reefs, so it is recommended to include Cheek Reef monitoring in this area to determine the degree of effectiveness of the implementation of management measures within the protected area and areas with recent conservation measures.

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Appendix 1: Hand signals designed by the expedition team to simplify underwater communication.



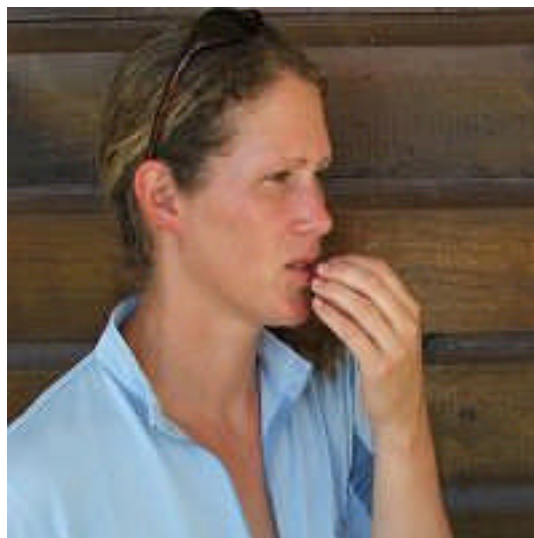
HARD CORAL – HC
Closed fist up and down



SOFT CORAL – SC
Open fist up and down



RECENTLY KILLED CORAL – RKC



NUTRIENT INDICATOR ALGAE – NIA



SPONGE – SP



ROCK – RC
Closed fist (NOT up and down)



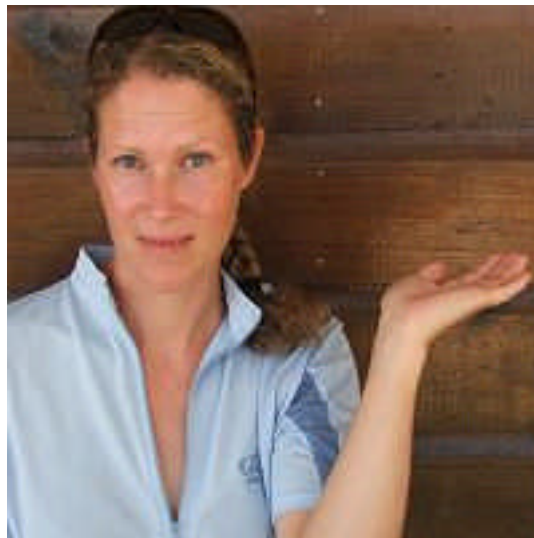
RUBBLE – RB
Circular motion with downpointed finger



SAND – SD
Wiggling fingers downwards
(because sand sinks)



SILT/CLAY – SI
Wiggling fingers upward
(because silt stays suspended)



OTHER – OT
Shrugging action with one hand

Appendix 2: Expedition leaders' diary by Jon Shrives, Thorben Selm & Kathy Wilden

23 February

Hello everyone and welcome to the Honduras 2009 diary. I'm Jon, your expedition leader, and you will be hearing from me regularly over the next few weeks. Thorben (my assistant) and I are just getting ready here in England, ready for the off later today, which brings me to the people you will be meeting during the expedition.

There's Thorben from Germany, expedition leader in training, who will be assisting me and learning the ropes of expedition leading. Thorben has lots of diving and first-aid experience, so he's the man to see if you are missing a leg or something along those lines. Then there's Marcio, our scientist from the Honduras Coral Reef Foundation (HCRF). There's also Jo Warwick from the UK who was hired by the HCRF to assist with diving and diving logistics. And there's yours truly.

We all look forward to meeting you in La Ceiba or on the island soon. My Honduras mobile number (FOR EMERGENCY USE ONLY OR IF YOU ARE ABOUT TO BE LATE FOR ASSEMBLY) is +504 9842810 – or it should be provided the SIM is still working and has been kept up-to-date by our friends at HCRF. I'll confirm this in one of my next diary entries, but for now, please note this number. It may well change, as may many other things, so just remember to stay flexible :) – it's an expedition after all ;>

Anyway, I'll see slot 1 at the Qunita Real on Sunday. If you are around and would like to go out for a drink before the official start of the expedition on Sunday morning (be there at 07.00 or miss the boat, literally!), then I'll be hovering around the lobby at 20.00 on Saturday.

I must be off to pack up the last few things and then catch a flight with Thorben later today. If you are still trying to swot up for the expedition, remember to read the published reports from previous expeditions available via www.biosphere-expeditions.org/reports.

So long

Jon Shrives
Expedition leader

26 February

¡Hola everyone! Jon here again. Just thought I would send a little update, now that Thorben and I have navigated our way from Heathrow to Newark and Miami, finally arriving in Honduras yesterday. After a long journey, we were finally rewarded with a beautiful boat ride from La Ceiba out to the Cayos Cochinos islands. The weather is ideal at the moment, with a reasonably cool 24 degrees Celsius, but warm waters of 27 to 28 degrees. There have been some light rain showers, resulting in a few more bug than normal, so please remember to bring some long, light clothing for the evenings, such as trousers and shirts, and plenty of repellent. I would also suggest bringing a lightweight waterproof or poncho for the odd patch of rain you may encounter on the transfer over. Thorben and I have met with Joanna Warwick, the expedition dive instructor, and Marcio Arrone the expedition scientist. Together we have sat down and worked out our sampling schedule and dive sites for the Reef Check surveys. We're all very excited and looking forward to the next few weeks, where we will gather a wealth of data on the local reefs for both the local management agency and Reef Check.

I'll be traveling back to La Ceiba on Saturday morning with Thorben to finalise some paperwork and do a bit of shopping for the expedition. Thorben and I will be hanging around the cocktail bar at La Quinta Real Hotel from 19:30 – 20.00 on the Saturday evening if you would like to meet up with us for an informal dinner and introduction. Otherwise the expedition will officially start at 07:00 on the Sunday morning at La Quinta Real reception. Please be on time as the morning is the best time of day to transfer over by speed boat, whilst the waters are (hopefully) flat and calm.

Otherwise I hope all your preparations are going well. Please remember to bring plug adapters for any of your chargers or electrical equipment (the system on the island is a US plug 110V) and a small padlock for the personal lockers in the hut. As an added safety measure I would also like you to all have my personal mobile phone number for here in Honduras, which is +504 33842310. This is to supplement the previous emergency contact number you have been given. It's a different network and company, and in the unlikely event that the first number does not work, you can try this one. Again, this number is for emergency use only; for example if you are going to be late for assembly on the Sunday morning.

Otherwise good luck (¡Buena Suerte!) with your packing and respective journeys, we're all looking forward to meeting you very soon!

28 February

Hello everyone! Jon here again! Bienvenidos a Honduras (welcome to Honduras) for the slot 1 team, who even as we speak, are making their way by plane and bus, to meet in La Ceiba for the start of the 2009 expedition. Hopefully Thorben and I will meet up with the team later on this evening, at the Hotel Quinta Real.

We've had a busy few days on Cayos setting up for the start of the expedition, but Marcio and Thorben did manage to squeeze in a dive to check the mooring lines at some of the dives sites we'll use. This was Thorben's first dive in Cayos Cochinos, and whilst he was snorkeling over to their descent point, both he and Marcio were greeted by a gigantic stingray, leisurely gliding along the sandy bottom bellow. As if this wasn't enough, after their descent down to the reef, they encountered a beautiful spotted eagle ray, swimming effortlessly over the coral backdrop. Let's hope this first time luck holds out for both slot one and two teams!

Well, the weather is a sunny 27 degrees Celsius now and there are no clouds in the sky, so hopefully the man-flu I contracted from Newark airport (nothing against Newark airport, it's just that it was minus 3 Celsius there!) should clear up in time for our first team dive on Monday. Thorben and I have to shoot off now to do some last few bits of paperwork, but stay tuned as we'll be in touch over the next couple of days to let you know how the slot 1 settles in! ¡Hasta luego!

2 March

Hello everyone! So good news! We all made it safely back to the research base on Cayo Menor, early yesterday morning. Previously, on the Saturday, Thorben and I successfully met up with the slot 1 team for a few evening drinks and an informal introduction and chat. Early the next morning we made our way to the La Ceiba dock, in a small convoy of trucks and taxis. From there we had a calm and sunny crossing from La Ceiba to Cayos Cochinos and the research base. We spent the day settling in and unpacking, and after some dry but very necessary safety briefs, the team members were introduced to the traditional Reef Check training video featuring the now legendary Craig and his "Outstanding!" presentation. After the video we then all made our way down to the beach where we set up a dry run of the Reef Check surveys. A 100 m tape was laid out on the sand and the team members took it in turns to practice counting fish, assessing invertebrate numbers or recording substratum type (yes a lot of SD! (Sorry SD is the reef check code for sand! A bit of an in joke!)). There were also a few surprise coconuts doubling as parrotfish, corals, whale sharks, you name it! Imagination was key! The team finished off the day with some well deserved cold beers and casual chats around the porch, watching the sun go down over the palm trees and the tranquil Caribbean sea.

Today the team had perfect weather for being indoors for the Eco-Diver lectures; rain, rain and more rain! Unfortunately we couldn't do our check dives, instead we enjoyed the shallow seas episode of the BBC's Planet Earth, and started some Reef Check indicator species revision. Even as we speak the team members are eagerly testing each other on fish, invertebrate and coral identification!

Well goodbye for now, but its more of an ¡Hasta Luego! (See you later!) as I'll be in touch soon to let you know how the rest of the training goes and brag about the weather (once it clears up!).

¡Ciao!

8 March

Hi everyone, for a change, and a special treat, I'm going to hand over to my assistant and expedition leader in training, Thorben, for this diary entry. But before I do that, just a quick reminder that the emergency contact number for the expedition has changed to +504 33842310 as the +504 9842810 number is no longer valid due to some problems with the SIM card.

Chat again soon, but for now, over to Thorben:

¡Buenos noches! (Yes, it is dark already) This is Thorben this time and I will give you a little update on what has been going on. Unfortunately for the past two days the weather has been either fairly miserable or windy or the sea was too choppy to go out and conduct some surveys. Instead we had some very interesting lectures by Jon. As these are usually given at Oxford University we all feel under intense academic pressure ;) Furthermore, we also conducted a few quizzes, sorry, I meant tests, for Reef Check and the group performed very well.

This morning we finally managed to get out and wet again. This was one of the few "fun dives" (believe it or not, we are actually here in order to do work!), diving El Avion, which translates to "The Aeroplane". Indeed we did find a two-engine aircraft at about 16 – 18 m depth, covered by loads of different forms of life, such as corals or sponges. Funnily, the door did bounce with the waves as if it was to say "Come on in" (which we didn't!). In the afternoon we went to visit some local fishing communities, getting a taste of the local way of life. It was interesting to see this and also that there are efforts to take fishing pressure off through local community projects. Projects such as a small restaurant and guesthouses for eco-tourism to provide alternative means of income, which makes them less dependent on fishing and thereby relieve fishing pressure. This is one of the many contributions aimed for by Biosphere Expeditions. It is good to see that it works!

We then de-briefed for the day. Now the team is very keen to catch up with the science again, i.e. the survey dives.

¡Hasta luego!

Thorben

10 March

Hola everyone! Jon here again. Thanks Thorben for the last diary entry.

So unfortunately Slot 1's run of bad luck has continued, with some more strong winds, and today we had to cancel a dive due to excessive current. However, slot 2 will be glad to hear, that although it's been windy, it has at least been very sunny too! We have managed some successful morning dives though, and the team has been working like a well-oiled machine. Yesterday's dive was a resounding success and completed in record time! At the moment we have our fingers crossed for a night where the wind will die down, so slot 1 can get a night dive in. Over the last few nights we've had some fantastic sightings of the majestic Eagle Rays, gliding around the dock, attracted in by the lights. We hope we can join them before Friday, when the slot 1 team have to head back to La Ceiba for the end of their time here! We have fingers and toes crossed for some better weather tomorrow afternoon, so please cross your fingers for us too! We'll be in touch again before we wrap up the slot 1 expedition on Friday! Stay tuned!

¡Hasta luego!

13 March

Hey everyone! Jon and Thorben here again! Well we're now in La Ceiba to wish goodbye to the outgoing slot 1 team and welcome the incoming slot 2. It's safe to say we managed to end the slot 1 expedition on a real high. After being dogged by bad weather and cancelled dives, the team came up with a great strategy to redouble our efforts. The team split in half, and on each dive we managed to do two transects! On top of this, we started doing back to back dives, to make the most of the good weather in the mornings. We would come back from our 8 am dive, and like a formula one pit crew, everyone would have a different job to turn the boat around inside of 20 minutes. Some would take the BCDs and regs, whilst others would scramble to get new, full SCUBA tanks, others taking the old ones away. Like a well oiled machine, the heroic efforts of the slot 1 team, allowed us to claw back 4 transects in one morning! The next day we repeated this feat, so that within 3 days, the exhausted team members managed to survey all but one transect - a weeks worth of work in just 3 mornings! They certainly earned their cold beers last night, and as a last night celebration we all chipped in to a big pile of snacks and swapped stories!

So, now we're in La Ceiba, and sad farewells have been made. Slot 1 have laid down the gauntlet for slot 2. We're all excited to be meeting up with the slot 2 team members, and again Thorben and myself will be in La Quinta Real Hotel lobby at 19:00 if anyone fancies meeting for an informal dinner before the expedition officially starts on the Sunday morning at 6:30 am in the hotel lobby. Again, if anyone needs to contact me in an emergency, for example failure to meet on the Sunday or late to the meeting, my contact number is +504 33842310

Looking forward to meeting you all, and congratulations again to the slot 1 team!

¡Hasta luego y buen viaje!

15 March

¡Buenas tardes! Although I should say buenas dias or buenas noches, depending where you are in the world right now! So the Slot 2 team have arrived in Cayos Cochinos. We were treated to a relatively easy boat journey this morning, albeit a bit bumpier than slot 1's glassy clam sea two days ago. Even with the swells, we all enjoyed the early morning mist, lazily draped around the emerald green mountains of the Honduran coastline. This stunning scenery evidently inspired the new team, as they excitedly chirped away in the boat, swapping diving stories and discussing adventurous travels. I have to admire their spirit. Even though some have travelled over to Honduras from far and wide, without a stop-over, they seem to have shrugged off their jet lag, and even as we speak, they are starting their first practice Reef Check transect on the baking hot sand of the research station's beach. Even three hours of my voice, as I gave various introductory talks and briefs, doesn't seem to have broken their spirits! Their enthusiasm is definitely encouraging! Perhaps the traditional "Outstanding" Reef Check video presentation with Craig, is responsible for the buzz - who knows!

Well with the paperwork done and the practice transect finished, all the team have to do now is enjoy some well earned first day R&R. They're going to need it, as the training continues tomorrow with an orientation and identification dive in the morning and another three hours of my voice in the afternoon! Poor things, but hopefully the content of the identification lectures will keep them awake!

We'll be in touch again to update you on how the training went and also if we got to see any cool rays or other exciting flora and fauna on our first day!

Until then - ¡Cuidate! (take care!)

19 March

Hello everyone! So the slot 2 team have settled in well and today are conducting their second day of data collection. Today the team also tried out the patent pending slot 1 method of back to back dives, two transects per dive. They passed with flying colours! Even with a few team members missing due to ear problems and some colds. Best they stay out of the water - better safe than sorry when it comes to ears and diving, but hopefully we'll be back up to a full complement soon. The second and third day of training also went well, and the team participated in the new Reef Check quiz (sounds nicer than an exam!) to test their identification skills and find out what they really knew about fish, invertebrates and substrata. This was also a useful exercise for the team to find their strengths and weaknesses and what they need to revise.

Our first real survey dive was yesterday at Peli 4 - a nice introductory site, with a gentle slope of a reef wall. Conditions were calm and the water a clear crystal blue - quite a contrast to poor slot 1's first few days! As I finished laying the 100 m long transect tape for the 12 m deep survey, Stuart (my dive buddy) and I floated in amongst a breathtaking school of several hundred bar jack. Usually these predatory fish roam around in trios or alone, and are somewhat timid. It was a pleasant surprise for us to be met by this wall of silvery fish, who rather than shy, were boisterous enough to school around us for a good few minutes, close enough to touch! Although this was a great treat for Stuart and I, it was nothing compared to the eagle rays Karen and Mel swam with off the pier on Tuesday! The rays had been attracted in so close to the pier, that rather than use scuba, it was sufficient to hop into the shallow waters with just snorkelling gear and watch these beautiful creatures glide by in the gloom, every now and then, turned a golden colour by the myriad of torches.

Well, stay tuned for the next update in a couple of days, when I let you know how our first week of data collection went!

¡Hasta luego!

25 March

Hello all. Firstly, apologies I've not been in touch for a while, it's been a dramatic few days here on the island, to say the least! Shortly after the last diary entry, a helicopter crashed just off the pier. The pilot escaped with minor injuries and was the only person onboard. He was extremely lucky, as the helicopter flooded and capsized quickly, but he managed to get himself out, and the Honduran boat drivers raced to the scene in minutes. All of this occurred at night to make things even more difficult! Whilst the team members witnessed the crash, no one else was injured, and all the debris remained at the impact site. The pilot was treated by Thorben and a local Honduran doctor, whilst some of the team and I rushed around gathering medical supplies and oxygen. Fortunately the pilot was not seriously hurt, but was evacuated to the mainland hospital in La Ceiba, where he is making a full recovery.

The next few days involved rediscovering the wreck once it had sunk, and several insurance teams visiting to inspect the remains of the helicopter. On the plus side we now have a new artificial reef!

Then I developed malaria. Fortunately for me it was the milder strain: *Plasmodium vivax*. I had to take a big course of big pills and spent a couple more days in bed feeling pretty poorly, sorry for myself and embarrassed, that of all the people – it had to happen to the expedition leader! Fortunately my fever broke on Monday night and I transferred back to the island first thing on Tuesday to check on the team. Since then I've been recovering well.

Regardless of the drama, the team managed to slot back into collecting data on their morning dives. One of the team members, Will, was even treated to the sight of a beautiful and delicate sea horse, although the rest of us, green with envy, are trying to persuade him it was only a hallucination!

Nurse sharks and turtles still seem ever elusive for this team, and as a final chance, I've sent the team out on a last day fun dive to the site "Peli 2.5" aka "Dicky C", the site where the 2008 expedition discovered two nurse sharks on two separate occasions. So fingers crossed!

Well, it's time to pack up and finish a few last pieces of paper work. The team all passed their Reef Check exams with flying colours, and I treated them to some underwater footage of Biosphere Expeditions' new study site: the desert fjords and coral fields of Musandam in Oman. This afternoon I intend to take the team over to the Plantation Beach Hotel on the larger island for a bit of afternoon R&R as a final treat. Then it's the last night revelries, but not too late, as we have a very early transfer to La Ceiba in the morning! I'll be in touch again to let you all know how our transfer went. Until then, I wish you all a hearty: ¡Hasta luego y adios!

27 March

¡Hola! Well, we all made it across to the official end of the expedition, early (very early!) this morning in La Ceiba. Although we were all a bit blurry-eyed from the 5 a.m. start, we were treated to a beautiful crossing. As the palm tree islands of the Cayos Cochinos faded behind us, the tall, lush mountains of the coast cut a stunning horizon; multiple shades of lilacs and purple against the pink dawn sky. With the formal debrief, thanks and farewells made, only a few team members are now left in La Ceiba, as most made their onward journeys by plane and bus.

I would like to take the opportunity to thank both teams for their hard work. Both slots faced their own unique set of challenges, yet both rallied round when it counted and went that extra mile to get the work done, and get the data collected. ¡Muchísima gracias everyone!

We wish you all a ¡Buen Viaje! (safe journey) back to your homes, and hope to see you again on another Biosphere Expeditions project sometime! Thank you too, to you the readers, hopefully you've all enjoyed the diary and are hungry for more! So, until the next expedition... ¡Cuidate y Adios!

Jon and Thorben

15 March

Just a little update from Kathy and myself. We are now over in La Ceiba and having finished our last bits of paperwork and shopping, we are looking forward to rendezvousing with the Slot One team. Last night Kathy and I checked out the 'Expatriate's Bar', where we will be having dinner tonight. It's a great place with a great atmosphere and a good selection of food - most of which is home grown by the owners or their friends. However we have been warned by one of the owners that the price of salad may go up soon. Apparently their main supplier was keeping a female jaguar on the farm in a converted macaw aviary! Of course the weight of an amorous male jaguar looking for a date, is a bit more than your average macaw, and so a breakout was facilitated! As you can imagine, the farmer and his staff are now a bit nervous to venture out into the fields now that they have two jaguars wondering around. Biosphere have several jaguar projects in other countries (www.biosphere-expeditions.org), but unfortunately Honduras isn't one of them! So for the meantime we'll keep the focus on reef conservation and assessment!

17 March

Hello again everyone! You'll be glad to hear that all the slot one team made it safely to the rendezvous on Sunday morning, regardless of jaguar breakouts! We had a good trip over to the island. The morning mist was just clinging to the mountains on the coast, otherwise it was a clear day with a smooth sea. Once we arrived, the team settled in and proceeded upstairs to the restaurant for a welcome brief, introduction and safety talk.

The team then regrouped in the dry lab for an introductory lecture on coral reef ecology, followed by lunch. The afternoon we went over the Reef Check methodology, which involved watching the Reef Check instructional video featuring the now legendary Craig from Reef Check – "Outstanding!", who is a firm favourite amongst Biosphere Expedition teams. The video was followed by the traditional beach practice transect, involving a special guest appearance by a duck tape denizen of the deep! Dive gear was then issued as required, and after a long day, the team relaxed on the veranda of the hut, sipping a nice cold (and well earned!) beer.

The next day we awoke to a very exciting boa spotting. The Cayos Cochinos are home to the endemic pink boa constrictor, a rare variation of the mainland boas, which are normally a greeny-grey to brownish colour. This snake can only be found on these two islands, and nowhere else in the world! Often scientists spend days in the local forest, hoping to find one. We found two sitting in the tree next to the hut, just on the way up to breakfast! We were then treated to a presentation about the history of the region by Adoni Cubas, the Director of Conservation for the foundation that manages the marine park. We also had a presentation from Tony Ives, founder and Director of the Development Support Group (GAD – Grupo Apoyo y Desarrollo) – a relatively new NGO, that has set up in the region to help local communities with sustainable development projects and education scholarships. Their website is <http://cayosscholarships.org/> for those interested in more information. It was really exciting and encouraging to hear the progress that is being made in the region. The rest of the morning was spent in identification lectures, as the team honed their skills in anticipation of practice surveys tomorrow.

We did, however, take a break from lectures in the afternoon, with an opportunity to get wet! The team visited Pelican Point 3 – a gentle, shallow dive site with some nice patch reefs and bombies. The site was ideal for a check dive and the reefscape was perfect for practicing identification following this morning's lectures.

23 March

Hello everyone! Sorry for the delay in the latest diary, but we've suffered a patch of bad weather and limited connectivity to the web. After initial Reef Check training for two days, the team started their first day of data collection. The previous day we all had a practice dive on the warm, shallow reef flat of Pelican Point Buoy 4, and so everyone was now settled into their specific roles. Steve and I started first, laying the 100 m transect tape, then returning to the start, to count indicator species of reef fish. We were then followed by Yvonne and Lydia collecting invertebrate data and our Gorgonian 'counter-in-chief'; Kathy. Last, but by no means least; we have Savanna and Velvet assessing the substratum that comprises the reef itself. The team has been collecting data like a well oiled machine, but sadly dives have been interrupted for the last couple of days, by a series of unusual cold fronts causing bad weather. However bad weather and cancelled dives have not interrupted the slot one team's adventures!

The station now has its own herpetologist, Lesley, who is out here studying the local black-chested ctenosaur (looks like an iguana, but I'm told by Lesley it's definitely not an iguana!). Lesley employed the services of our team, thinking up elaborate ways to catch the surprisingly agile reptiles! Unfortunately one of the larger ctenosaurs managed to give Lesley a nasty bite on her thumb, and the team had to suspend catching activities to do a bit of first aid. A couple of stitches and a thumb splint later, Lesley and Kathy were gallantly leading the team over the top of the island to explore the remote and untouched beach on the other side. The trek took the best part of the afternoon, with the team finding all sorts of interesting creatures in the rock pools of the other beach. Now the weather has cleared up, and we have sprung back into action with some back to back diving, increasing the sample rate to three dives a day, making up for lost time! Today we lost Kathy and Lydia from the team. Kathy is returning back to the Biosphere office in the sunny UK and will be sorely missed by everyone. Lydia who was visiting Velvet, had been drafted (press-ganged!) into working with us, and has been a key ally. Although we've been spoilt by having two extra pairs of hands on the dives, we are still raring to go, and our spirits have been lifted today, by the kind donation of chocolate Easter bunnies, flown in all the way from Austria by Yvonne! So Buena viaje Kathy and Lydia and Happy Easter to everyone too!

26 March

Well we've been dogged by bad weather again! But it hasn't deterred the Slot 1 team one bit! Although we lost a day of diving yesterday, the team has made up for it with some extra dives today. Even with all this work going on, we've still had the chance to see some great reef life whilst diving. On the day that Kathy and Lydia left, we performed two survey dives (no time off, when making up the dives missed due to bad weather!). On the first dive, we had enough spare time to explore 'El Avión' the namesake of this site. Lying just off the reef is a small twin engine Cessna plane wreck, which crashed at the site in the mid 1990s.

Many a story abounds about the wreck's origins and reasons for crashing. Tales vary from drug trafficking, to aerial surveys for the United States Geological Survey, to rumours of CIA involvement! All depending on which divemaster you ask, of course! If exploring the now coral encrusted wreck wasn't exciting enough for one dive. We were then greeted by a wonderful formation of eight Caribbean reef squid, performing a fine multi-coloured underwater ballet for us. Being somewhat of self-confessed cephalopod geek, I couldn't believe my luck; I've only seen reef squid twice before in 500 dives within the marine park. Far rarer than turtles – which we see all the time (unless you're Kathy, in which case they tend to hide from you. Sorry Kathy!).

As if that wasn't enough for the team and I, we were treated to something really unusual on our second dive of the day, at the dive site 'Arena'. There at the end of our fish transect, Steve and I stumbled upon a real oddity and photographic opportunity; an octopus, out in the open (they're normally tucked away in a crevice during the day), bold as blue, eating a queen conch! The canny creature had turned the gigantic snail on its back, and was merrily chomping away at the soft underside.

When disturbed, the octopus dragged the conch back to the lair, using it as composite shield and living larder! Our series of underwater adventures was ultimately topped off last night, when on a night dive in the local bay, Steve and Savanna's torches attracted in a school of eagle rays, who gently glided in to inspect these strange bubbly creatures. All Savanna and Steve could do was gaze back in awe, as the rays cruised into within a meter of the divers, chomping away at small fish and jellies on the way!

27 March

Hello again everyone. I just wanted to send out a quick note to let the incoming Slot Two Team know that I will be in La Ceiba again this Saturday and hanging around Banana Republic Guesthouse at 7:15 pm local time, if anyone fancies meeting up for a pre-expedition dinner. Otherwise the Expedition will officially start at 6:30 am on the Sunday morning at the Banana Republic, where we will all meet up with the Honduran Coral Reef Foundation's truck to load up our luggage for our trip to the dock and then onwards to Cayos Cochinos! Again if anyone needs to contact me in an emergency (i.e. problems meeting up or you will be late for assembly on the Sunday morning), then my cell number is: (+504) 99842810. Otherwise I look forward to meeting the Slot Two team this weekend! I hope you all have a good flight over and please feel free to bring dive torches for a night dive. Buen Viaje!

30 March

¡Hola! You'll be glad to know the Slot 2 team have successfully made it out to the island. We had a smooth crossing, where, despite having done the La Ceiba to Cayos route countless times over the last few years, the only person who got wet was yours truly!

After a day of briefings and introductions to the Reef Check method for surveying coral reef health, the team are now settling in to their new Caribbean home. We've had great weather the last few days, which has been a welcomed return to the norm after the Slot 1 team's unlucky rainy patch. Tomorrow the team continues training with a three hour session on identification followed by a check dive in the afternoon. Team 'Bufs' and T-Shirts have been issued and already people are keen to get out diving and collecting data. This enthusiasm combined with the good weather forecast (keep your fingers crossed!) bodes well for the next 12 days of the expedition, and there is a lively atmosphere of anticipation and excitement on the island.

I'm now off to watch the Biosphere Expeditions versus Honduran all-stars, volleyball match, which has just started. Although the Honduran staff have the home field advantage, we have a secret weapon; Lesley the herpetologist has played professionally and at international level, so we might be in with a chance! Stay tuned for more news from the field within the next few days. ¡Hasta luego!

6 April

The Team has seen and done a lot since my last entry!

We returned to Cayo Timon (site of the hawksbill turtle and self-publicising stingray) to conduct another survey dive, this time at a slightly deeper depth. Halfway through the transect, Roland and Anna spotted a huge adult hawksbill sitting on the crest, contently watching us swim up and down laying transect tapes. In contrast to the previous turtle, this adult had obviously seen it all before and wasn't fazed by divers snapping away with their cameras. As if that close encounter wasn't exciting enough, the second dive of the day was even more exhilarating. After laying down the transect tape at the dive site 'Peli 2', Dominik and Tom spotted something distinctly not reef shaped, sticking out of the rocks. Suddenly I heard them signalling me, both clanging on their tanks. I turned around to see what all the commotion was about. In a blur of bubbles, they were both making a hand signal that all divers hope to see. A hand signal that is sadly all too infrequent these days; one I had longed for since 2004. There was no mistaking their gestures, as they frantically hit top-centre of their heads in a vertical palm salute.

The mock dorsal fin signal could mean only one thing: shark! Sure enough, in a small sandy hole on the reef below, a nurse shark had curled up for a daytime nap. Fast asleep, the shark did not care a bit as we all crowed in to take pictures. You could practically hear it snoring underwater! We were ecstatic! Shark numbers are seriously threatened globally and they are in danger of extinction, mainly due to the shark fining trade. For example; we have seen three turtles here in the last week. In 500 dives within Cayos Cochinos over the last six years, I have only ever seen two other nurse sharks! It was a real treat!

The next day was reasonably uneventful in comparison. Plenty of data collected though, and with the good weather we've had, we are actually ahead of schedule! Time enough for a night dive! The team visited the dive site 'Arena'; so called for its round stadium-like shape. With the torches briefly switched off, the team experienced the bioluminescence, their movements exciting the glowing plankton in the water. Sleeping parrotfish and huge wandering lobsters also impressed the team. One of the most beautiful sites was the elegant and delicate basket stars, roaming slowly over the reef, wafting their giant fern-like arms in an attempt to catch a night time snack.

Today the team is off for a well deserved break. This afternoon we'll visit the local Garifuna communities in Cayo Chachahuate and the east end of Cayo Major (the big island opposite the island we are based on.) to see how the local fishermen live and view successful community development projects, such as extensions to the local school and construction of the new ecotourism lodges.

It's back to work tomorrow. We only have three more days for the last few data collection dives, before we pack up for our departure. We wouldn't mind seeing another shark before then though!

10 April

Well, sadly this is my last diary entry from Cayos Cochinos, as the expedition comes to an end. Today has mostly been spent packing as we have a very early departure tomorrow morning! Yesterday was our last day of diving, and due to the team's eagerness, we were ahead of schedule with data collection. This meant we had all day free to do some fun dives and explore some other dive sites around the region. First thing in the morning we ventured out to 'Peli 1'. Part of the 'Peli' series of sites (you might recall diary entries about Peli 4 and Peli 0), this site boasts a breath-taking sheer wall, that drops down to 30 meters. The team just roamed around the top 18 meters though, admiring the myriad of fish life swarming around the delicate branching corals of the reef crest. This was followed by a dive off Cayo Largo Arriba, a relatively un-explored site in the east of the marine park. Here the team discovered a huge underwater bank, covered in corals and algae – completely unexpected! Even though the team saw yet another turtle (they're a lucky lot the slot two team!), the highlight was a very up-close and personal encounter with an eagle ray. Completely unafraid, this magnificent spotted giant, cruised within feet of the team, circled around us for a good look and then majestically glided off into the deep! What a way to end the expedition! In the evening we celebrated with a tense, yet hilarious game of volleyball, where Dominik proved once and for all, the Swiss are very good at bobsleigh and skiing, but not so great at beach volleyball! He did make up for it in buckets of enthusiasm though. At the post-volleyball party, we celebrated our successful data collection with a little treat – I'd squirreled away some chilled white wine, some red wine and a jar of olives! Needless to say, all was gobbled up by the team pretty quickly!

Well with packing almost done, its time to pop over to the hotel on the larger island for some R&R followed by a surprise cake I've order for the team's last dinner this evening!

Thank you again everyone for all your help, enthusiasm, humour and hard work. It's been a great month and you can all be proud of what we have achieved here. Perhaps see you again some day, if not same place next year?

Hasta luego

Jon