

# The Basis for the Establishment of a Coastal Marine Park surrounding Isla Galeta

**Research in Panama  
ENVR 451**



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Smithsonian Tropical Research Institute



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## **1.0 Internship Components**

### **1.1 Executive Summary (English)**

#### **The Basis for the Establishment of a Coastal Marine Park surrounding Isla Galeta**

Researchers: Sarah Pease & Anna Swick-Coryell

Host Institution: Smithsonian Tropical Research Institute, Isla Galeta Marine Laboratory.  
Smithsonian Tropical Research Institute, Unit 0948, APO AA 34002.

The Smithsonian Tropical Research Institute (STRI) was established in Panamá in 1923 and today is the foremost scientific tropical research establishment in the world. It has since founded research stations all over Panamá, with laboratories in Bocas del Toro, Barro Colorado Island, the Amador Causeway and Isla Galeta.

The Isla Galeta Marine Laboratory was established in 1964 and is located east of the Caribbean entrance to the Panamá Canal near Colón. Isla Galeta is a center for both education and scientific research. Each year the lab receives over 10,000 visitors, mostly from Panamanian public middle schools, and to date, over 300 publications have been produced from studies performed at the lab.

The aim of this project was to create a coastal marine park on the eastern coast of the district of Colón to protect the mangroves, seagrass beds and coral reefs. These three key coastal ecosystems are plentiful on the Caribbean coast of Panamá and contribute greatly to marine biodiversity and stability. Hoping to conserve these ecosystems, STRI and the Isla Galeta Marine Laboratory saw a need for such a park due to the intense industrialization and development in the area. For instance, there is currently a large-scale oil refinery in Bahía las Minas, within the area of the proposed park, and there are plans to build another large refinery further east.

Thus, the objectives of the researchers were to collect information regarding the study region, interview professionals about the process of park establishment and management, perform preliminary ecological surveys of the three key ecosystems within the prospective park (coral reefs, seagrass beds and mangroves) and determine the potential effects a park could have on nearby residential communities.

The study site is located in the central region of Panamá, just east of the Caribbean opening to the Panamá Canal. The marine park would extend from Punta Galeta eastward to the Islas Naranjos, and include the water out to 2.5 kilometers off of the coastline.

Research began with an extensive literature review. Scientific articles, maps and land use documents were collected from STRI libraries, the National Environmental Authority of Panamá (ANAM), internet resources and professional contacts. Data collection also included interviews with people working on similar projects to gain insight on park management tactics, potential difficulties and current ecological issues specific to the study site. Finally, some preliminary field work was performed by car and boat to survey the general layout and environmental state of the region.

The literature review provided extensive background information on coastal marine ecosystems and their functioning and value, as well as specific environmental issues surrounding the area of study. The land use documents reviewed included the first ever land use plan (POT) for the district of Colón, that may soon be law, as well as the Environmental Impact Assessment (EIA) for a proposed port project on nearby Isla Margarita. Since any decisions regarding land

use around Colón will ultimately affect Punta Galeta and the proposed protected area, these documents supplied much useful information regarding possible obstacles and benefits of planned developments.

Field work also offered invaluable first-hand knowledge regarding the contents and state of the area. The western portion of the proposed park was visited by car to survey the residential and industrial areas and their interactions with the coastal habitats. Clear evidence of contamination was seen in mangroves and bodies of water. This same section of the park was viewed again by boat, but this time the researchers continued on to the eastern section, just past the Islas Naranjos. The majority of the mangroves appeared quite healthy and undisturbed. It was discovered that of the Islas Naranjos, Isla Arriba, owned by a man from Germany, was not entirely without development, containing a few huts and a wooden boardwalk. Furthermore, although there has been a decrease in fauna in this region, biodiversity remains high within these unique ecosystems.

The research shows that there is a high degree of industrial development in the area, but little public awareness or participation in the legal process. The importance and necessity of creating a protected area in this region became increasingly apparent to the researchers throughout the course of this study. With the creation of a marine protected area, it is expected that anthropogenic contamination will decrease and public environmental action will increase.

This study has laid the groundwork for the establishment of a coastal marine park ranging from Isla Galeta to the Islas Naranjos. There remains, however, much work to be done. It will be important to continue networking to gain the support of local government officials, NGOs and the community. Also, a more comprehensive ecological survey of the potential park is still needed, especially for the underwater ecosystems (corals and seagrasses). Finally, it will be important to have a thorough understanding of the socioeconomic effects the park will have on the communities within this region.

## **1.2 Resumen ejecutivo (Español)**

### **La base para el establecimiento de un parque marino-costero en el área de Isla Galeta**

Investigadoras: Sarah Pease & Anna Swick-Coryell

Institución Anfitriona: El Instituto Smithsonian de Investigaciones Tropicales, Laboratorio Marino de Isla Galeta. Smithsonian Tropical Research Institute, Unit 0948, APO AA 34002.

El Instituto Smithsonian de Investigaciones Tropicales (STRI) fue establecido en Panamá en 1923 y hoy en día es el establecimiento de investigaciones tropicales científicas más conocido del mundo. Desde su inicio, ha fundado estaciones de investigaciones por todo Panamá, con laboratorios en Bocas del Toro, la Isla Barro Colorado, el Causeway en Amador e Isla Galeta.

El Laboratorio Marino de Isla Galeta fue establecido en 1964 y está ubicado al este de la entrada caribeña del Canal de Panamá cerca de Colón. Isla Galeta es un centro para ambos educación e investigaciones científicas. Cada año el laboratorio recibe más de 10,000 visitantes, la mayoría de escuelas básicas generales de la República de Panamá, y hasta el momento más de 300 publicaciones han sido producidas de estudios hechos realizados en el laboratorio.

El propósito de este proyecto fue crear un parque marino-costero en la costa al este del distrito de Colón para proteger los manglares, los pastos marinos y los arrecifes de coral. Estos tres ecosistemas son abundantes en la costa caribeña de Panamá y contribuyen mucho a la biodiversidad y estabilidad marina. En la esperanza de conservar estos ecosistemas, el STRI y el Laboratorio Marino de Isla Galeta vieron la necesidad tener este tipo de parque por el desarrollo urbano y la industrialización intensa en el área. Por ejemplo, actualmente hay una gran refinería de petróleo en Bahía las Minas, dentro del área del parque que está en propuesta, y también, hay planes construir otra refinería más al este.

Entonces, los objetivos de las investigadoras eran coleccionar información relacionada a la región del estudio, entrevistar a profesionales sobre el proceso del establecimiento y manejo de los parques y así hacer un recorrido preliminar de los tres ecosistemas claves (los corales, los pastos marinos y los manglares) en el área del parque en propuesta, y determinar los efectos potenciales que un parque así podría tener sobre comunidades locales.

El sitio del estudio está localizado en la región central de Panamá, justo al este de la entrada caribeña del Canal de Panamá. El parque marino se extendería de Punta Galeta al este hasta las Islas Naranjos, y incluiría 2.5 kilómetros de las aguas costeras.

Las investigaciones empezaron con una revisión extensiva de la literatura. Muchos artículos científicos, mapas y documentos del uso del suelo fueron coleccionados de las bibliotecas de STRI, ANAM, recursos de la red y contactos profesionales. La colección de datos también incluyó unas entrevistas con personas trabajando en proyectos similares, para ganar percepción de tácticas de manejo, problemas potenciales y cuestiones ecológicas actuales que eran específicas al sitio del estudio. Finalmente, un poco de trabajo de campo preliminar fue hecho en carro y bote para hacer una evaluación del plan general y el estado ambiental de la región.

La revisión de la literatura proveyó mucha información sobre la historia de los ecosistemas marinos-costeros y su funcionamiento y valor, tanto como problemas específicos acerca del área del estudio. Los documentos del uso del suelo que fueron revisados incluyeron el primer plan del uso de suelo para el distrito de Colón (el Plan de Ordenamiento de Tierra del Distrito de Colón, POT) que podría ser realizado en ley muy pronto y el Estudio de Impacto

Ambiental (EIA) para un proyecto propuesto para un muelle sobre Isla Margarita, que está muy cerca al parque que se está proponiendo. Porque todas las decisiones sobre el uso del suelo de Colón van a afectar directamente Punta Galeta y el área protegida potencial, estos documentos suministraron mucha información útil de los obstáculos posibles y beneficios de proyectos de desarrollo planeados.

El trabajo de campo también ofreció conocimiento de primera mano invaluable con respecto a los contenidos y estado del área. La porción al oeste del parque propuesto fue visitada en carro para revisar las áreas residenciales e industriales y sus interacciones con los habitantes costeros. La evidencia de la contaminación fue obvia en los manglares y en el agua. Ésta misma área del parque fue revisado otra vez en bote, pero ésta vez las investigadoras continuaron hasta la sección al este, justo pasado las Islas Naranjos. La mayoría de los manglares parecían bastante sanos y no perturbados. Fue descubierto que de las Islas Naranjos, la Isla Arriba, la cual tiene como dueño a un alemán, no está completamente libre de desarrollo, y de hecho tenía algunas cabañas y un sendero de madera. Además, aunque había un descenso en la fauna de la región, la biodiversidad se mantiene a un nivel alto en estos ecosistemas únicos.

Las investigaciones muestran que hay un alto nivel de desarrollo industrial en el área, pero poco conocimiento o colaboración con el público. La importancia y necesidad de crear un área protegida en la región se hizo aún más aparente a las investigadoras durante el curso del estudio. Con la creación de un área protegida marina, está anticipada que vamos a ver menos contaminación por acción antropogénica y un aumento de acción ambiental por parte de la gente.

Este estudio ha puesto la base para el establecimiento de un parque marino-costero que abarca desde Isla Galeta hasta las Islas Naranjos. Todavía, hay que trabajar mucho más. Será muy importante continuar con la creación de redes para ganar el apoyo de los oficiales del gobierno local, organizaciones no-gubernamentales locales y la comunidad. También, es necesario hacer una evaluación ecológica más comprensiva del área del parque potencial, especialmente para los ecosistemas debajo del agua (como los corales y los pastos marinos). Finalmente, es muy importante tener un muy buen entendimiento de los efectos socioeconómicos que el parque podría tener sobre las comunidades en la región del parque.

### **1.3 Contact Information**

**Table 1: Contact Information**

<b>Host Institution</b>	<b>Researchers</b>
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	<b>Internship Supervisor</b>
	Rafael Samudio Email: samudior@si.edu

### **1.4 Thank You Notes**

Thank you notes should be addressed, using the above contact info, to Dr. Stanley Heckadon-Moreno, Jorge Morales and also the staff at the Isla Galeta Marine Laboratory.

### **1.5 Days Spent on the Project**

**Table 2: Time Distribution**

	<b>Site</b>		<b>Total</b>
	<b>Panamá City</b>	<b>Punta Galeta</b>	
<b>Days in the Office</b>	20	13	33
<b>Days in the Field</b>	2.5	1	3.5
<b>Total</b>	22.5	14	<b>36.5</b>

\*\*It should be noted that 1 day=8 hours, not including travel time or breaks.

## **1.6 Information about the Host Institution**

The Smithsonian Tropical Research Institute (STRI) has been conducting research on biodiversity in Panamá since 1923 with the establishment of a field station on Barro Colorado Island (STRI<sup>1</sup> 2010). Since then, STRI has completed numerous scientific and socioeconomic studies all over Panamá and today is recognized as the leading tropical research institute in the world. Presently there are STRI research stations in Barro Colorado, Bocas Del Toro, Punta Culebra and Punta Galeta (STRI<sup>2</sup> 2010).

Dr. Ira Rubinoff, the current Director Emeritus and Senior Staff Scientist at STRI, established the Isla Galeta Marine Laboratory (**Appendix A: Fig. 3**) in 1964 (STRI<sup>3</sup> 2010). Today, the area acts as an environmental safe haven in a sea of development, as Galeta is located in quite possibly the most intensely industrialized region on the Caribbean coast of Panamá (Guzmán 1996).

Although the focus of research at Punta Galeta is clearly on marine biology research, Galeta has grown into an educational facility that provides a wide range of opportunities for learning. Primary and secondary school children can travel to Galeta to learn about marine life; teachers can complete training sessions on how to better incorporate marine biology into their curricula; and university students can complete internships, fellowships, or research courses in a diverse variety of fields. To date, over 300 scientific articles, with topics ranging from sediment types to new brittle star species, have been written using data collected from the area around Punta Galeta.

## **2.0 Introduction**

### **2.1 General Context**

Coastal marine ecosystems, especially in tropical regions, are renowned for their high species diversity. They are major suppliers of numerous essential resources; in particular, they provide nutritional goods and services for a large part of the planet (Holmlund & Hammer 1999). The ocean's biodiversity plays an integral role in its ability to offer these goods and services among other things, such as water quality maintenance and resilience (Worm *et al.* 2006). One might think it would follow that maintaining this diversity would rank high on the global list of priorities, however, in reality; the global ocean is declining in biodiversity, most notably in coastal areas (Gray 1997). Losses are often due to direct factors like pollution, destruction of habitat and over-exploitation; but indirect causes including climate change and its related biogeochemical disturbances, also have highly significant impacts (Lotze *et al.* 2006).

A typical coastal marine region consists mainly of three key ecosystems: coral reefs, seagrass beds and wetlands, such as mangrove swamps (Coastal Ecosystems 2001). It is due to the interactions of these three ecosystems, both biologically and physically, that coastal marine areas are able to provide so much (Guzmán & Jiménez 1992). Panamá's 1,295 kilometers of coastline is rich in all three types of ecosystems and on the Caribbean side, almost all of it, as Guzmán discovered, is fringed by extensive coral reefs (2003).

Coral reefs are not only fascinating, beautiful ecosystems, but they are also unique habitats and crucial places of productivity (Hoegh-Guldberg 1999). Due to their sensitive nature however, corals are especially at risk from coastal development (Guzmán 2003); a decidedly problematic fact for the central Caribbean coast of Panamá, which is quite possibly the most intensely industrialized region of this side of the country (Guzmán 1993).

But corals are not the only things that can suffer in the face of rapid, concentrated development; seagrass beds and mangrove swamps, too, are inevitably affected by either the direct or side-effects of industrialization. In fact, it has been posited that human activities, especially human-induced inputs into coastal waters, are first to blame for the global decline in seagrasses (Short 1996). Since seagrass and mangrove ecosystems often serve as nursery grounds for many species of reef fishes (Nagelkerken 2001), it is imperative that all three of these systems are healthy and intact.

Apart from providing a unique habitat and nursery, mangroves also play an important role in nutrient cycling and coastline preservation (Bravo 2004), while seagrasses help to clean the water by extracting sediments and nutrients (Importance of Seagrass 2010). Furthermore, mangroves are great hubs of diversity; on the roots of Caribbean mangroves off the coast of Panamá one can find over 25 species of foliose red algae (Levings & Garrity 1994). All three ecosystems hold their own vital elements, but when seen as a whole; their importance becomes considerably more significant.

Along the coast of Bahía las Minas on the Caribbean side of Panamá there are over 80 kilometers of mangrove forests, seagrass beds and coral reefs (Guzmán *et al.* 1991). This area, however, has suffered greatly due to human activity. It started with excavation, dredging, filling and erosion in the late 19<sup>th</sup> century, and continued on to pollution via drainage, insect control and industrial plants in the 20<sup>th</sup> century (Guzmán 1991). On top of these former assaults, since 1968 the area has felt the full force of two major oil spills (Duke 1997), the consequences of which scientists are still uncovering today.

With increasing industrial development all over Panamá, development is encroaching more and more every year on the natural landscapes. One such area is the STRI's marine laboratory at Punta Galeta. With the Colón Free Zone inching its way into 'protected' land, little by little the coastal marine conservation area around Punta Galeta is becoming endangered. Although protected areas are only one piece of the necessary action (Gray 1997), there is a definite need for more, better-protected coastal land in this region of intense development if anything at all is to survive in this part of the Caribbean.

## **2.2 Specific Problems Addressed**

The creation of a coastal marine park requires, among other things, an analysis of both the ecological and socioeconomic conditions of the area. The researchers performed a preliminary survey of the environmental health of the surrounding mangroves, seagrass beds and corals by reviewing the relevant literature and also by making excursions into the field. Assessing the ecological status of these ecosystems centered on the deforestation and degradation of mangroves as well as coastal land and water pollution and disturbances due to both residential and industrial influences.

Nearby development projects, such as a new international airport, oil refinery and the rerouting of Galeta's only access road and their potential impacts on the proposed park were also major focal points of the study. More specifically, much of the required work included learning about the possible consequences of the first ever land use plan for the area, which could soon become law (Plan de Ordenamiento de Tierra del Distrito de Colón - POT); as well as a newly proposed port project on nearby Isla Margarita. Any decisions made regarding land use in Colón will ultimately affect Punta Galeta and the surrounding area. As of yet, there is very limited organization of land use in this area.

Strategies of park management were another area of study. STRI representatives expressed interest in having the park run by a board of directors ('patronato-style') instead of solely by the National Environmental Authority of Panamá (Autoridad Nacional del Ambiente, ANAM). Thus, research was also conducted on this type of governance.

### **2.3 Project Objectives**

The final objective of the Smithsonian Tropical Research Institute (STRI) for this project is to create a coastal marine park in order to protect the distinctive ecosystems found along the coastline of the Colón-region, including the mangroves, coral reefs and seagrass beds. Ideally the park would include, among others, the following areas: Punta Galeta, Largo Remo, Payardí, Samba Bonitas and las Islas Naranjos (Arriba and Abajo) (**Appendix B: Fig.6**). The protected area would extend 2.5 kilometers into the ocean, principally for the protection of the coral reefs in the areas described.

Within this larger framework, the goal of this internship was to perform a preliminary ecological and socioeconomic survey of the area. By compiling and confirming the findings from existing literature, as well as through the addition of updated information collected from investigations conducted during the internship-period, the researchers provided STRI with some of the data necessary to attain and manage the prospective conservation area.

Another priority during the project was to contact, via email or in person, different groups, or people, that could provide information relevant to parks such as the one proposed. Intentions were, to make connections with those people or organizations who may be interested in aiding in the planning or management process of the proposed park. Through this type of networking, STRI would have in its possession many contacts that could be beneficial in the park's birth and development.

Generally speaking, the mission of this internship was to provide STRI with as much information as possible about the proposed park area and to aid in the acquisition of the land to be protected.

### 3.0 Methodology

#### 3.1 Study Site

The Isla Galeta Marine Laboratory is located on the Punta Galeta peninsula [9°24' N, 79°52' W (Guzmán 1991)], just east of the city of Colón and is found in the district of the same name. Punta Galeta played an important role for the United States during World War II when it served as a major reconnaissance location for the pentagon (STRI<sup>3</sup> 2010). Because of the historically strong military presence, today the region contains many remnants of batteries and army/naval stations that could perhaps be protected in the future as historical sites.

Since Law 21 of July of 1997, the region has been recognized under Panamanian regulation as an “Área Protegida” (Appendix B: Fig.7). In 1998, with the adoption of Law 41, ANAM became responsible for all environmental aspects of nationally-owned land in Panamá (ANAM 2003). The protected area constitutes nearly 700 hectares of



Figure 1a: Panamá



Figure 1b: Central Panamá

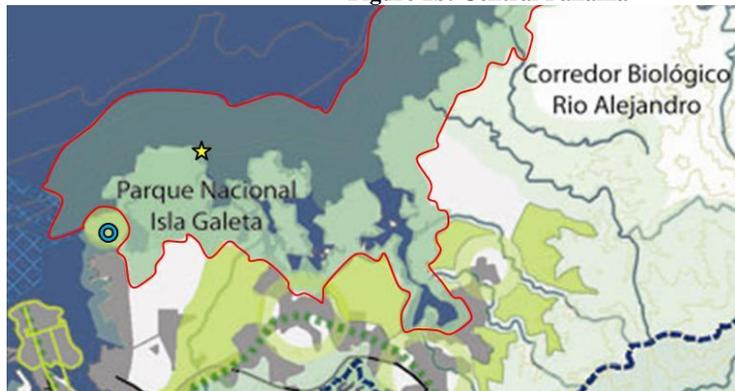


Figure 1c: Proposed Park Area

Figure 1: Study Site

mixed forests, mangrove swamps, seagrasses and corals (ANAM 2003). The rest of Colón east of the Canal Zone has never had an official land use plan or any sort of coordinated strategy for land organization.

The area around Punta Galeta may be legally protected but it is not necessarily actively protected. Some companies have illegally cleared the mangroves on protected land for shipping container storage to expand the Free Zone of Colón.

Despite its current status as a place for public environmental education, it was not until the year 2000, after ownership of the Panamá Canal was handed over to Panamá, that access to Punta Galeta was not restricted solely to research personnel (STRI<sup>3</sup> 2010).

**Figure 1** shows the specific study range. In **Figure 1c** the star denotes the Punta Galeta Marine Laboratory; the blue circle shows the location of Isla Margarita, the site of a major new development project; and the red outline gives an approximation of the area that would be included in the desired marine park. It would be comprised of the presently protected area eastwards to the Islas Naranjos and extend 2.5 kilometers seaward (the figure only shows 1.5 km seaward).

### **3.2 Ethics**

Since part of the process of data collection required interviews and networking, the guidelines of the McGill Code of Ethics were followed throughout the course of this internship. Before all interviews and conversations, the researchers made sure to state their identities and affiliations as students from McGill working with the Smithsonian Tropical Research Institute, as well as the purpose of their visit and project. All participants were aware of the interview-situation prior to the start, and in the final products, names were disclosed only upon consent.

Lastly, all interviewees mentioned in this report consented to the use of data from their interview and were offered a copy of the final report.

### **3.3 Literature Review**

Information on the history and current issues surrounding this project was gathered from a variety of sources. In Panama City, the STRI library was the main source of literature, and at the study site, the Punta Galeta library was used. Much information was also gathered using online journal resources as well as professional recommendations from supervisors, scientists and architects working in related fields.

The focus of the literature analysis fell on publications about the three main ecosystems of concern (mangroves, seagrass beds and coral reefs), as well as the two major development projects of current importance—the proposed land use plan for the area of Colón (POT) and the Environmental Impact Assessment (EIA) for a new port on Isla Margarita (**Appendix E**).

### **3.4 Cartography**

Maps were gathered primarily through GoogleEarth and online resources offered by ANAM. Additional useful maps were found in official documents such as the proposed land use plan for Colón and the Environmental Impact Assessment for Isla Margarita.

Maps were used to illustrate areas of development, geomorphology and forest (mangrove) cover, as well as to demarcate field tour routes and possible park zones. The researchers used these visual representations to help create a work plan and identify high priority areas of study. They were also ultimately useful in presentations and reports to convey objectives and results of the project to supervisors, professionals and to the general public.

### **3.5 Interviews**

Non-structured, informal interviews were conducted with professionals from fields related to the creation or management of environmentally protected areas. More specifically, the researchers spoke with the general director of Parque Natural Metropolitano, Dionora Víquez, to learn about the ‘patronato-style’ strategy of park management, as well as with Arq. Kurt Dillon, with the Louis Berger group, who has been charged with creating the first ever land use management plan for the district of Colón. Finally, marine biologist Héctor Guzmán was consulted regarding the creation of a field work methodology as well as the most up-to-date information on the ecological state of the coral reefs within the prospective park area.

As stated in the above Ethics section, the guidelines of the McGill University Code of Ethics were followed during all interviews and no information has been disclosed without consent.

### **3.6 Galeta Field Work**

Field work was carried out in and around the area of the proposed park over the course of two excursions, one road tour and one boat tour. Jorge Morales (on-site internship supervisor) and Gabriel Thomas (Galeta staff) accompanied the researchers on both occasions. They helped organize transportation and tour routes, and since they are both very familiar with the area they were able to provide much useful information to the study.

The road tour took place on April 9<sup>th</sup>, 2010. **Figure 2a** shows the exact route taken during the trip. The letters denote key locations visited during the tour. The tour covered the western, terrestrial section of the potential park, starting in the residential area of Cativá and ending near Bahía las Minas at the entrance of the old cement factory on Samba Bonitas. The tour also extended to the entrance of the Refinería Panamá on Payardí.

The researchers, Morales and Thomas followed the route shown and stopped at places that looked as though they could be of import (possible pollution sources, areas of biodiversity, fishing areas, etc.); photographs and notes were taken.

The boat tour took place on April 12<sup>th</sup>, 2010. **Figure 2b** shows the route that was followed as well as the important sites or events. The boat was launched from Puerto Pilón at about 9am. The route extended out past the oil refinery to the Islas Naranjos, as well as to two nearby river outlets. The tour then moved back towards the old cement factory and to a cove on the north side of Largo Remo. The researchers, Morales and Thomas, were accompanied by Joaquín Cordel, a local boat owner and knowledgeable citizen of the community. Throughout the tour Cordel offered his opinions and understandings of the issues at hand.

Both tours contributed greatly to the researchers' knowledge of the area with respect to mangrove cover and health, as well as industrial and urban developments. Tours were documented photographically, cartographically and via note-taking. Mangrove health was assessed only superficially, using presence of garbage, plant cover and overall mangrove appearance to judge their ecological status.



Figure 2a: Road Tour



Figure 2b: Boat Tour

**Figure 2: Galeta Field Work**

See **Appendix A** for photos and **Appendix C** for corresponding place names.

## 4.0 Results

### 4.1 Literature Review

In the coastal waters off of Punta Galeta, there are two main species of seagrass: turtle grass (*Thalassia testudinum*) and manatee grass (*Synngodium filiforme*). Here, the species abundance and composition differs among seagrass sites. This is due mainly to the surrounding habitats (especially coral reefs) and their relative proximity to the seagrass. There are also significant seasonal fluctuations in the diversity and abundance of organisms in the area. (Heck 1977)

Sea urchins graze on turtle grass and help to determine the seagrass cover along with herbivorous fish like parrotfish and surgeonfish. The herbivorous fish are, in turn, controlled by fishing intensity. Additionally, it has been observed in Galeta that sometimes urchins graze on live corals. The presence of a halo of sand between corals and seagrass is directly related to urchin feeding (Hay 1984). Urchins and fish also serve to help graze the shallow-water fleshy algae from corals, saving the corals from suffocation by these rapidly growing algae. High algal cover leads to the loss of corals, which in turn leads to a loss of biodiversity (Guzmán, PI: 2010). The urchin, *Diadema antillarum*, is very important to the Punta Galeta-Bahía las Minas area because it grazes more and faster than any other urchin in the area. Highly grazed areas have a greater algal diversity contributing to greater overall biodiversity of the system (Huston 1985). *D. antillarum* had high densities in sand, mangrove, seagrass and coral ecosystems until it suffered from an epidemic leading to a mass mortality of 93% of all individuals of the species in 1983-84. The species has been making a very slow recovery and was not replaced by any other echinoid in terms of niche (Lessios 1988). During the study for this report, the researchers observed a fairly high *D. antillarum* density in the shallow waters around the Isla Galeta Marine

Laboratory; Jorge Morales commented that the recovery rate around the lab appears to be better than in other areas of the Caribbean.

Heavy metals act as indicators of high pollution levels in coral tissues. The metals originate from oil discharges and spills, the use of antifouling and anticorrosive paints on boats and structures and effluent discharges from refineries. They are carried to the ocean by rivers or runoff where they are widely distributed (up to several kilometers from the source) by currents. Seagrass beds and mangroves act as sinks for these heavy metals, reducing their effects on corals. Increasing deforestation and erosion, however, has led to increased sedimentation of rivers, carrying the heavy metals out to the ocean. On the Caribbean coast of Central America, heavy metal concentrations in coral tissues are higher than most of the rest of the world and are considered a serious regional threat to humans and other organisms. (Guzmán and Jiménez 1992)

The oil spill of 1986 had resounding effects on the ecosystems in Bahía las Minas and the area surrounding Punta Galeta. Over 30 studies have been done on the aftermath of the spill. The studies on the effects of the spill on marine ecosystems and organisms have created a huge resource database, which has been a valuable tool in the understanding of the effects of oil spills on the coastal-marine environment.

Directly after the spill, much of the oil sank and was incorporated in coral tissues and sediments. The hydrocarbons in oil are toxic to corals and other life forms. Signs of stress were observed on most corals on reefs down to 6m deep within Bahía las Minas. The total coral cover on the heavily oiled Galeta reef decreased by 76% at 0.5-3 m and by 56% between 3-6 m, although some areas were fairly untouched by the oil spill, particularly the bay area between Largo Remo and Punta Galeta. (Guzmán et al 1991)

The number of corals, total coral cover and species diversity based on cover decreased significantly with increased amounts of oiling. *Acropora palmata*, a large, branching coral responsible for much reef building and growth, had the highest decrease in cover of all coral species, and was practically wiped out of the Galeta reef. Oiling also slowed the growth of three huge coral species (Guzmán et al 1991). Oiling affected gonad size in corals, and were significantly smaller in corals that had been heavily oiled. Gonad size is the best measure of long-term sublethal effects of oil on coral reproduction. Other effects included lower fecundity and larvae survival. (Guzmán 1993)

Oil slicks on the water of Bahía las Minas from the landfill beneath the refinery and the mangroves were still common occurrences five years after the oil spill of 1986, especially after heavy rains or particularly high tides. The rainy season and reproductive season happen to overlap, and coral gametes rise to the surface right after spawning, making them likely to encounter oil slicks. In 1988, heavily oiled sites still had oil on them 82% of 122 days visited. (Guzmán 1993)

Over two years after the spill, there was a significant decrease in cover, size and diversity (measured by cover) at four unoiled reef sites. Subtidal reefs, especially along protected coasts may suffer extensive damage from chronic oil exposure after major oil spills. Crustaceans are sensitive to petroleum hydrocarbons with effects from behavioral changes to acute toxicity; bivalves too suffer from chronic oiling, accumulating high levels of hydrocarbons, which significantly reduce the growth and reproduction probability of these organisms. Lots of oil is still locked up in the mangrove and seagrass sediments and reef framework; chronic effects may be less serious than immediate effects as the oil has changed its chemical composition.

Nevertheless, long-term chronic oil pollution may cause serious changes in reef ecosystems. (Levings and Garrity 1994)

In 1985, prior to the oil spill, coral cover in Bahía las Minas was generally low, probably due to heavy deforestation and erosion in the area. The decline in coral populations in Bahía las Minas between 1986 and 1988 could have been due to a number of factors, including: the mass mortality of *D. antillarum*, the associated increase in macroalgae overgrowing corals, an epidemic disease of acroporid corals or coral bleaching. (Levings and Garrity 1994)

In terms of recovery, there are a number of important factors involved: the speed of recruitment of new, healthy individuals, the abundance and condition of survivors and the nature and intensity of biological interactions and physical disturbances that affect the growth, survival and reproduction of corals. In general, the recruitment of juvenile corals into Caribbean reefs is a slow process (Levings and Garrity 1994). It was estimated that it would take 1-2 decades for Bahía las Minas to fully recover from the oil spill (Guzmán et al 1991). Populations of most small invertebrates living in beds of algal turf on reef flats recovered to unoiled levels within 15 months after the spill (Levings and Garrity 1994).

Vanadium is very abundant in crude oil and can be used to indicate oil pollution when found in coral tissue. Coral tissue is an excellent indicator for many contaminants because it grows continuously. Vanadium has been found in increasing levels in coral tissues due to oil pollution (Guzmán and Jarvis 1996).

The oil spill of 1986 also had a devastating effect on the mangroves of Bahía las Minas. Mostly low and mid inter-tidal zone mangroves were affected by the spill, areas dominated by *Rhizophora mangle*, a species very sensitive to water-borne pollutants because of their special adaptations to living in super-saline, water-saturated environments. Trees die either through

suffocation or by toxicity of the oil approximately 1-2 months after oiling. It is difficult to identify trees that have been non-fatally, negatively affected by oil; however the impact zones of oil on the mangroves appeared to be 5-6 times the size of areas of deforestation in the region. After the small oil spill in 1968, it took ten years for the mangrove areas deforested by oil damage to recover. (Duke 1997)

Sediment cores taken in 1992 showed oil residues from the 1968 spill in Bahía las Minas. Approximately 377 ha, or 42% of mangroves in the bay were affected by the spill, most of which was *R. mangle*. The oil spill did not appear to cause any change in species composition in the area although *R. mangle* did not totally recover from deforestation (Duke 1997).

There was a 60% loss of submerged live prop roots of mangroves containing boring isopods at oiled sites 5 years after the 1986 oil spill. Habitat for juvenile spiny lobsters (*Panulirus argus*), which consists of foliose red algae and arborescent hydroids and bryozoans, was reduced by 40-50% 5 years after the spill. In channels and lagoons, habitat losses were directly proportional to decreases in the number of submerged prop roots per unit shoreline, in other words habitat loss was related to the surface area of submerged prop roots. Additional losses of juvenile habitat losses were recorded on the open coast because roots were significantly shorter at oiled sites 2-4 years after the spill and because of losses in sessile animals. (Levings and Garrity 1994)

Salt marshes, seagrass beds, coral reefs and mangrove forests (habitats created by their plant or animal components) are especially vulnerable to negative impacts from disturbances, like oil spills, because of physical and chemical cascading effects. (Levings and Garrity 1994)

#### **4.2 Environmental Impact Assessment (EIA): Isla Margarita**

On February 12, 2010, the researchers were made aware of a pending \$285 million development project on Isla Margarita, which would involve deforestation, dredging and filling, to build a port with waste treatment facilities. A public notice had been printed in the February 5<sup>th</sup> and 6<sup>th</sup> editions of the newspaper (**Appendix D**), Diario La Estrella. At that time, a Category 2 EIA had already been completed for the project, before anyone from STRI or of the group creating the POT knew of the project. Shortly after the notice was published, members from the Isla Galeta Marine Laboratory went to the island but were denied access at the gate. The researchers at this time opened up a mini-study to find more information on this project and how it would affect the creation of a coastal marine park. This project would be a huge industrial, commercial-type development in an area that has already felt human intervention (US military).

There were four companies involved in this development project: Panama Canal Colon Port Inc. (PCCP), United Crown Construction Inc., Isla Margarita Resources S. A. and Gold King Investment Inc. These companies leased the land through concession from the district as long as ten years ago. The director of the EIA was Ing. Benigno Jaramillo and it cost \$1250, paid to ANAM to perform.

In the EIA, they planned on constructing and operating a container patio and a port with maintenance and servicing capabilities of Panamax-size boats (**Appendix B: Fig. 8-9**). The land area required for the project is 39 Has and 1112.62 m<sup>2</sup> and the seafloor area required is 22 Has and 3693.55 m<sup>2</sup>. All 101 trees in the construction site will be cut down and replanting will occur in an ANAM-run park. Most of the project area will be transformed into impervious surfaces. The EIA also mentions that Randolph highway (the only access road to Galeta) could be closed down and a new access route to the Free Zone created.

ANAM, the Autoridad Marítima de Panamá (AMP), the Autoridad de Recursos Acuáticos de Panamá (ARAP), as well as the aforementioned companies, were involved in the EIA process and were present for a site visit. During the site visit, no fauna were observed and, additionally, no flora were observed in the dredge and fill area, except for at the breakwater where reefs and marine fauna were observed (principally the urchin *Echinometra lucunter*). The EIA reported no fragile ecosystems in the area. No historic or culturally important sites were found on or around the development site, however later in the report, bunkers were mentioned as being present though not formally marked as National Monuments. The report concluded that these bunkers would not be affected by the development project. ARAP expressed concern in a response to the EIA that the mangroves that the project area includes, were not accounted for in the EIA. A number of other concerns were addressed in their response to the EIA, and ARAP concluded that there were reasons to interfere with the project because of the mangroves and the likelihood that they will be negatively affected by said project (**Appendix G**).

The EIA discusses the temporary housing in Coco Solo, home to approximately 100 families, saying that these families would need to relocate. As part of the EIA study, 15 interviews were performed in December in the area to determine the residents' feelings on the project, although no mention was made in the interviews of relocation. The project would generate employment for people in the area (current unemployment rate in district of Colón: 17.60%), especially during the construction stages.

#### **4.3 Plan de Ordenamiento de Tierra (POT) del Distrito de Colón**

The district of Colón has an area of 116,108 Has, 5,501 Has of which were urbanized in 2000 (4.74% of total area of the district). Colón has a population of 174,000 people, 64% of

whom live in urban areas outside of the Canal Zone. From 2000 to 2025, population levels are expected to increase greatly at a sustainable 3% growth.

One of the goals of the POT was to develop ecotourism in the district. The POT of Colón included the proposal to turn the Isla Galeta protected area into National Marine Park Bahía las Minas (**Appendix B: Fig. 1**), which would extend the current protected area up the coast to the Islas Naranjos and out into the water 1.5 km. A number of green areas have also been proposed to help protect the waterways and serve to connect the ecosystems. The plan would also create a new coastal road, vía Lacustre-Costanera, which would originate from the highway in Cristobal and border the Coco Solo river, the new national marine park and the industrial areas of Bahía las Minas, and would then cross the bay north of Puerto Pilón to end in Río Alejandro (**Appendix B: Fig. 2**). This road would be designed as a monumental boulevard. In a related matter, a new public transport system would be formed, which would direct heavy public transport over this new coastal route.

The POT suggests the international airport planned for France Field, be placed in Portobelo, where it will not interfere with expansion and connections within the Free Zone and will not severely impact the marine lab on Isla Galeta or the people who live in the residential areas of Cristobal. The document also suggested the creation of biological corridor Santa Rita to connect national parks Chagres and Soberanía and would connect to the new marine park. The POT proposes that Isla Margarita be turned into a cultural-ecological tourist hub with a marina, public green areas and access to the new National Marine Park. Under Law 47 of 2003, the military monuments on the island would be protected as national monuments (batteries and coastal defense artifacts) and public areas. The POT stands for 15 years (until 2025), with a maximum of one revision each term per elected mayor.

The POT was incorporated in the Strategic Environmental Evaluation (EAE). The POT was written with the idea of sustainability in mind, and to find a balance between the necessary development and the need to maintain healthy ecosystems and protect the waterways. Plans to create a program of conservation and management for the ecosystems of the new National Marine Park existed in the POT. Also, a new environmental education program for the entire district of Colón has been proposed. The environmental section of the POT stated that an effort should be made to ensure that the quality of the water in protected areas is not harmed by industry or development. No anthropogenic disturbances within protected areas, especially within mangroves and coral reefs would be tolerated under this section of the POT. The Strategic Environmental Evaluation section of the POT discussed the environmental problems that affect the district, including pollution of coastal ecosystems. One action cited as being a major necessary step to improving the state of the ecosystems was to improve the treatment of solid and liquid, residential and industrial waste.

The researchers found in the POT that there are a number of mining concessions in the proposed marine park area (**Appendix B: Fig. 3**).

#### **4.3.1 Interview with Kurt Dillon**

A primary interview with Kurt Dillon, a World Monuments Fund Architect specializing in urban development in the Canal Zone, was held on January 27, 2010. Dillon had been subcontracted by the Louis Berger Group Inc., which in turn had been contracted by the district of Colón, to develop the first POT for the entire district. Dillon and fellow architect, Adriana María Vega, briefly presented the proposal to the researchers and elaborated on pieces of the proposal that might affect the proposed protected area. They also showed the researchers a number of maps from the proposal.

Some of their proposed plans include addition of control over the industrial areas in the district and having Samba Bonitas (where the old cement factory is) developed into a small port. Currently, there is a plan to expand the France Field airport in Colón into an international airport whose flight plan would have traffic going essentially over the current protected area and the lab at Punta Galeta. Dillon's plans would move this new airport to the district of Portobelo, adjacent to the proposed park area (just east of the Islas Naranjos) but not in it and the flight path would not go over the park. The proposal includes the new park in its plans with 1.5 km out from the coastline protected; however the protected area would exclude the industrial areas on Samba Bonitas and Payardí, which include the electric plant owned by GDF Suez, Refinería Panamá and the proposed port on Samba Bonitas (**Appendix B: Fig. 4**). Navigation channels would need to be placed through the park to the industrial areas, but at the time of study the exact location of these channels had not been determined. Dillon's proposal included a biological corridor connecting the new park to the Santa Rita biological corridor and the Parque Nacional Soberanía. A new coastal road was also proposed directly south and adjacent to the new park border for a distance. This road would connect up to the current road on Punta Galeta and would provide access to previously poorly accessible islands and areas (like Samba Bonitas) and would serve to reduce some traffic on the main highways. Dillon also proffered the idea of developing Isla Margarita into a tourist hub with hotels, restaurants and a marina. He proposed to have 100 m out from the coast protected and have the military monuments (old battlements, etc.) on the island turned into a National Monument.

Dillon mentioned that a landfill already exists within the proposed park area. He also shared with us that the Panamanian government owns most of the land near the Free Zone where the container patios are, but that the land is leased out to private companies for 30 years at a time

through concessions. The Free Zone wants to close Randolph highway and add a customs station, which would cut off all access to Punta Galeta. Part of the reasoning behind moving the international airport to Portobelo was to hinder the process of a \$5 billion petrochemical project by Centro Energético Latino Americano (CELA) being proposed for the area on the north side of where the airport would go in María Chiquita. This project was co-founded privately through many nations and progress on it had recently slowed due to the economic crisis. Dillon assured the researchers that the proposed zoning for the park area would ensure no further coastline development occurred. He also said that one of the reasons there had not been much development so far in this area was because there were no real access roads.

He explained that there was a small Kuna fishing village (Viviendo Progreso Kuna) near the park, not in it, but that they fish within proposed park waters. Another fishing town in the city of Colón, called La Playita, has fishermen who fish within proposed park waters.

Colón is made up of 14 jurisdictions, each with a representative that works with the elected Mayor in a regional jurisdiction. The proposed park would pass through 4 jurisdictions of Colón: Cristobal, Samba Bonitas, Cativá and Puerto Pilon. The municipality would probably support a mixed management board for the park in the hopes of securing possible surplus from economic activity related to the proposed park.

Originally, Isla Margarita was part of the area the researchers proposed be protected, but Kurt Dillon made the researchers aware of the fact that the island has already been zoned in the canal area zoning as a 'centro urbano' (an area for urban-type, residential development) and it would require a new to change the zoning.

Dillon suggested the researchers contact Juan Maté, a marine biologist at STRI who helped with the creation of Coiba National Park and its extension as well as a number of other

marine parks in Panamá. He also noted that the representatives of the local jurisdictions ANAM, AMP and ARAP needed to be involved in the creation of this new park.

Secondary and tertiary meetings with Dillon occurred on February 25 and 26, 2010.

The primary purpose of these meetings was to share with Dillon details and maps of the proposed project and Environmental Impact Assessment for Isla Margarita, before which he had not been aware of. Dillon had a number of questions about this new project which the researchers answered, including the exact location of the project, who owned the land and whether STRI had put in a response to this recent development (there has been no formal response to this development to date by STRI). As had been previously discussed, the re-zoning of an area is difficult, requires a public meeting and is handled by the Ministry of Housing; however a Category 2 EIA project (as this project) does not require such a meeting. Dillon said that the temporary housing in Coco Solo that was referred to in the EIA for the project on Isla Margarita is governmental housing for victims of house fires.

Dillon made the researchers aware that the international airport project was moving along. He also told the researchers that the deforestation of mangroves within the buffer zone along the road out to Punta Galeta is where people are taking out iron and other metal scraps from the ground for recycling, and that there will be no replanting of the mangroves that have been lost due to it. There is a 50 m buffer zone around Río Coco Solo. Kurt suggested working with the port authority (AMP) to get a buffer zone on the park project and that we start by trying to get a 300 m zone because it will likely get made smaller by the AMP.

#### **4.4 Interviews**

##### **4.4.1 Dionora Víquez**

An interview with Dionora Víquez, the General Director of Parque Natural Metropolitano (PNM), was performed on February 4, 2010. The main purpose of this interview was to gain insight into how an environmental conservation park can be created in Panamá with a Patronato-style governance instead of the traditional ANAM-run park. The PNM Patronato is made up of eight representatives, including the Alcaldía de Panamá, ANAM and STRI. The other members are from both the public and private sector, with the public sector in the minority (**Appendix F**). As Víquez pointed out, this balance of power means that fluctuations in current politics have little effect on the park. Coiba National Park has a similar Patronato set-up, except that eight out of twelve members are governmental, leaving it vulnerable to political influence.

PNM does not rely on any government money for funding to run the park; since the park is run in a similar way to a business, enough money is brought in by the park on its own. The park plants and sells trees, they sell buttons for a donation to the park and as an advertisement, they make a profit off of a specific perfume whose profits benefit the park, and trail maintenance and guides are paid for by trail and guide fees. There is an animal-rehab program at the park, which is funded by businesses that work on and around the canal. The park also has a gift shop and hosts a number of free events. These free events attract large numbers of guests, introduce more people to the park and should help ensure plenty of funding in the future. The park also offers a variety of programs for the community and school groups, some of which are free. Private school visits are used to fund visits from some public schools. Educational and children's visits make up most of the visitors to the park.

To get the PNM running, Víquez said that for the first five years the municipality really funded the park until it could start supporting itself. Still, the municipality donates some of the money generated from a non-obligatory tax to the park every year.

PNM paid a lot of money to have an external company perform an environmental assessment to help decide the zoning of the park (**Appendix B: Fig. 10**). There are zones in the park where people can go and zones that are protected and people are not permitted. The management plan indicates which zones will have intensive or non-intensive use. Currently, there are plans for expansion of park development including, new trails (bike and horse), a canopy walk and an area for camping.

Viquez advised that when creating a park like PNM, there must be a ‘padrino’, an initial organization to foster and fund the park and set up the patronato by deciding how many members it will include and which organizations will be offered membership. Projects and investigations with final products from research done at the park, aid the groups in the patronato by providing them with useful information. Ms. Viquez also warned to be careful when choosing private organizations for the patronato because there needs to be enough funding from private organizations to maintain the park, but sometimes these wealthy organizations are not as ‘green’ as advertised or the organization may be seeking a power-role in the patronato for political reasons.

#### **4.4.2 Héctor Guzmán**

An interview with Dr. Héctor Guzmán, marine biologist for the Smithsonian Tropical Research Institute, was held on March 11, 2010. Dr. Guzmán has done a number of studies on the state of the coral reefs around Punta Galeta and Bahía las Minas. The purpose of this interview was to hear from Dr. Guzmán what the state of the coral reefs in the area was, especially after the oil spill in 1986, and also to get his opinion and ideas on the creation of a marine park in this area.

Dr. Guzmán provided a number of his scientific articles pertaining to corals in the proposed park area and also suggested a few other readings, including an article about seagrasses written by Jackson et al. in 1989. He was also able to share that, in general, much of this area has not recovered fully from the oil spill and suffers from chronic oiling, leaving poor reefs with low growth rates and low diversity. He also noted that this area has ocean currents from west to east, meaning that the worst oil-caused damage is east of the spill location at the refinery on Payardí. One area that he said had looked like it was making a recovery was the cove on the northeastern side of Largo Remo; this was the area he believed could benefit most from conservation. The seagrasses near the Islas Naranjos were also in pretty good shape according to Guzmán.

Dr. Guzmán made a few suggestions regarding how to move the study along. One recommendation was to speak with local fisherman to learn about the state of the area. This would also be a good way to gain contacts with boats that could possibly help with boat tours in the future. A flyover of the potential park area was one suggestion he made, saying that this would provide a very valuable view of the mangroves, corals and the area in general, to determine what is there and what state things are in.

Dr. Guzmán was also able to recommend some potential patronato members or at least groups who maybe should be involved in the project in the future, these included: the Audubon Society of Panamá, Kiwanis, Rotary Club, the Alcaldía de Colon, ANAM, ARAP, the Royal Authority, the Nature Conservancy, local clubs and environmental NGOs and a group representing tourism. When questioned about MarViva, the NGO which worked on the creation of Parque Nacional Coiba and is currently working on Parque Nacional Marino Golfo de Chiriquí, he responded that they were not a good potential member of the patronato, citing that they were mainly interested in the Pacific coast.

#### **4.5 Road Tour**

The drive out to the cement factory was mainly through a residential area, ending with the Cooperativa de Vivienda Progreso Kuna, a residential coop area for one of the nation's major indigenous peoples groups. The housing in this area was mainly in the barracks-style, with a majority of one-storey houses and much of them went right up to the water's edge. There was not too much road traffic in the residential area, only one large truck was observed. The residential area was mainly without trees or green areas, there were no mangroves, just palms, banana trees and a fair amount of trash. A few trenches ran through the residential area, these were filled with water and trash. There was some evidence of construction within the residential area, a number of cinder-block buildings were underway and a new church, neither of these was close to the water or mangroves.

In the bay east of the residential area, two boats were out fishing; one with a man who was net casting from a small boat (**Appendix A: Fig. 4**) and another larger boat (called a 'panga') with two young boys net casting.

As soon as the housing area stopped (just before the connection between Samba Bonitas and the mainland), there were mangroves. At the connection between the island and the mainland there was a small dirt boat launch facing approximately northwest. Looking approximately northwest up the bay, the mangroves lining the shore seemed to be quite full and in good condition, as did the water (**Appendix A: Fig. 5**). The mangroves in this area were red and white mangroves. There was a definite presence of food trash (pineapples, watermelon, etc) and other debris on either side of the boat launch along the shore (**Appendix A: Fig. 6**). Trash was also found along the roadside, particularly near one sign prohibiting the dumping of trash (**Appendix A: Fig. 7**). A flock of turkey vultures were observed overhead to the west of the boat launch. Across the road from the boat launch there was evidence of a recent brush fire; the mangroves

here were blackened and leafless with ash beneath them and there was a smell of smoke and burning in the air.

On Samba Bonitas along the road there was an extensive mangrove swamp with red, white, black and grey mangroves. Among this swamp many epiphytes and large termite mounds were present. A number of small, well-trodden, manmade paths were present through the mangrove swamp to the water's edge providing water access from the road.

At the entrance to the old concrete factory, burning grass could be seen just beyond the entrance gate. No flames were visible, just thin smoke.

Between the two peninsulas that were explored by road, a little stream was crossed which was extremely murky with opaque, white-ish water.

The road out to the refinery on Payardí was filled with a constant stream of oil trucks going in both directions (**Appendix A: Fig. 8**). There was a lot of traffic, noise and dust out to the refinery. The road itself is a mix of dirt and pavement with a lot of potholes. In addition, it runs directly alongside a pipeline, which runs along the edge of the mangroves, with little to no space between (**Appendix A: Fig. 9**). There were two water outlets visible from the road that exited from the thermoelectric plant. The southern outlet had very murky and strong smelling water flowing out to the mangroves with two inflatable booms across the exit of the water into the mangroves (**Appendix A: Fig. 10**). Fish and birds were present in this outlet (**Appendix A: Fig. 11**). The northern outlet had a huge quantity of water with a very high flow rate, being pumped out from the thermoelectric plant and directly into the mangroves. Around the edge of the water there was significant green algal growth (**Appendix A: Fig. 12-14**).

Mangroves lined the road between the thermoelectric plant (**Appendix A: Fig. 15-17**) and the refinery and were filled with trash.

Just before the entrance to the oil refinery there was a significant amount of professional landscaping with ornamental plants (**Appendix A: Fig. 18**).

#### **4.6 Boat Tour**

The bay off of Puerto Pílon and northwards towards the refinery had a considerable amount of healthy-looking fringing red mangroves around it. The water here was turbid and light brown. Jorge Morales mentioned that this area had very high bacteria levels in the water due to heavy residential development (**Appendix A: Fig. 19**) and high levels of industrial activity nearby. Frigate birds and white herons were observed in the area, along with one line-fisherman in a small boat.

In the middle of the bay exit towards the thermoelectric plant port there was a sunken boat in the water marked by a small stick, barely covered by water. There were two small mangrove islands near wooden pilings and covered with small birds. Also in the water near the thermoelectric plant and refinery were a few permanent navigational signs. Near the signs a few men were fishing. On the shore east of the refinery a fifth species of mangrove can be found within the proposed park area, *Pelliciera rhizophorae*, a rare species with very limited geographic range (Morales, PI: 2010) only known to exist in a few other places on the Atlantic (Duke 1997).

Also on the shore east of the refinery was a point called ‘Punta Muerto’ which was surrounded by unhealthy reefs with lots of sedimentation. This may have been due to boat traffic since it was near the exit of the bay (Morales, PI: 2010). Morales also said that when it rained, there was a lot of movement of material (sediment, contaminants, debris) out of the bay. The refinery itself had its oil tanks very close to the water with no obvious signs of any catchment basins or trenches in the case of an oil spill from the tanks (**Appendix A: Fig. 20-21**). In the

water off of the refinery docks floated empty, rusty, old oil tanks. It was not clear whether these were tethered to the sea floor and were acting as buoys or moorings or whether they were just free-floating.

As the boat was moving northwards towards the Islas Naranjos, looking back towards the refinery showed very tall mangroves to the west of the refinery (**Appendix A: Fig. 22**). Around 9:30 am a dolphin was spotted jumping out of the water very close to the boat, which was in turn still fairly close to the refinery. Morales commented that there were “lots of dolphins always south of the southern Islas Naranjos; although the fisherman said that there were more dolphins in the past and that there used to be tons of them. The shoreline of the mainland near the islands was sandy, with few/sparse mangroves intermixed with palm trees and beaches, especially exposed peninsulas were void of mangroves. Morales mentioned that perhaps the mangroves here had been cut down in the past for residential purposes, although there was no visible sign of any residential use of the area. There were a couple of patches of thick mangrove. Directly south from Isla Abajo of the Islas Naranjos was the entrance to Rio Viejo, where exposed pilings were seen near a small sandy beach. There was a sailboat moored or anchored near the Islas Naranjos. The islands were surrounded on most sides by shallow reefs that appeared to be in good condition from the surface; Isla Arriba especially has a huge, shallow fringing reef to the northeast (**Appendix A: Fig. 23**).

There was one house visible on Isla Abajo, possibly a summer home for a foreigner. The fisherman who drove the boat for the study said there was a lagoon inside of Isla Abajo, although this could not be verified from the water. Isla Arriba had four visible buildings on its southern corner: two palm thatch huts on stilts, a cinderblock building under construction, and a small house with a red tiled roof (**Appendix A: Fig. 24**). There was also a boardwalk leading to at least

one more building. There was sparse vegetation dominated by palms near where the buildings were, but the rest of the island consisted of mainly patchy mangroves. There were many birds on Isla Arriba, especially sand pipers. A large number of crabs were also observed. The island had one man on it at the time of the study, he was working on the construction of the cinderblock building and shared that the island was owned by a German man who planned to develop the island in the future for tourism and who visited occasionally. Mr. Chaves also mentioned that people were welcome to stay on the island if they could arrange transportation.

Past the Islas Naranjos eastward, back on the shore of the mainland there were fringing mangroves however they were intermixed with other tree types. The fisherman told us that there were more mangroves beyond what we could see and perhaps beyond that some pasture land for cattle, but no real development. In the Río Merceditas inlet there were red and black mangroves with a little bit of trash in them (**Appendix A: Fig. 25**). There were also many sardines and other bait fish jumping out of the water, especially near in inlet to the river. One great blue heron was observed in the inlet. The fisherman said that there was fewer fauna than there used to be but that nothing was going extinct, he also said it would be a good idea to protect the area as long as artisanal fishing was still allowed. The next inlet to the north and east is for Río Grande where tons of pelicans were seen with thousands of small sardines and other fish flitting against the top of the water (**Appendix A: Fig. 26-27**). There was a substantial amount of fringing mangroves here with a small bit of trash in them, which appeared to have floated in with the tide. The fisherman recounted that this inlet was an excellent fishing spot.

Returning back down the coast towards Payardí and the tall mangroves west of the oil refinery, it was seen that many of the outer-edge, exposed mangroves here had fallen down, many appearing to be freshly fallen. Further west on Payardí were two obviously man-made,

large sand piles right near the water. On Payardí across from the old cement factory (**Appendix A: Fig. 28**), the mangroves appeared to be in bad shape, most were dead. Further in the bay, between Payardí and Samba Bonitas, the mangroves looked good and healthy. There was some activity on the northern side of the cement factory right near the water's edge, with a few people moving large blackened objects with shovels that may have been metal scraps. In the inlet north of the cement factory there were a few large, commercial fishing-style boats that appeared to be moored or docked; beyond these boats was a partially sunken large boat.

The last part of the boat tour went up towards the cove on the northeastern part of Largo Remo, through an area with a stream of fast-running water between the mainland and a small island. This area was quite beautiful with lots of healthy-looking fringing mangroves, clear water, highly diverse algae, and a large quantity of huge sea stars (*Oreaster reticulatus*) which were visible from the boat. As the boat entered the stream another boat was exiting, the other boat appeared to be a fishing boat. There was also a snorkeler in the stream who appeared to be fishing either by hand or with a small spear. The view of the cove on Largo Remo from the end of the stream showed a pretty area with mangroves and beaches but there were also an impressively large quantity of plastic soda bottles floating around in the cove and gathering against driftwood and the shoreline.

## **5.0 Discussion**

The literature review offered a wealth of relevant data, especially with respect to background information of the study site and key ecosystems. Seagrass beds, coral reefs and mangrove forests are unique, essential habitats, formed by their imperative constituent organisms. Functioning as a contiguous unit, these systems offer nurseries, feeding grounds,

breeding sites, water quality maintenance and other essential services. Importantly, as a result of their inherent connections, there is a strong cascading effect in response to perturbations.

From the numerous publications reviewed by the researchers, it is clear that these highly diverse ecosystems are major contributors to the world's biodiversity and therefore global ecological stability. Despite the fact that corals, seagrasses and mangroves are strengthened by each other's presence, they remain exceptionally fragile systems that are easily devastated by anthropogenic activities. Thus, the protection of marine diversity is crucial and is best achieved through conservation of coastal habitats and landscape diversity (Gray 1997).

Due to the proposed park's location within such a highly industrialized region, chemical contamination, such as oil, is a major concern. The two major oil spills in and around Bahía las Minas had numerous detrimental effects and many as of yet unseen consequences. Mangrove cover decreased and coral reproduction was compromised. More optimistically, however, these systems have shown great recovery in the 25 years since the last oil spill. Despite this exhibited resilience, oil pollution cannot be taken lightly. It should be assumed that, given the high level oil production and industrial activity in the area, there will be future instances of discrete contamination. It is therefore advisable that stricter environmental and safety regulations be implemented on local industry in hopes of avoiding another ecological disaster.

While there is a strong presence of valuable ecosystems in this region, much intense development and industrialization is desired and promoted. Being located directly beside the Panamá Canal makes Isla Margarita a highly prized, competitive region making projects like the port on Isla Margarita commonplace.

It is clear that this project is moving rapidly and with little to no public participation or consultation. Given Isla Margarita's close proximity to the current and prospective protected

areas, it is vital that action be taken quickly in an effort to reconcile these conflicting agendas. Without some sort of collaboration, the plans for Isla Margarita will most likely remain ecologically unsound, despite protests from ARAP, as well as some from ANAM.

In their EIA, the promoters of the Isla Margarita Development reported no fragile ecosystems in the area of development. This, however, is most likely a falsity, since both mangroves and coral reefs are clearly visible on the maps compiled by the researchers. Furthermore, the claim was made that there were no historic or cultural important sites in the area. Later on in the report, however, mention is made of old military bunkers that are not currently formally marked as national monuments and are therefore not necessary to protect. These are only two of many instances that give the researchers reason to doubt the integrity of the EIA for Isla Margarita.

So far the focus has been on environmental preservation and the dangers involved in industrialization. It is extremely important not to neglect the socioeconomic factors that make up a substantial part of this complex issue. In a region where unemployment abounds, the needs of the people must be considered and integrated into the discussion. It therefore follows that industrial developments such as the one on Isla Margarita are valued and supported. The researchers implore that the Isla Galeta Marine Laboratory representatives contemplate these social issues in their endeavor to create a new park. It is of utmost importance that a balance be struck between human and environmental needs.

In light of this, it is very promising that plans for land use are materializing in the district of Colón. The researchers were grateful to learn that a section of land has already been partitioned off within the POT for the prospective park. There are, however, a few discrepancies between the original park outline and what has been proposed in the POT. For example, a

distance of 1.5 kilometers off of the coast has been demarcated in the POT for the marine park, whereas the initial plans proposed by Dr. Stanley Heckadon-Moreno called for 2.5 kilometers. The researchers believe that a STRI representative would be able to negotiate this value with the POT organizers.

Another incongruity between the desires of STRI and the POT plans lies in the designation of the park as a National Marine Park. It has been explicitly stated by representatives of the Galeta lab that the new park be directed using a patronato-style of governance, headed by the Alcaldía of Colón, as opposed to being strictly ANAM-run. Given that the POT is still in its planning stages, this can also likely be rectified through discussion.

STRI should also be aware that the POT clearly proposes areas of industrial development within the prospective park. In particular, it calls for the transformation of the old cement factory in Samba Bonitas into a small port. This development would take away any chance of recovery the area had, and would also increase anthropogenic effects. Even a small port would increase boat traffic, road traffic and human presence and would facilitate all kinds of development in the area. Also, the addition of the proposed coastal road would amplify the negative effects on the environment, especially since the road would most likely receive a high degree of heavy traffic with the addition of a new public transport system routed along it. Furthermore, from the maps in the POT it does not appear that there is a sufficient buffer zone between the road and the park, specifically in the places where the road crosses through the park.

On the other hand, the proposed coastal road would provide a new access route to the Isla Galeta Marine Laboratory. This could be an important development with the possibility of the closing of Randolph highway. It could also encourage park visitors and improve Galeta's accessibility.

The researchers would also like to point out that several mining concessions (**Appendix B: Fig. 7**) exist within the study area and in the future could be potentially harmful and disruptive within a conservation park.

It should be noted that the researchers strongly believe that the uses for Isla Margarita outlined in the POT are far more environmentally desirable than those proposed in the Panama Canal Colon Port project, and would produce favorable results for the park. A tourist hub adjacent to the park would ensure a healthy stream of visitors and sustained awareness and success of the park as a conservation area.

Interviews with Kurt Dillon consistently proved that he was interested in reconciling the interests of Louis Berger and STRI. Many of the plans in the POT, for instance, moving the location of the new airport such that it blocks the construction of an enormous petrochemical plant, are in line with Galeta's wishes. He was also very helpful during the onset of the project by orienting the researchers in the history and current activities of the study region, as well as by recommending potentially useful contacts in the creation of this park.

From the interview with Dionora Viquez, the researchers learned of potentially helpful patronato members, as well as how to create and run a patronato-style park. She also offered many valuable tips on acquisition of funds and zoning processes and categories. Above all, she stressed that in a successful patronato, private organizations outnumber public ones; this way, political influence is minimized.

Meeting with Héctor Guzmán provided invaluable resources and advice, especially with respect to the researchers' field work methodology. He also recommended many possible patronato members and site-specific information, some of which may prove helpful in future zoning of the park.

The road tour was vital in providing general information for the researchers on the residential and industrial areas within the proposed park. The quantity of housing right on the water's edge was impressive and helped account for the quantity of residential waste that was observed in the mangroves and along the shorelines. The amount of garbage within the potential park area is impressive and hopefully, if the park were to be instated, there would be high incentive to keep the area cleaner. The researchers were also surprised to find relatively healthy-looking mangroves in such close proximity with large industrial buildings and high housing density. This is a good sign for the ecosystem and shows that it is possible for humans and these ecosystems to coexist in a healthy manner.

The presence of fishing in the shadows of the refinery and thermoelectric plant was unexpected and perhaps a bit worrying. Most of the fishermen in this region were artisanal fishers, yet the researchers were concerned about potential health effects from consuming fish that come from the waters near the discharges of these two large industrial areas. There was obvious water contamination in several areas on the road tour and there is the clear possibility of contamination that could not be seen but would have to be tested for (bacteria). These issues could also affect potential zoning of the park in the future when determining which areas are marked for aquatic recreational activities such as swimming.

During the boat tour, researchers observed that the oil refinery is extremely close to the water, this bodes badly for the future as far as the likelihood of oil spills goes, especially as the oil refinery gets older.

From the comments of Jorge Morales and Joaquín Cordel, it appeared that there had been a decrease in fauna in the last few decades, perhaps as a result of the oil spill or increased habitat

loss. Despite this, many of the areas the researchers witnessed appeared to be quite healthy and in particular the area around the cove on Largo Remo appeared to have high biodiversity.

The Islas Naranjos turned out to be owned by foreigners, this was unknown by the researchers until they arrived there. At least Isla Arriba is being developed for small-scale tourism, which may not be bad for the new park; however work must be done to open up communication between the land owners and STRI to work out plans for the new park and how they relate to the islands. These islands were quite beautiful and anything that STRI could do to keep them that way would be beneficial to the coastal ecosystems and the park. Perhaps STRI could work with the landowners to facilitate small-scale ecotourism and recreation in the area. There are a lot of fringing reefs around the islands, which may be great for snorkeling.

The mainland across from the Islas Naranjos is in wonderful condition and has basically no development along its shoreline. This area hosts lots of baitfish and other wildlife as well as a diverse array of mangrove species. As long as no new roads are built out to these shorelines, this area should remain in good condition unless another oil spill occurs.

The mangroves on the northwest side of Payardí were in poor shape when the boat tour was performed. It is likely that this area is too strongly influenced by industrial activity to support a healthy ecosystem; the researchers believe that the outflows from the refinery and thermoelectric plant may play a large role in the condition of these forested areas.

There was definite activity at the old cement factory, although it was not clear exactly what was going on. Future research should establish what is going on and what future plans exist in this area.

## **5.1 Recommendations**

### **5.1.1 Areas of Future Research**

A more in-depth study of seagrasses needs to be performed. The information presented in this report covers all three key ecosystems, but a focus was inadvertently placed on corals and mangroves, simply because there are more publications available and the researchers' contacts happened to specialize in the latter systems. Nonetheless, it is important to have a thorough, and preferably location-specific, understanding of seagrasses and their role in the larger system of coastal marine areas.

The researchers would also like to advise that more recent and higher-quality maps be located or created for the study site. These would be useful in creating and presenting park plans, as well as determining possible zoning types, another recommended area of revision. The areas presented in this report are only preliminary zones and need to be more thoroughly investigated and decided upon. This will require consultations with a number of people, including, for example, local community members and groups, as well as those working on the POT.

It will also be very important to keep up to date with new developments in the Isla Margarita project and its EIA, as well as with the POT for Colón. The outcomes of these two plans will have significant, direct effects on the prospective park, and therefore it will be important to be aware of any unfavorable decisions they might make. On a related note, the researchers would also like to urge any future collaborators to further pursue some of the many helpful recommendations which Kurt Dillon provided and are included in this report. He had numerous useful ideas that, unfortunately, were unable to be fully researched.

Future research will be necessary in the realm of potential patronato members and more extensive networking. It would be advisable to use the recommendations of Dillon,

Viquez and Guzmán to compile a list of possible organizations and then make contact with them. It will also be imperative to try to get the Alcaldía of Colón on board and involved with the creation of this coastal marine park. In future networking, it may be important to create ties with the man from Germany who owns the Islas Naranjos, as a way to be informed of any developments in that region.

### **5.1.2 Future Field Work**

The researchers strongly recommend that an underwater survey (especially of seagrasses and corals) be performed. It would also be prudent to perform an entirely new environmental survey, but this time with professionals who specialize in the key ecosystems. This would provide much necessary information for the creation of the park, and would help in the possible establishment of marked zones. It would also be advisable to carry out an archaeological survey of the area, as was done at the Parque Natural Metropolitano prior to zoning.

The researchers attempted to set up a flyover of the area, at the suggestion of Guzmán, in order to obtain recent, good-quality photos of the area. The flight, however, fell through at the last minute and the researchers very much hope that this endeavor will be pursued in the future.

Finally, it is of great importance to consider the kinds of implications this type of park could have on the human dimension. Therefore, the researchers call for a thorough socioeconomic survey of surrounding communities, as well as connecting with and involving local groups and community members. Local social involvement will play a crucial role in the creation and success of this park, and so the importance of gaining community support and cooperation should be recognized.

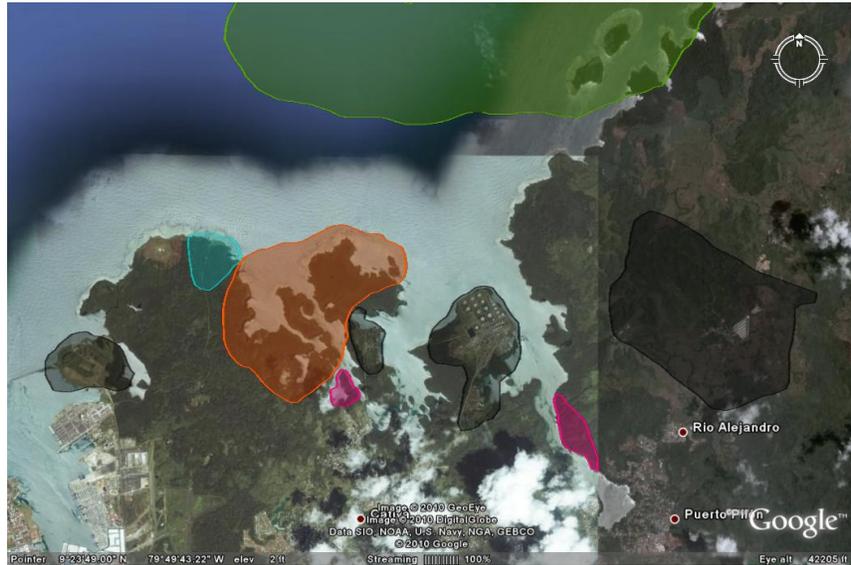
### 5.1.3 Recommended Readings

The issues addressed in this project are complex and, for the most part, highly documented. **Appendix H** contains a list of relevant literature on issues relating to this study. It should be noted that the CARICOMP manual could be of particular use in designing field work methodologies for studies of all three key ecosystems.

### 5.2 Preliminary Zonification

The researchers have proposed a preliminary zoning map using data collected during the study (**Figure 29**). Five types of zoning were applied to the park area: areas where fishing is permitted, recreational areas (for camping, hiking, swimming, etc), areas of tourism (visitor center, etc), untouchable zones (areas which will be off limits to all uses-except for research) and unzoneable areas (which are zoned outside of the proposed park’s jurisdiction).

The fishing zone was based off of a map in the POT showing areas of marine resources (**Appendix B: Fig. 5**) and off of observations made during the boat tour. This zoning should not be considered exclusive as the local artisanal fisherman are likely to continue to fish in the bays near their



**Figure 29: Preliminary Zoning Map**

Zoning Legend	
Color	Zone
Green	Fishing Area
Pink	Recreational Area
Aqua	Tourism Area
Orange	Untouchable
Black	Unzonable

communities (Viviendo Progreso Kuna). When zoning, considerations should be made for which areas are currently used for fishing, where the fish are and where the fish nurseries are.

Recreational areas were zoned near residential areas and either current or anticipated road access. More research is required to determine whether these areas are safe enough for recreation, in both a social and health-minded context.

Tourism was zoned only to include the current area inhabited by the marine lab. Once the park is established, it may make sense to expand tourism to an additional secondary location or to expand on Punta Galeta. The first priority though should be to increase the number of paying visitors and expand the tourism services at the current location on Punta Galeta.

The untouchable zone was drafted using observations and information from marine biologist, Héctor Guzmán. This zone protects the highly diverse cove on Largo Remo and the bays to the west of Largo Remo, which were unoiled during the oil spill of 1986. These areas should see minimal disturbance.

Unzoneable areas were located to show the areas that are currently zoned for industrial uses. The Islas Naranjos could also be considered unzoneable as they appear to be private property.

Future zoning should take the POT plans into account and rely more heavily on current research, field work and knowledge along with the opinion of the local residents. Local residents should be an excellent resource for determining current use patterns, which, when reasonable, should not be changed by the zoning.

## **6.0 Conclusions**

The findings of this report show both the necessity and achievability of a coastal marine

park near Punta Galeta. Despite the inherent difficulties that are borne out of the prospective park's location in such an industrialized section of the Caribbean coast, the research shows that the resources and the will to create this park do indeed exist. The literature and field work carried out during this study proves that conserving a natural area in the midst of almost unbridled development is not only possible but also essential. The loss of these natural spaces to industrialization would likely lead to collapsed local fisheries as well as the loss of any future eco-tourism. It is therefore the sincere hope of the researchers that STRI and the Isla Galeta Marine Laboratory recognize the urgency of this situation and move now to accomplish that which they have begun.

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## **8.0 Appendices**



**Figure 3: Isla Galeta Marine Laboratory**



**Figure 4: Boat Launch at Samba Bonitas**



**Figure 5: Fisherman near Cooperativa de Vivienda Progreso Kuna**



**Figure 6: Shoreline at Samba Bonitas filled with trash.**



Figure 7: Sign at Samba Bonitas



Figure 8: Trucks driving to and from thermoelectric plant



Figure 9: Close proximity of road, pipeline and mangroves near thermoelectric plant



Figure 10: Booms on southern outlet from thermoelectric plant



Figure 11: Fish in southern outlet



Figure 12: Water exiting thermoelectric plant from northern outlet into mangroves



Figure 13: Northern outlet with plant in back



Figure 14: Sign near northern outlet: "It is prohibited to swim or fish in this area."



**Figure 15: Thermoelectric plant with planted palms**



**Figure 16: Thermoelectric plant**



**Figure 17: Thermoelectric plant**



**Figure 18: Landscaping on Payardí**



Figure 19: Puerto Pilón; start of boat tour



Figure 20: Oil Refinery



Figure 21: Oil Refinery



Figure 22: Mangroves near refinery; front ones fallen (perhaps cut?)  
down



**Figure 23: Corals and mangrove above Isla Arriba**



**Figure 24: Huts on Isla Arriba**

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**Figure 25: Río Merceditas Inlet**



**Figure 26: Río Grande Inlet**



Figure 27: Pelicans at Río Grande Inlet



Figure 28: Old Cement Factory

## 8.2 Appendix B: Maps

### 8.2.1 Maps: POT

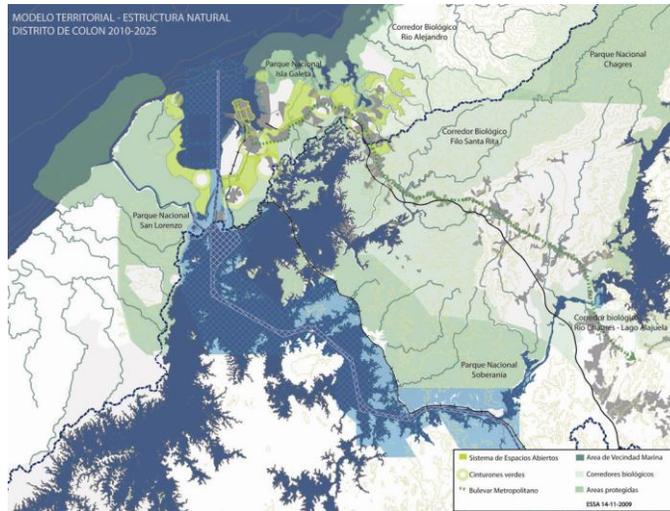


Figure 1: Natural Areas of the POT

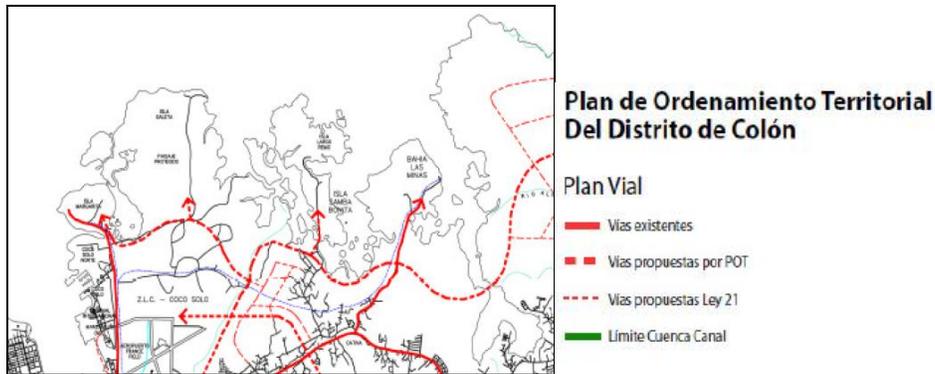


Figure 2: Proposed Roads of the POT

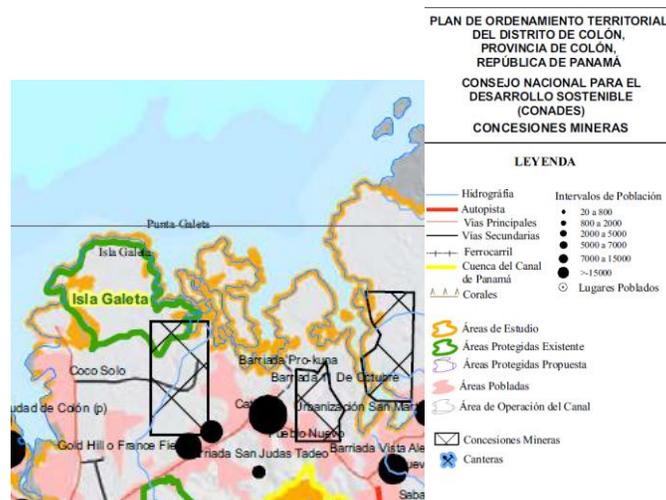
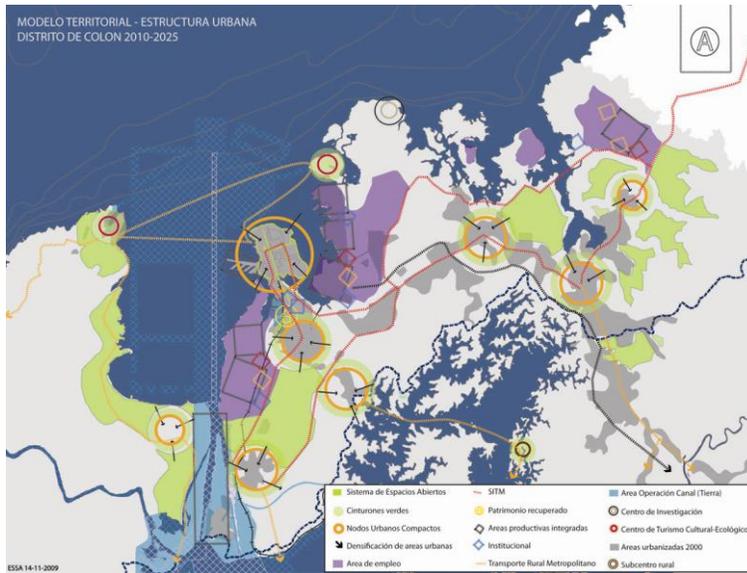
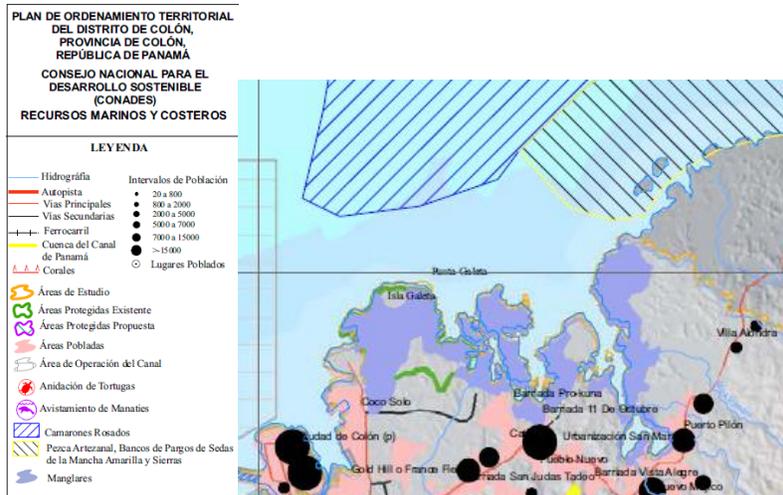


Figure 3: Mining Concessions



**Figure 4: Urban/Industrial Development of the POT**



**Figure 5: Marine Resources**

## 8.2.2 Maps: Other



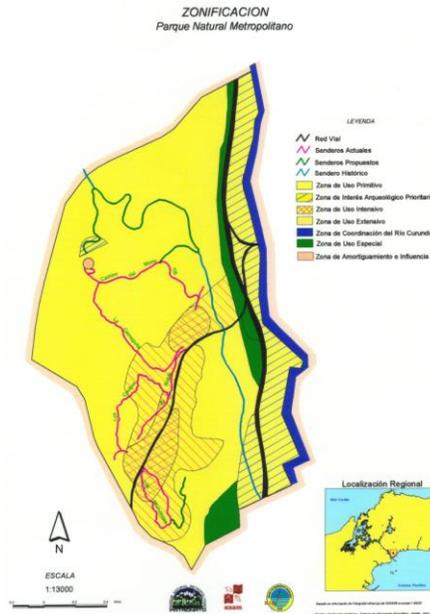
**Figure 6: Regional Place Names**



**Figure 7: ANAM Protected Areas and National Parks**



**Figures 8 & 9: Isla Margarita & Port Plans**



**Figure 10: Parque Natural Metropolitano Zoning**

### **8.3 Appendix C: Corresponding Place Names for Maps**

<b>Corresponding Place Names for Maps</b>	
<b>A</b>	Bay east of residential area, Cooperativa de Vivienda Progreso Kuna. Location of two separate fishing boats both occupied by net casting fishermen.
<b>B</b>	Old concrete factory on Samba Bonitas.
<b>C</b>	Road access to Samba Bonitas from mainland; Location of boat launch.
<b>D</b>	Murky stream between the two peninsulas explored during the road tour.
<b>E</b>	Location of the thermoelectric plant on Payardí, also the location of two water outlets from the plant.
<b>F</b>	Refinería Panamá, oil refinery on Payardí.
<b>G</b>	Inlet for Río Merceditas.
<b>H</b>	Inlet for Río Grande.
<b>I</b>	Location of dolphin sighting.
<b>J</b>	Location of tall mangroves near the oil refinery.
<b>K</b>	Location of sunken boat.
<b>L</b>	Boat tour starting point in Puerto Pilón.
<b>M</b>	Isla Abajo of the Islas Naranjos.
<b>N</b>	Isla Arriba of the Islas Naranjos.
<b>O</b>	Stream between the mainland and a small island near the cove on the Northeast side of Largo Remo.

## **8.4 Appendix D: Aviso de Consulta Pública**

### **AVISO DE CONSULTA PÚBLICA PRIMERA PUBLICACIÓN**

La Empresa Panamá Canal Colon Port Inc., cumpliendo con lo señalado en el Artículo 36, del Decreto Ejecutivo No. 123 de 14 de agosto de 2009, hace de conocimiento público que durante QUINCE (15) DÍAS HÁBILES contados a partir de la última publicación del presente aviso, se somete a la CONSULTA PÚBLICA el ESTUDIO DE IMPACTO AMBIENTAL CATEGORÍA II denominado:

1. **Proyecto:** Panama Canal Colon Port
2. **Promotor:** Panama Canal Colon Port Inc.
3. **Localización:** Provincia de Colón, distrito de Colón, corregimiento de Cristóbal, ubicación Isla Margarita.
4. **Breve Descripción del Proyecto:** Se realiza a solicitud de las empresas: United Crown Contruction Inc, Isla Margarita Resources S.A. y Gold King Investment Inc, proponentes del proyecto Panama Canal Colon Port (PCCP), la cual administrará y desarrollará todas las actividades del proyecto que involucra todas las operaciones del muelle, terminal de contenedores y carga general. El proyecto consiste en desarrollar las siguientes obras: Relleno de Fondo de Mar, con arena y una cantidad de 480,000 M3. Dragado de Fondo de Mar de 365,000 M3. Tala y Demolición de Infraestructuras Existentes. Patio de Contenedores. Muelle de Pilotes. Área de Administración y Fumigación. Área de Mantenimiento de una Sola Planta de 5,000 M2 y altura de 7.50 metros de altura. Área de Logística con galera de 27,000 M2. La Maquinaria a Comprar se instalará en el muelle. Se contempla Reparar o Instalar una nueva Planta de Tratamiento de Lodos Activados y aeración suspendida.

#### **5. Síntesis de los Impactos Esperados y las Medidas de Mitigación Correspondientes**

**Impactos Positivos:** Mejorar o instalar una planta de Tratamiento. Recolección adecuada de los desechos comunes o peligrosos que pueda generar el proyecto. Dinamización de la economía. Aumento de la población. Generación de empleos directos, permanentes o indirectos. Tratamiento y manejos de las aguas residuales. Saneamiento ambiental en general.

**Impactos Negativos:** Modificación de los patrones de uso del suelo. Modificación de la textura y estructura del suelo. Remoción de la capa orgánica del suelo. Modificación del perfil. Remoción de la cobertura vegetal. Modificación del hábitat. Modificación del paisaje. Contaminación atmosférica por hidrocarburos.

**Las Medidas de Mitigación Propuestas son:** Manejo adecuado de los desechos sólidos, incluyendo control y monitoreo constante. Control de las aguas residuales mediante mejoras o construcción de una planta de tratamiento. Implementar la siembra de plantas y arbustos ornamentales, para mejorar el entorno paisajista. Protección de los drenajes pluviales naturales y artificiales. Los trabajos dentro del proyecto se desarrollarán en horario diurno de 8 horas. Proveer a los trabajadores del equipo de protección necesaria. Establecer sistema de señalización en toda el área del proyecto. Exigir mantenimiento adecuado a los equipos y maquinaria para evitar fugas de hidrocarburos, gases tóxicos y ruidos. Adecuar áreas verdes en la acera del proyecto y jardinería.

Este documento estará disponible en la oficina de la Administración Regional de la Autoridad del Ambiente de Colón y en el Centro de Documentación de ANAM, localizada en la instalación de la institución, ubicada en Albrook, Edificio No. 804, planta baja en horario de 7:30 a.m. a 3:30 p.m.

Los comentarios y recomendaciones sobre el referido estudio, deberán remitirse formalmente a la Administración General de ANAM, dentro del término de (15) días hábiles anotado al inicio del presente aviso.

### **8.5 Appendix E: Land Use Documents**

The Plan de Ordenamiento de Tierra del Distrito de Colón and the Environmental Impact Assessment for Isla Margarita are digitally included in this report, in case there is need for more information regarding these complex matters. Please see the attached CD.

### **8.6 Appendix F: Parque Natural Metropolitano Patronato Members**

<b>List of Parque Natural Metropolitano Patronato Members</b>	
<b>Governmental Organizations</b>	<b>Non-Governmental (Private) Organizations</b>
<ul style="list-style-type: none"><li>• Alcaldía de Panamá</li></ul>	<ul style="list-style-type: none"><li>• Asociación de Investigación para la Propagación de Especies Panameñas (AIPEP)</li></ul>
<ul style="list-style-type: none"><li>• Autoridad de la Región Interoceánica (ARI)</li></ul>	<ul style="list-style-type: none"><li>• Smithsonian Tropical Research Institute (STRI)</li></ul>
<ul style="list-style-type: none"><li>• Autoridad Nacional del Ambiente (ANAM)</li></ul>	<ul style="list-style-type: none"><li>• Sociedad Audubon de Panamá (SAP)</li></ul>
	<ul style="list-style-type: none"><li>• Asociaciones Cívicas Unidas (ACU)</li></ul>
	<ul style="list-style-type: none"><li>• Soroptimista Internacional Panamá Pacífico</li></ul>

### **8.7 Appendix G: EIA Recommendations from ARAP (Español)**

Recomendaciones técnicas de ARAP:

1. Presentar ubicación UTM de las estructuras a desarrollar en toda el área del proyecto, con su correspondiente ubicación en un croquis y bosquejo de las mismas.
2. Aclarar en el mapa: Adjunto 5, Plano General del proyecto existen puntos que se muestran dentro del área de manglar.
3. Explicar donde o cuales el sitio de depósitos de los materiales productos del dragado. Ya que se contempla dragar 365, 600 metros cuadrados.
4. Establecer las medidas de mitigación y contingencia relacionadas a las etapas de dragados y relleno del fondo marino.
5. Establecer medidas de prevención y mitigación durante la fase de construcción, principalmente en la puesta en suspensión de material particulado fino.
6. Incluir la barimetría del sitio seleccionado por el promotor en donde se van a realizar el dragado y relleno.
7. Aclarar porque dentro del inventario de las especies de flora terrestre existente dentro del polígono del proyecto, no se menciona al mangle rojo (*Rhizophora mangle*) ya que en el borde del muro de contención existen mangle.
8. Aclarar si el EsIA incluye la construcción del futuro desarrollo de centro de negocios y zona industrial y logística. Mencionadas en el mapa Adjunto 5, de ser así explicar en que consisten las mismas, y adecuar el plan de manejo incluyendo las mismas.
9. Ampliar las medidas de contingencia por posibles derrames de hidrocarburos.
10. Aclarar el método de tratamiento de agua servidas (negras y grises), indicando cuales son las recomendaciones de mitigación asignadas que le permite la descarga del efluente del sistema de tratamiento de las aguas residuales e incluir el diseño.
11. En la página 87 se habla del lodo activado, indicar cual será el manejo final del mismo.
12. Adjunto 5, página 46, Plano General del proyecto, se encuentran las áreas demonizadas Futuro Desarrollo Parque de Negocios y FD Zona Industrial y Logística, en esta caso se

pregunta al promotor si éstas están incluidas en esta EsIA. De ser así deben presentar un Inventario Forestal, pues según esta plano dichas áreas de manglar y bosque serán intervenidas con las áreas mencionadas anteriormente. Además, estas áreas también intervendrían áreas del fondo marino por lo que deben realizar una descripción de dicha área junto con su batimetría.

13. En la página 25, punto G, se debe ampliar la información sobre el Programa de Mitigación para las aguas servidas que vierta la planta de tratamiento.
14. Los impactos a los ecosistemas marinos-costeros son causados por contaminaciones y movimientos de suelos que al final desaguan al océano, se les solicita por ende una descripción de ambiente físico, explique más sobre la zona marina.
  - ARAP concluye que hay necesidad a entrometerse en el proyecto por causa de los manglares. Es probable que el proyecto vaya a afectar los manglares. Tienen muchas dudas del EsIA.
  - Informe Técnico de Evaluación de ANAM (el 18 de febrero, 2010)

## **8.8 Appendix H: Recommended Readings**

### **Coral Reefs**

- Guzmán, H. M., et al. 2008. Historical decline in coral reef growth after the Panama Canal. **Ambio 37(5): 342-346.**
- Guzmán, H. M. 2003. Caribbean coral reefs of Panamá: present status and future perspectives. In: Jorge Cortes (Ed.), Latin American coral reefs: 241-274. Amsterdam: Elsevier Science B.V.
- Guzmán, H. M., et al. 2003. Natural disturbances and mining of Panamanian coral reefs by indigenous people. **Conservation Biology 17: 1-7.**
- Guzmán, H. M. and E. M. Garcia. 2002. Mercury levels in coral reefs along the Caribbean coast of Central America. **Marine Pollution Bulletin 44: 1415-1420.**
- Lozano, S. 2002. Patrones de dispersión temprana de huevos y larvas del coral *Siderastrea siderea*, en la Bahía de las Minas, Caribe Panameño. Panamá: Smithsonian Tropical Research Institute.
- Guzmán, H. M. and I. Holst. 1994. Biological inventory and present status of coral reef at both ends of the Panama Canal. **Revista de Biología Tropical 42(3): 493-514.**
- Guzmán, H. M. and I. Holst. 1994. Arrecifes de coral y comunidades coralinas. **Scientia (Panamá) 8(2): 60-79.**
- Guzmán, H. M. and C. E. Jimenez. 1992. Contamination of coral reefs by heavy metals along the Caribbean coast of Central America (Costa Rica and Panamá). **Marine Pollution Bulletin 24(11): 554-561.**

### **Mangroves**

- Sousa, W. P. 2007. Mangrove forest structure and dynamics, Punta Galeta, Panama. **Bulletin of the Ecological Society of America 88(1): 46-49.**
- Wang, L., et al. 2004. Comparison of IKONOS and QuickBird images for mapping mangrove species on the Caribbean coast of Panamá. **Remote Sensing of Environment 91(3-4): 432-440.**
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- Lin, B. 2001. Mangrove filtration of human waste contaminants in El Rio Coco Solo, Colon, Panamá. Department of Ecology and Evolutionary Biology, Princeton University, Princeton University, Princeton, New Jersey.
- Duke, N. C. 1997. Reforestación de manglares en Panamá. In: C.D. Field (Ed.), *Ecosistemas del Manglar*: 231-258. Managua: Editora del Arte.
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- Duke, N. C., et al. 1994. Los Manglares. **Scientia (Panamá) 8(2): 80-98.**
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- Duke, N. C. 1991. Study of Mangrove Recovery "Panamá". **Newsletter of the International Society for Mangrove Ecosystems 3: 5.**
- Roman, A. C. 1985. El manglar: un ecosistema en peligro. La Prensa.
- Victoria, E. and A. Batista. 1980. Estudio de las comunidades que habitan las raíces del mangle rojo *Rhizophora mangle* L. de Punta Galeta, costa Atlántica de Panamá. Biology Department, University of Bogota Jorge Tadeo Lozano, Colombia, Fundación Universidad de Bogotá Jorge Tadeo Lozano, Bogotá, Colombia.
- Oil Spill**
- de Vega, G. B. and A. Soler. 2007. Epifitismo de micro y macroalgas que se presenta en granjas marinas del género *Eucheuma* en hábitats afectados por el derrame de petróleo en 1986, Punta Galeta, Distrito de Colón, Informe final. Colón, Panamá.
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- González, T. E. R. and I. M. P. Vega. 2003. Evaluación post-derrame de los niveles de hidrocarburos en moluscos bivalvos (*Crassostrea rhizophorae* e *Isognomon alatus*) y sedimentos asociados a manglares de Bahía Las Minas, Provincia de Colón. Biology Department, University of Panamá, Panamá.
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- Duke, N. C., et al. 1997. Large-scale damage to mangrove forests following two large oil spills in Panamá. **Biotropica 29(1): 2-14.**
- Duke, N. C. 1996. Mangrove reforestation in Panamá: An evaluation of planting in areas deforested by a large oil spill. In: C.D. Field (Ed.), *Reforestation of Mangrove Ecosystems*: 209-232. Okinawa: International Society for Mangrove Ecosystems.
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- Guzmán, H. M., et al. 1994. Injury, regeneration and growth of Caribbean reef corals after a major oil spill in Panamá. **Marine Ecology Progress Series 105(3): 231-241.**
- Garrity, S. D., et al. 1994. The Galeta oil spill: I. Long-term effects on the physical structure of the mangrove fringe. **Estuarine Coastal and Shelf Science 38(4): 327-348.**
- Burns, K. A., et al. 1993. How Many Years Until Mangrove Ecosystems Recover from Catastrophic Oil Spills? **Marine Pollution Bulletin 26(5): 239-248.**
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- Garrity, S. D. and S. C. Levings. 1993. Effects of an Oil Spill on Some Organisms Living on Mangrove (Rhizophora mangle L.) Roots in Low Wave-Energy Habitats in Caribbean Panamá. **Marine Environmental Research 35: 251-271.**
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