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FINAL REPORT

PROYECTO DE PANAMA COLON CONTAINER PORT: An estimation of the environmental impacts

By Laura Peña Silva and Sandrine Royer

Days in the Field: 5; Days working in Panama city: 5

Presented to Nilson Ariel Espino and Stanley Heckadon

McGill University

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EXECUTIVE SUMMARY

English version

Project of Panama Colon Container Port: An estimation of the environmental impacts
By Laura Peña Silva and Sandrine Royer
Laboratorio Marino Punta Galeta
Smithsonian Tropical Research Institute
Unit 0948
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In a country where the service sector accounts for more than 75%, the development of the port facilities is highly relevant. As Colon is located at the eastern entrance of the Panama Canal, it is strategic to invest in the advancement of this sector. However, the population has expressed a desire to couple this development with the preservation of the environment, since the sector has been deteriorated due to a lack of planning over the past decades. The Environmental Impact Assessment (EIA) is a process that is meant to ensure such environment-friendly practices by taking into account all the potential environmental and socio-economic impacts of development project and making recommendations to lessen to negative effects. Nonetheless, EIAs tend to be incomplete or influenced by economic or political factors.

It is in this context that we analyse the environmental impacts of a new port project, the Panama Colon Container Port, that worries the scientists of the region by its proximity to fragile ecosystems. This study aspires to provide the Marine Laboratory of Punta Galeta with tools to better understand the extent of the port project and its potential environmental and socio-economic impact in order to allow them to inform the community and further protect the biodiversity of the region.

Our methods consisted of a series of interviews with biologists, a technician from the Ministry of Environment, and a lawyer from the Centro de Incidencia Ambiental de Panama (CIAM). We further produced or used visual material to support the information, and we analysed the EIA to examine the completeness of its content. We further conducted a literature review to deepen the understanding of certain aspects of the project.

Firstly, we investigated on the company responsible for the port, its previous projects, and its plans for the current development project was conducted. Secondly, the environmental elements of the affected areas were determined to achieve a better understanding of the potentially affected life forms. Lastly, we investigated the lack of any information in the EIA about the probable environmental impacts of the project.

Our results showed that the EIA provided a complete analysis of the biodiversity present inside the breakwater area, but the potentially affected ecosystems in Punta Galeta and Nombre de Dios were omitted from the report. We found that the construction and operation might affect the fragile coral reefs and mangroves present in the sights adjacent to the port. We assessed the relevance of the port to the economy of the region and the country, as well as its positive impact on employment opportunities. We subsequently recommend measures to mitigate the impacts of the port, such as building a barrier to protect the corals from the sedimentation coming from the

construction. We also recommend more transparency in the EIA's process and the company's' communication to allow the public to have a better understanding of the development projects in their community.

Spanish version

Proyecto del Panama Colon Container Port: una estimación de los impactos ambientales
De Laura Peña Silva and Sandrine Royer
Laboratorio Marino Punta Galeta
Smithsonian Tropical Research Institute
Unit 0948
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En un país donde el sector de servicios representa más del 75%, el desarrollo de las instalaciones portuarias es de gran enfoque. Dado que Colón se encuentra en la entrada este del Canal de Panamá, es estratégico invertir en el avance de este sector. Sin embargo, la población ha expresado su deseo de vincular este desarrollo con la preservación del medio ambiente, ya que el sector se ha deteriorado debido a la falta de planificación en las últimas décadas. La Evaluación de Impacto Ambiental es un proceso que tiene como objetivo garantizar prácticas respetuosas con el medio ambiente teniendo en cuenta todos los posibles impactos ambientales y socioeconómicos del proyecto de desarrollo añadiendo recomendaciones para mitigar los efectos negativos. Sin embargo, tienden a ser incompletos o estar influenciados por factores económicos o políticos.

Es en este contexto que analizamos los impactos ambientales de un nuevo proyecto portuario, el Panamá Colón Container Port, que preocupa a los científicos de la región debido a su proximidad a ecosistemas frágiles. Nuestro estudio tiene como objetivo proporcionar al Laboratorio Marino de Punta Galeta herramientas para comprender mejor el alcance del proyecto del puerto y sus posibles impactos ambientales y socioeconómicos para que puedan informar a la comunidad y proteger la biodiversidad presente.

Nuestros métodos consistieron en una serie de entrevistas con biólogos, un técnico del Ministerio de Medio Ambiente y un abogado del Centro de Incidencia Ambiental de Panamá (CIAM). Además, producimos y usamos material visual para apoyar la información, y analizamos el EIA examinando la integridad de su contenido. También realizamos una revisión de la literatura para profundizar la comprensión de ciertos aspectos.

En primer lugar, se realizó una investigación sobre la empresa responsable del puerto, sus proyectos previos y sus planes para el proyecto de desarrollo actual. En segundo lugar, se determinaron los elementos ambientales de las áreas afectadas para lograr entender a fondo las especies posiblemente afectadas. Finalmente, determinamos la omisión de información en el EIA sobre la probabilidad de los impactos ambientales.

Nuestros resultados mostraron que el EIA proporcionó un análisis completo de la biodiversidad presente dentro del área del rompeolas, pero omitieron los ecosistemas potencialmente afectados en Punta Galeta y Nombre de Dios. Descubrimos que la construcción y la operación podrían afectar los arrecifes de coral y los manglares presentes en los sitios cercanos al puerto. Sin embargo, evaluamos la importancia del puerto para la economía de la región y del país, así como su impacto positivo en las oportunidades de empleo. Entonces recomendamos medidas para mitigar los impactos del puerto, como cortinas para proteger los corales de la sedimentación proveída por la construcción. También recomendamos aumentar la transparencia

en el proceso de EIA y la comunicación de las empresas para permitir que el público entienda mejor los proyecto en desarrollo en sus comunidades.

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We would like to distinctively thank all the respondents of our interviews, including Dr. Thomas Goreau, Dr. Wayne Sousa, Dr. Hector Guzman, and Isaías Ramos, for taking the time to respond to our questions. Also, special thanks to CIAM for working with us and sharing their information on the legal processing of Environmental Impact Assessments. We would also like to thank Milton Solano for his help with GIS mapping and data management.

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INTRODUCTION

On April 10th, 2017, the Environmental Impact Assessment (EIA) of the Panama Colon Container Port project was approved by the Ministry of Environment, giving the green light for the beginning of the construction of the chinese project. The same year, the company presented modifications to the plans, which were the object of a lawsuit carried out by the Centro de Incidencia Ambiental (CIAM), admitted by the Court on January 29th, 2018. Instructions were then given for the port to completely stop the construction while the court case was ongoing. It is because of these concerns and those of scientists from the Marine Laboratory of Punta Galeta that our investigation took root, guiding us to study the EIA to figure out its completeness, but also to understand the potential environmental and socio-economic impacts related to this project. This next section will display a literature review to establish a basic knowledge of the different stakeholders and key concepts. The following section will lay out the methods used to realize our investigation. The results will then be presented for each of the three objectives: the description of the port project, the environmental elements present in the surroundings, and the content of the EIA and its modifications. Lastly, there will be a discussion concerning the potential impacts of the port, both environmentally and socio-economically.

Environmental Impact Assessments

An EIA is a prevalent process in many countries, consisting of an evaluation of all the potential environmental impacts that a development project may have during its construction and operation. It also looks at the possible social and economic repercussions in order to develop appropriate strategies for a sustainable development (Lee & George 2006). The literature shows that in “developed countries”, the EIAs are mostly meant to allow all the actors to find a common

ground. The government, the stakeholders and the public should all find solutions through this process (Moster, 1995; Kolhoff, Runhaar, & Driessen, 2009). In developing countries, Kolhoff, Runhaar, & Driessen argue that the objective of this mechanism is rather to "provide scientifically sound knowledge on the environmental impacts of proposed projects. EIA is considered a 'compliance tool', comparable to a robust environmental clearance or permitting procedure" (2009). The processes in these countries often lack regulatory framework, sufficient public participation, and competence of the consultants. Moreover, monitoring programs are often absent, and therefore inspections are insufficient to control the application of environmental regulations (Kolhoff, Runhaar, & Driessen, 2009).

In Panama, article 1 of law 41 of July 1998 stipulates that the EIA is a duty of the state in order to promote a sustainable development and support a reparation of any environmental damages (DIEORA, 2017). According to the General Environmental Law, the Ministry of Environment is the entity responsible to examine and approve all EIAs of projects that might have environmental repercussions (Suman, 2002). The organization responsible for the EIAs in Panama is the Direccion de Evaluacion y Ordenamiento Ambiental (DIEORA), and the promoters of the projects are in charge of presenting the evaluation to this body. The only people permitted to carry out the reports are the consultants that are registered in the Registro de Consultores Ambientales de MiAmbiente (DIEORA, 2017). This process was implemented in order to encourage the creation of mitigation measures for projects that have a considerable environmental impact. Nonetheless, the country's procedure has important flaws such as "difficulties of cumulative analysis, limitations in the qualifications and number of personnel, reactive (rather than proactive) environmental evaluation, and the economic and political momentum that many projects generate"

(Suman, 2002). The process also tends to lack community involvement and transparency (D'Orazio, 2008; Debyser & Hoffmann, 2014).

There have been many situations where the flaws in the country's EIA process has been aparent in recent history. For example, in May 2014, four environmental organizations succeeded in blocking the project of an pipeline that the Ministry of Environment previously approved. The project that was located in a protected area in the region of the Tocumen airport, raised concerns about the disappearance of wildlife habitats. It was also demonstrated that it was violating articles 17 and 109 of the Constitution, that protect the right to life and the health of the population. Another example of the difficulties regarding the application of the EIA process is the case of North Property in 2014, a company that started its activities the same day the EIA was approved by the Ministry of Environment without having the seal of approval of the EIA previously placed on the site and without the permission of the compatibility of the ACP (Panama Canal Authority), two things that are mandatory before the beginning of any project. The Ministry of Environment was also accused of approving this EIA in less than 3 days, without the preliminary obligatory consultation of the ACP, therefore going against the Law 21 of July 21st of 1997 concerning the use of land in areas reverted. The activities, resulting in the obstruction of water bodies, deforestation, modification of the landscape, erosion and transformation of the fertile soil, caused environmental damage estimated to cost more than $830,000 to restore (Prieto-Barreiro, 2016).

Presently, we sensed a lack of transparency when trying to communicate with the stakeholders responsible of the Panama Colon Container Port (PCCP). It was impossible to obtain any further information about the extent of the project, either social or economic. Moreover, while the Supreme Court of Justice mandated the construction to stop due to the lawsuit presented, newspaper reports show a 30% advancement in the development of the project (Rodríguez, 2018).

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Plus, our several attempts to obtain more information from the Ministry of Environment were canceled or postponed. We were refused verbal responses on the same day the interviews were scheduled. The promised written answers were never given, indicating that the Ministry may have been filtering the accessible information.

Therefore, this literature review and the current actions of stakeholders in Panama strengthens the necessity to invest more time in the analysis of these studies, in order to limit environmental degradation whilst being aware of the economic and social costs or advantages.

Urban Development of the city Colón - Goals and Challenges

In Panama, where the service sector accounts for more than 75% of the GDP (Focus Economic, 2018), it is evident that the strategic location of Colón at the eastern entrance of the Panama Canal influences the city's development. Indeed, with the Free Zone and four ports in the area[1], the city is at the centre of an important economic zone that can benefit the country as a whole (Panamá, 2010). Between 2010 and 2013, 89% of the investment made in the region were directed to commercial ports, industrial activities, and public infrastructures (La Estrella de Panamá, 2014). It is however important to take into account the fragile and rich ecosystems present in its surroundings in order to allow a sustainable development. In fact, the conclusions drawn from a series of interviews, meetings, and workshop conducted in the context of the "Elaboración del plan de ordenamiento territorial del distrito de Colón" revealed that the protection of the environment is a priority for Colón's population. Indeed, it was decided that the development plans for the city and the surroundings should enhance the "preservación de los sistemas naturales que por su valor

[1] Colón Conteiner Terminal (Managed by Evergreen), Manzanillo International Terminal (Operated by Stevedoring Services of The America), Panama Port Terminal (Managed by Hutchinson Whampoa) and Colon Port Terminal. At present the city has two new cruise ports, these are: Colón 2000 and Pier 6 of the port of Cristóbal (EIA, 2017).

intrínseco, cultural, científico o de servicios ambientales críticos, no deben objeto de impactos antropogénicos que de alguna manera pueden alterar sus procesos internos" (Panamá, 2010). A sustainable development respecting the environment therefore seems to be a priority for the population. However, the wish for an increased efficiency for the ports' activities in the area is also a key aspect of these plans, in order to improve the economic efficiency and, more specifically, the port-comercial system. It is pointed out that this development should be done in a way that respects the environmental and social demands (Panamá, 2010).

Nonetheless, the region is facing several challenges in its development process. Recent investigations evoked a lack of communication between the different government agencies involved in the planning of the area, leading to an "important institutional failure, through which large risks, both with environmental and human costs, are incurred" (Debyser & Hoffmann, 2014). The authors deepen this statement by revealing that the Panamanian centralized system of governing culminates in the absence of local decision makers in the urban planning of the district. This seems to lead to an unbalanced division of the profits produced by the projects, the majority of which are incurred by stakeholders in Panama city, whilst the environmental costs and other negative externalities are supported by the local people (Debyser & Hoffmann, 2014). Repercussions such as the contamination and the sedimentation resulting from deforestation and change in land use have been affecting the mangroves and the coral reefs, and the coastal water is increasingly polluted. The population of Colón expressed its disquietude about this topic in the Urban Development planning process, and while the regional economic development is desirable, the people voiced concern about the lack of planning resulting in environmental degradation (Panamá, 2010; Estrella de Panamá, 2014).

Consequently, this literature reveals a need for economic development coupled with a necessity for measures to protect natural resources of the sector. This should be kept in mind when inspecting the project of the Panama Colon Container Port, as its social and economic effects should be taken into consideration along with its environmental impacts.

METHODS

To understand the PCCP project and its impacts, three types of methodology were chosen: interviews, visual material, and a full analysis of EIA and literature search.

Interviews

Semistructured and unstructured interviews were chosen to obtain information from a wide scope of stakeholders and opinions. Casual conversations became more structured as knowledge expanded further into the research, and interviews became more focused and specialized to a certain topic. The questions from our structured interview with the Ministry of Environment and semistructured with the scientists can be found in the Appendix I.

The stakeholders were selected based on the goal to obtain different perspectives, therefore we selected a group of scientists knowledgeable of the area, lawyers working on the case, and governmental authorities. Our colleague Jairo Castillo, coordinator of the educational program in Punta Galta put us in contact with Dr. Wayne Sousa, from the University of Berkeley and an expert in the mangroves of Punta Galeta, and Dr. Thomas Goreau, a coral specialist and president of the Coral Reef Alliance. Both professors were interviewed in a semi-structured manner focusing on their specialization through email (Appendix II). Hector Guzman, who has studied the Caribbean

coral reefs for many decades, was interviewed, and he illustrated the present and future challenges faced by the marine ecosystems.

To deepen our understanding in the EIA processing, Marianela Caballero, a technician for DIEORA (Direccion de Evaluacion y Ordenamiento Ambiental) of the Ministry of Environment was asked to answer written and orally a set of structured questions, but denied to do so. We wanted to explore the legal processing of the project and combine our findings with those concluded by CIAM. Accordingly, we interviewed Isaías Ramos, field biologist at CIAM that worked on the lawsuit presented to the Court (Appendix III).

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Visual Material

To grasp the scale of the project and understand the extension of its impacts, we decided that creating visual material was important for future studies. For this reason, we analysed the different plans of the construction of the port provided in the EIA (Appendix IV).

To determine the environmental impacts we mapped the mangrove cover over time in the areas surrounding the PCCP. The map was constructed using online databases and QGIS and the area in hectares of mangroves affected and potentially lost was determined to be 23.54 ha (Appendix V). Unfortunately, there is no available data to map the coral cover, but there are some pictures taken by Eduardo Estrada to demonstrate their existence (Appendix VI). The photographer provided us with images, both terrestrial and aerial, of the area of Punta Galeta natural reserve and Isla Margarita (the port's construction site) showing the fauna and flora found in these sites, as well as the exact site of the port construction (Appendix VII).

Analysis of the EIA

By cause of the impediments with access to information by the personal of the PCCP and DIEORA, we focused a large part of our research to the analysis of the EIA. Missing and inaccurate information on the study was the reasoning for the lawsuit and halting of construction. A thorough analysis of the previous and modified EIAs was the most effective way to understand the scale and impact of the PCCP. To complement all the information received and further investigate, research of past literature and news articles was done through the STRI library and online.

Limits of methodology

The first limitation encountered was the difficulty to access exhaustive and accurate information. The studies executed in the area did not report fully the diversity and stauts of the biology present. This made it difficult to obtain quantitative data on the potential impacts of the port construction. Additionally, the constraverises between scientists' opinion on the living cover of coral reefs in distinct areas and our inability to personally assess these made it more laborious to come to a full conclusion. Secondly, due to the current state of the project, the Ministry of Environment did not present any interest in answering any questions related to the PCCP. Over many visits, the technician postponed the interviews and/or denied to answer any question verbally. We suspect the project status is the reason to the legal barriers and confidentiality restrictions.

The second limitation is that of the accuracy of our maps representing land cover, which was limited by the databases available to us. Forest cover map were updated to 2012, but no maps are found for future dates. The studies of the current extension of mangroves and the lack of information regarding the location of coral reefs made it difficult to create accurate maps. The pixel size of 15m x 15m also influences the accuracy for the dimensions of the area.

RESULTS

Results from objective 1: Panama Colon Container Port Description

About the Company

Landbridge group is a Chinese company based in Rizhao China, and specializes in infrastructure and in the energy industry. Additionally, it runs an industrial chain of port logistics, petrochemical and cultural tourism, taking advantage of the locations of their ports. Landbridge has a total domestic overseas asset value of 51.6 billion yuan making it one of the largest private enterprises in Shandong province (Landbringe Group Introduction, 2016). Although categorized as a private company, it is well known of its ties with the Chinese government. The president of Landbridge, Ye Chang, is affiliated with the People's Republic of China party (PRC) as a member of the 12th National CPPCC Committee (Wade, 2015). The company is guided partly by the communist party of China and thus the decisions are guided by the interests of the Chinese government. Further, a private militia was created to support the government's interest in technology and science (Wade, 2015). Information regarding the director of the company, He Zhaoquing, concludes his links with the government of China, as he also was an ex-official of the People's Liberation Army. He now controls the development of the ports.

Previous projects by Landbridge are located in Asia and Australia. The company in Rizhao, China focuses on the refinery, production, selling, storing and transportation of gasoline and other chemical products (Bloomberg, 2018). The port in Darwin, Australia was a US$506 million investment for a rent of 99 years, with 80% of property rights. The location of the port is strategically planned, close to the American military base and the maritime entrance to Asia. This position allows the company to oversee all incoming and ongoing trading activities (Conin, P. &

Benich, P., 2015). The Landbridge port in Asia, Oceania and soon in Panama, aim to contribute to the development of the three countries by actively engaging in the maritime trade around the world.

Description of the Project in Panama

Landbridge group has signed with the government of Panama in May 2016 for a two-part project that includes the construction and operation of the container port in Isla Margarita, and a thermoelectric plant for liquefied natural gas in Parque Río Alejandro in Puerto Pilón, Colón (Appendix VIII). Although the same company is responsible for both plans, distinct EIAs are approved and our research is focused on the environmental impacts of the former.

The Panama Colon Container Port (PCCP) is designed by Port Design Institute (PDI) and constructed by China Communication Construction Company (CCCC), both chinese entreprises. The latter is the largest design and construction group in China, the world's largest crane manufacturer and the second largest for dredging (China Communication Construction Company, 2008). Shanghai Gorgeous, a chinese investment company, is advancing US$1.1 billion to the development of this part.

The port will be constructed in Isla Margarita, in the area of Coco Solo, which was the location of a former US naval base known as Fort Rudolph (Georgia Tech Panama, 2018). The Autoridad Maritima de Panama granted under Law 43, an area of 39 ha of land and 22 ha of sea floor. The first stage of the port consists of constructing three docks, two of which can receive Super Post-Panamax ships, and one for Post-Panamax. The container park will also contain 12 cranes, eight for Super Post-Panamax and four for Panamax, which will allow the handling of 2.5

million TEUs per year (World Maritime News, 2017). The second and third stage correspond to a logistics park and additional cranes to manage in a future 11 million TEUs (Telemetro, 2017).

Post Panamax is the size of containers with a longitude of 285 m, 32 m wide and 12.5 m of draft with a capacity of transporting 5,000 TEUs. Super Post Panamax ships can transport 40% to 50% more containers and it is the largest size that can travel through the new expanded locks of the canal. The dimensions are 400 m of longitude, 59 m wide, and 15.5m of draft, with a capacity of 12,000 to 20,000 TEUs (Oliveira, 2015).

Port Dimensions

The total area of the PCCP is 614,806.17 m2 (61 ha + 4,806.17 m2), but to understand the port's extension, we divided it into three parts: land area, sea bottom area, and dredging and deposition area.

Land area consists of 39 ha +1,192.62 m^2 its location is on Isla Margarita. It is broken down in the following sections:

Component of the port	Dimension
Container park	38.4 ha
Administration area	1 ha + 2,074.79 m^2
Fumigation area	2 ha + 6,908.70 m^2
Area for control of operations	6,878.54 m^2
Maintenance area	4 ha +2,729.03 m^2
Intermodal area	7 ha + 0,412.13 m^2

The sea bottom area extends to 22 ha + 3,693.55 m^2. This area is inside the breakwater in Bahía Margarita, and will be filled with sand for the construction of a dock measuring 1,495 m long.

For the construction of the project it is necessary to dredge in two different areas. Firstly, the dredging area inside the breakwater will be of 5 ha + 116,65 m^2 to obtain a depth to -16 m for the construction of the dock and accommodation of Super Post Panamax ships. For the construction of the port on the land area, a volume of 4,080,000 m^3 is required to be filled. Furthermore, since part of the dredged material cannot be considered as filling material, it will need to be discarded in a deposition zone. Such area was determined by the AMP to be 5 km to the north of the dredging area (Appendix IX). The area for deposition is estimated to be 225 ha and will be divided in section of 250 x 250 m and each disposition will be in a different area to lessen the impact.

Secondly, sand dredged in Nombre de Dios is needed for the construction of the port, since cement and additional construction materials need to support the marine stress and the sand inside the breakwater is not adequate for such process. (Murray & Famania, 2016; Isaías Ramos, Personal Communication, 2018). This dredging volume was estimated to be 365,600 m^3 but the EIA rectified the total volume of dredging needed to 5,850,000 m^3 which is 16 times larger than first approved (Murray, 2017). As explained later in this paper, such an increase is critical for the surrounding environment.

Results of objective 2: Environmental Elements of the Sectors

The area of construction is mostly dominated by port infrastructure and developments, but it surprisingly remains a rich environmental sector. Located next to the protected reserve of Punta Galeta, mangrove forests and coral reefs surround Isla Margarita, in addition to what is identified in the EIA for inside the breakwater: algae (60%), mollusks (1%), cnidarians (1%), arthropods (1%), annelids (1%), fish (27%), crustaceans (5%) and echinoderms (3%). Unfortunately, the EIA does not mention the existence of the biodiversity outside the breakwater that will indirectly be affected by the construction of the port. Below, we decided to further explore the importance of coral reefs, mangrove forests and seagrasses, that the EIA unexpectedly ignores (Murray & Famania, 2016).

Corals

The coral reefs along the central Caribbean coast of Panama have been heavily exploited for centuries and used widely for the construction of forts, buildings, and military bases (Guzman et al., 2008). Moreover, the oil spills of 1968 and 1986, and the construction of the canal have further declined the live coral cover of the region. Today, ongoing disturbance from sedimentation and dredging, as well as discharges in to the sea from coastal towns and ports continue to affect the health of the corals (Guzman et al., 2008). Additionally to anthropogenic effects, diseases, fungi, temperature rises and even hurricanes have impacted the health of these coral reefs. Studies show a reef surface of 48 km^2 from Kuna Yala to Belen River, and one of the three largest reefs is located in Isla Galeta with a coastal area of 25 km (Guzman, 2003). Many reefs present in Bahía Limon were destroyed when the entrance of the Panama Canal was built and the coral reefs inside the breakwater are long dead for centuries; a small reef of *Porites porties* and *Millephora* species are present, but in very bad conditions. Nonetheless, footage form a recent preliminary study by Dr. Goreau show surprisingly healthy reefs just outside the breakwater (Goreau, Personal

Communication, 2018). The species found in Dr. Thomas' study include: *Siderastrea sidereal*, *Agaricia tenuifolia, Porites divaricate, Diploria clivosa, Porites astreoides, Porites colonensis, Millepora complanata, Acropora palmata* (nearly completely vanished almost everywhere in the Caribbean due to diseases), *Acropora cervicornis Agaricia agaricites, Siderastrea radians, Favia fragum, Montastrea cavernosa, Colpophyllia natans, Diploria strigose* (Goreau, 2018). Also, previous literature confirms that the live cover in the central Caribbean region of Panama is about 15%, and 20-40% around Isla Margarita (Appendix X). Plus, in the coast of Nombre de Dios, a 15 kilometer stretch of coastal fringing reefs demonstrate a healthy state (Guzman, 2003; Goreau, 2018). These living corals are very important and act as barriers creating calm and protected areas where seagrasses and other organisms refuge, feed and reproduce. Corals are indicators of marine ecosystem health since the population of fish is proportional to the coralline area (Goreau, 2018).

Mangroves

Mangrove forests are highly productive ecosystems that provide important ecological and economic services. They play a crucial role in providing sustainable habitat for fauna, safe breeding, nurseries for a diversity of fishes and shellfishes and are the place of refuge for countless life forms. These forests owe their richness from their complex vegetation structures, sheltered beaches and tidal mudflats, that protect the animals and the coast from predators and weather impacts (Zakaria & Rajpar, 2015). Despite their critical ecological and economic significance, mangrove forests are one of the world's most endangered ecosystems (Region & Dow, 2008), and are being lost at a rapid rate because of human development, deforestation, urbanization, conversion into paddy fields and aquaculture ponds, or overharvesting of timber (Zakaria & Rajpar, 2015; FAO, 2007). Interestingly, mangroves typically disappear as per capita GNP increases (Region & Dow, 2008), and Panama, which once had 300,000 ha of mangrove forest

cover but lost 41% of this area from 1960-1988, is an example of that. The rate of mangrove destruction has been highest on the Caribbean coast with a loss of 71% of forest cover, and results from Region & Dow (2008) on the impacts of land cover change on mangroves in the Northeastern Panama Canal Region, show a decline in mangrove forest of 13%, but an increase in port development, storage yard, cleared, and railroad development from 1996-2008. If the rate of decline continues, Region & Dow (2008) predict that a 51% of mangrove forests area will be lost by 2030. These results were attained before the development of the PCCP project and are worrisome since the laws that protect these forests are typically ignored in favor of economic gain (McCall 2005; Region & Dow, 2008).

Specifically, just the area of Colón has presently only 10% of the mangrove forest remaining intact and has continuously decreased since the construction of the Free Trade Zone and the Canal. (Stanley Heckadon, Personal Communication, 2018). Previously in 2007, two companies expanded their container cargo areas in Coco Solo, the Manzanillo International Terminal (MIT) and Colón Container Terminal (CCT), and so converting 69 ha on mangrove forest into shipping container area (Castillo & Croston, 2007; Region & Dow, 2008). The sites also impacted indirectly 29.9 ha of mangrove forest in the protected area of Punta Galeta, since the sites are upstream of the river that provides freshwater to this forest (Region & Dow, 2008). As for the construction area, according to the EIA, it does not present mangroves and only 0.1% of tree cover is present, which does not have any monetary value (Murray & Famania, 2016). Adversely, satellite images, previous studies, and recent drone images show a small area of mangrove forest and some of the organisms (Appendix VII) on the eastern side of Isla Margarita, bordering Punta Galeta Protected Reserve (STRI, 2018; Murray & Famania, 2016).

Seagrasses

Beds of seagrasses appear to be very healthy along the Caribbean coast of Panama, entrance of the canal, and Punta Galeta. Four species of seagrasses were observed in a study led by STRI and a group of scientists: *Thallasia testudium*, *Syringodium filiforme*, *Halophila decipiens*, and *Halodule wrightii*. In the EIA report, the *Halophila baillonis* is mentioned in to be in the area. According to the IUCN red list, this species is endangered but no mitigation measures are presented (Short, 2010; Murray & Famania, 2016).

Results for objective 3: Content of the EIA

Introduction

There are two main reasons motivating our interest for the analysis of the Environmental Impact Assessment for the Panama Colon Container Port project. First, as stated previously, the Centro de Incidencia Ambiental de Panamá (CIAM) opened a legal process to pause the construction activities of the port, considering that some elements of the EIA and its modifications were worrisome for the members of their team and for the scientists from the Laboratorio Marino de Punta Galeta. One of the alarming elements was the fact that the PCCP company announced an error in the amount of sand needed to dredge raised concern. Effectively, as already mentioned, the EIA study approved a volume of 365,000 m^3 but the company actually needs 5,850,000 m^3 of sand (Murray & Famania, 2016). Another reason for CIAM's lawsuit was the absence of biological species affected and ongoing processes from the EIA.

Second, as explained in the literature review section in the introduction, the Panamanian EIA process tends to face some challenges such as the qualification and number of staff, influence from political or economical momentums, or reactive evaluation. Furthermore, as Debyser's & Hoffmann's research enlightened it, the fact that the Colón's local office for the Ministry of

Environment was only responsible for development project of category I leads us to suppose that «people who may know nothing about Colón or the plight of its inhabitants or environment make decisions based on questionable recommendations made within the EIAs» (Debyser & Hoffmann, 2014). Therefore, we grasped a need to analyse the EIA for this development project to detect any important oversight in the process.

EIA content

The chapter two is essentially a summary of all the other chapters, and we will therefore not expand on its content. The chapter three explains that the the category II was chosen for the project because it might have significative environmental impacts, and it explains the methodology of the EIA. Their methods are mostly a field study in order to collect datas of physical (climate, hydrology, air quality, etc), biological (fauna and flora terrestrial and marine), socio-economic, historic, and cultural impacts relative to the construction, operation, and abandonment of the port. It also consists of a module for the participation of the citizens, which is divided in three part: a first consultation consists of workshops with institutions and organizations, a second consultation happens with the citizens of the area affected, and a third consultation is planned through a public consultation after the approval of the EIA (Murray & Famania, 2016).

Chapter four provides superficial informations about the promoter, Panama Colon Container Port Inc, giving juridical number, location, and contact information. Chapter five describes the project work and activity. It gives information about the dimension of the port's several buildings and facilities, the sea bottom area that is needed and the quantity of sand that will be put there, the dimensions of the dredged area inside the breakwater. They assess that the possible environmental impacts generated by these activities could include turbidity because of sediment

suspension, and they precise that the degree of these impacts will depend on the type of material removed. There should not be any need to build new streets, as there is already one that link the sector to the other routes. Since the project will need 500 workers in the stage of construction and 200 workers in the stage of operations, the EIA argue that the port's activity will bring economic activity to the sector by increasing the need for services in the sector (restaurants, taxi, etc.). They assure that they will employ electrical and structural engineers as well as other specialists to supervise the work, that will be hired from the national territory. It estimates up to 7 000 indirect jobs and 1 000 direct jobs (Murray & Famania, 2016).

Chapter six explores the different physical aspects *inside* the project's zone. It assesses that there is no mangroves on that site, and that the sandy bottom has no seagrass, only dead corals. The soil where the project will be built is categorized as non-arable soils with severe limitations that could be suitable for pastures, forests and reserve lands, but that are unsuitable for crops. As it was an military base for the United States, it is classified as a light-industrial zone. The currents in the sectors are said to be going East all year round. As of the noise disturbance created by the construction, within 2 kilometers the predicted disruption would be of 40 dBA, which is considered as non-disturbing for the population. Close to the construction sites, the noise estimation is around 85 dBA. The construction should not create any particular odor (Murray & Famania, 2016).

The chapter 7 considers the biological factors presents in the zone. In the Caribbean of Panama, there are currently four species of marine herbs reported: Thalassia testudinum, Syringodium filiforme, Halodule wrightii Halophila decipiens. However, in the construction zone there is no presence of these species. Regarding tree diversity, we can find real palms, coconut trees, ficus species in the zone. Therefore, within the project site, they state that there are currently no exotic, endemic, or endangered species, since the current vegetation is common. There is a

compensation program that plans the process to evaluate the value of the indemnisation for the cutting of the trees, and the company is asked to plant 10 trees for every tree cut. They attest that there is no marine flora in the area. The mangroves that are found next to the site are planned to be protected through the construction of a wall. The activity at the port are not supposed to affect the fishing activities. The report however acknowledges that boats can bring sediments of different types, can change the salinity of the zone, and bring other organisms (Murray & Famania, 2016).

Chapter eight presents an assessment of socioeconomic elements regarding Colon. In 2010, the city's population was of 241,728 inhabitants with a population density of 52.9 inhabitants per km^2. In 2010, Cristobal's population was of 49, 422 inhabitants. On p. 161 of the report, the data provided by the EIA about the employment rate seem to be inaccurate, since the computation presented in the tables do not work. The median age of the population in Colon is 25 years old, and the unemployment rate in the province is 9.61%. In the region there are currently four ports: *Colón Container Terminal* (Managed by Evergreen), *Manzanillo International Terminal* (Operated by Stevedoring Services of The America), *Panama Port Terminal* (Managed by Hutchinson Whampoa) and *Colon Port Terminal*. There are also two new cruise ports, which are the *Colón 2000* and the *Pier 6* in the port of Cristóbal. The predominant economic activity in the area is industrial commercial sector, transport, and storage. The report finally presents the results from the public's opinion investigation, and in general the people support the construction of the port but ask for an exhaustive Environmental Impact Assessment (Murray & Famania, 2016).

Chapter 9 examines the possible environmental impacts of the port. A table in the Annexe XX summarizes those. As of the chapter ten, which presents the Plan de Manejo Ambiental (PMA), we were unable to find it. The indemnisation are addressed in chapter 11. For every environmental or social cost that will create the project, an indemnisation is planned. The estimated contribution

of the Panama Colon Container Port to the local and regional economic activity through investment is approximately B / 4 405 000.00. Furthermore, the monetary injection in terms of employment should be about B / 2 160 000.00 for the construction part, and it should be of B / 480 000.00 for the operation activities (Murray & Famania, 2016).

The last chapters mostly present the conclusion, bibliography, and annexes.

DISCUSSION

Environmental impacts of the port

Port and urban developments have had negative impacts on the marine and coastal ecosystems in Colon region since the times of Spanish colonization and human disturbance has increased by the construction of the canal starting in 1880 (Guzman et al., 2008). The ecosystems most affected include mangrove forests and coral reefs, which are the main concern since they are not mentioned in the EIA that was carried out for this project and that there is no plan for the mitigation of the impacts from the PCCP (Murray & Famania, 2016). The previous contamination and sedimentation caused by the change in terrain and deforestation has led to the deterioration of the mangrove and coral ecosystems and impacted all the species dependent on their habitats (Panamá, 2010). Therefore, we focus on the environmental impacts on the species of corals and mangroves present just outside the breakwater, around Isla Margarita and Nombre de Dios.

The port activities will increase the turbidity of the water, reducing light for coral growth and increasing the resuspension of pollutants in the mud. The presence of pollution from oil, chemicals and raw sewage in the port will further the areas' degradation (Thomas Goreau, Personal Communication, 2018). The coral reef at Isla Margarita protects the coast against erosion in the

dry windy season. If the corals were to die, then shore erosion will become a serious problem and large, expensive seawalls and breakwaters will be needed to replace the ecosystem services provided by the coral reefs (Goreau, 2017).

Furthermore, dredging 50 km east of the coral reefs in Nombre de Dios will have huge negative impacts on the corals (Goreau, 2018) and large impacts on the economy of the towns along the coast of the bay. Landbridge increased the volume of the dredging 16 times that proposed in the first approved EIA without adapting measures of mitigation. Studies by Dr. Goreau and Dr. Guzman show that the area is composed of some of the most extensive, biodiverse coral reefs in the Caribbean. The new volume of sand dredged of 5,850,000 m^3 will destroy these reefs and seagrasses by increasing turbidity and sedimentation affecting coral and sea growth. This will contribute to the loss of ecosystems for thousands of species (Goreau, 2018). Moreover, dredging will create an extensive gap in the sea bottom, thus eroding the sand from the beaches and destroying the coastal line (Isaías Ramos, Personal Communication, 2018).

Comparatively, distinct impacts will result from the dredging site inside the breakwater. The EIA affirms that the company intends to only dredge once. Nevertheless, adverse effects of erosion need to be accounted for and will require future dredging every few years to keep the depth of the port at the established measure. This procedure will surely increase sedimentation, trigger a cascade of effects throughout the drainage systems of the area, and disturb the life forms (Isaías Ramos, Personal Communication, 2018).

The eastern edge of the island is bordered by mangroves growing on the edge of the central lagoon which is part of Isla Galeta protected area (Wayne Sousa, Personal Communication, 2018). The EIA establishes the building of a wall for the protection of this mangrove forest bordering Isla

Margarita. This management option may seem adequate for the conservation of the forest present on site, but according to Ramos, it will not conserve this ecosystem in the long-term. Throughout the years, the mangrove forest will dry out due to their inability to conduct nutrient and air exchange on the side of the wall, and underground dispersal of chemicals (Isaías Ramos, Personal Communication, 2018). While the construction may not directly affect the reserve of Punta Galeta, increased soil acidification, sedimentation changes and increased pollutants presence are negative externalities of the nearby PCCP (Region & Dow, 2008). Therefore, any clearing or construction by the edge of the lagoon will threaten the ecosystems of the Punta Galeta reserve. High sedimentation load can bury the aerial roots of mangrove trees, clogging the small pores called lenticels. These allow for gas exchange and as the air oxygenates the root rhizosphere, it allows the tree to uptake nutrients. Once buried, the soil becomes anoxic, developing toxic level of hydrogen sulfide, and eventually leading to suffocation (Wayne Souse, Personal Communication, 2018).

It is well known that thousands of species are dependent on mangrove forests, and contribute to water filtration, terrain maintenance and decrease erosion as well as protection the coast, coral reefs, and seagrasses from weather impacts. Moreover, they are important to the society and economy of the region, since they moderate changes in temperature. Plus, they trap air contaminants, which makes them one of the most important carbon sinks in the tropics. They are also an important breeding and feeding site, which is crucial for the fishing industry (STRI, 2018; Cashion, 2013). As 15-24% of Panama's mangrove forests are endangered, additional deterioration threatens to have adverse effects in the country (Cashion, 2013). Mangrove forests also impact the seagrass beds and coral reefs adjacent to them, which rely on their sediment and pollutant filtering services (Region & Dow, 2008) (Appendix XI) .

Although ecological compensation for ecosystem destruction is a requisite for this EIA approval, the loss of the mangrove forest cannot be counteracted by the reforestation of mangrove trees in a different area. CIAM's biologist posits that the trees are usually planted far from the area, and sometimes even in other provinces, since they cannot be planted in the location already developed. It takes decades after being disturbed for mangrove forest to grow back, and ecosystems rarely fully recover (Jean Dow, 2008; Hector Guzman, Personal Communication, 2018).

Socio-economic impacts

First, the port will create direct and indirect employment. In the EIA, it was forecasted that the port would generate 1,000 jobs directly (Murray & Famania, 2016). Nonetheless, in the news it is revealed that the project has employed 240 people up to now, and the estimated number of jobs created over the three years of construction is 800. Furthermore, the EIA projects that the construction phase will generate up to 7,000 indirect jobs, which includes the demand for services like leasing of machinery and tools, food supplying services, and transportation (bus and taxis). During the operation phase, the project anticipates to create 200 direct jobs. Furthermore, the company assures that it will hire electrical and structural engineers from the national territory as well as other domestic specialists to supervise the work. For the construction phase, the monthly salary is planned to be B/.600 per month, which is approximately B/.21/day (Murray & Famania, 2016). This is higher than the national average that is between 1.22 to 2.36 Panamanian balboas per hour (Panama Minimum Wage Rate, 2018), which corresponds to B/.9.76 to B/.18.88 per day. For the operation phase however, the salary is expected to be B/.400, which makes approximately B/.14 per day, which falls in the national average.

This generation of employment is well needed in the area which suffers an unemployment rate of 9.61% (Murray & Famania, 2016). At the moment, it is hard to confirm or invalidate the numbers presented in the EIA, since they are mostly predictions. However, it is certain that such a major project will generate employment in the region, with reasonable salary that are above or equal to the average salary in Panama.

Second, the port's capacity to admit Super Post-Panamax boats should economically benefit Panama as a whole, as it will allow a greater accessibility and better services for these bigger boats in the sector. This project has the potential to boost the revenues of the shipping sector, which is vital to the Panamanian economy. Ramos, from CIAM, reported that China is one of the most important clients of the Panama Canal (Isaías Ramos, Personal Communications, 2018). The construction of this port undertaken by a Chinese company closely linked to the Chinese government is therefore very strategic for the asian country, providing them with better accessibility to the Canal. It should also be economically beneficial for Panama as it will enforce their relation with this important client.

Third, the potential disturbance from the construction and operation activities is evaluated to be null. Indeed, the noise level is planned to be very low and there should not be any strong odors. Moreover, the area is already a port zone, thus it is already the scene of high industrial activity.

On the other hand, attention should be brought to the probable repercussions of the port's demand for sand largely supplied by the dredging activities in Nombre de Dios. This part of the project is not executed by the PCCP itself, but rather by a boat registered in Limassol, Greece. Importantly, this means that all dredging efforts were excluded from the initial EIA (Marine

Traffic, 2018). The boat is taking the sand right in front of Nombre de Dios (Appendix XII), without a concession (Isaías Ramos, Personal communication, 2018). This company is separated from the Landbridge group, since the latter only gave it the mandate of providing a specific quantity of sand for the construction of the port. Legally, this makes the port non-responsible for any damage in the region. However, for the purpose of this report, the effects of these dredging activities will be considered as repercussions of PCCP because without the project, the dredging would not be happening.

For both Hector Guzman and Isaías Ramos, biologists, this part of the project was a very concerning for several reasons. First, the dredging of 5.850.000 m^3 is predicted to have an important impact on the sandy beaches of Nombre de Dios. As explained previously, with the gravity, the sand from the coastal beaches will shift down towards the gap created by the dredging. This will degrade the beaches which represent an important attraction for the tourists, and this could impact negatively the economy of the region. As Nombre de Dios is a rich historical and cultural area, it is important to protect it from economic decline (Isaías Ramos, Personal Communications, 2018; Hector Guzman, Personal Communications, 2018).

Finally, the EIA affirmed that the fishermen would not be affected by this new port (Murray & Famania, 2016). However, with the constant development of Colon's area, the coral reefs and mangroves' health is degrading and their numbers are shrinking, which impacts the the fish population because it is losing nesting sites. As an example of the importance of the mangroves for fish population, it is estimated that "one hectare of healthy mangrove ecosystem produces about 1.08 tons of fish and fishery products per year" (Schitz, 1991). Therefore, a threat to the mangroves might diminish the fish population and, in the long run, could certainly affect the fishermen industry.

Therefore, this project will create many jobs and business opportunities because of its accommodation for Super Post-Panamax, and should not result in a great disturbance for the population. However, it threatens the sandy beaches in Nombre de Dios, and therefore it may impact negatively the economic revenues of the region. The effect on coral reefs' and mangroves' health might also affect the fishermen.

CONCLUSION

Altogether, the present situation in Isla Margarita needs more attention in order to support sustainable development that will benefit the population in the long run. Several elements brought to our attention that the current management might need improvement. First, the process lacks local involvement in crucial decisions that can determine the use of resources in a way that might jeopardize future development. Second, the literature brought to light considerable flaws in the Panamanian EIAs process, such as the lack of knowledgeable staff. Third, the population of Colón manifested its desire for a economic development coupled with environment protection. Consequently, it appeared relevant to investigate the potential environmental effects of this new development project to ensure that the EIA was complete. As the economic development is also an important factor to take into account given the importance of the service sector in the country, it was important to keep in mind the socio-economic effects of the port.

An examination of the dimensions and predicted activities related to the construction and operation of the port was coupled with the assessment of the environmental elements of the affected sectors to provide an analysis of the potential environmental and socio-economic impacts of the port. The use of visual material, the realization of interviews, and the analysis of the EIA and its modification were carried out to achieve this goal.

The conclusion of the analysis is that the construction of the port will have direct and indirect environmental impacts that are worrisome for the future conservation of the area and the Punta Galeta Natural Reserve. The dredging and construction will impact the coral reefs, outside the breakwater, around Isla Margarita, Punta Galeta, and in Nombre de Dios, plus further degrade the mangrove forests in Isla margarita and nearby. The impacts on the corals and mangroves will affect the seagrasses, and all the species dependent on these. The main concern rises from the absence of any mentioning regarding these elements in the EIA, plus a lacking plan for the mitigating these impacts. As of the socio-economic impacts, the port will bring new employment opportunities and will increase the port services in the region, which suggests a boost in the local and national economy. However, the dredging of sand in Nombre de Dios threatens to affect the beaches which are crucial for local economy, and the worsening of the health of corals and mangroves threatens the fishing industry. Therefore, the EIA lacked consideration for both environmental and socio-economic impacts of the port project.

Recommendations

Following the completion of this study and considering the socio-economic and environmental impacts we would like to propose some recommendations for the mitigation of the port's impacts. We recommend for the company to take into account the impacts of future dredging in the canal to maintain the depth. The company plans to only dredge during the construction, but, over the operation, erosion will fill the canal decreasing the depth inhibiting the ships to go by. This threatens to increase sedimentation, and as explained above, it might degrade the ecosystems nearby.

The best way to protect corals would be to prevent sediment from affecting them, while reducing pollution by nutrients. Dr. Goreau suggests that the turbidity formed inside the breakwater can be prevented from getting out to Isla Margarita with silt curtains which are easy to implement (Personal Communication, 2018). To protect the mangroves, a strong monitoring plan should be implemented to ensure the long-term life of the area found in Isla Margarita. Preventing these mangroves from degradation will help conserve those in nearby in Punta Galeta and thus ensure the protection of the coral reefs and seagrasses in the surroundings.

Further from technical recommendations, we want to emphasize the need for transparent and informed consent, as well as community outreach for the processes and impacts of the project. Our field research demonstrated a knowledge gap between the population and the construction of the port. We encourage the company to communicate with the communities around Isla Margarita and the city of Colón, since these populations will be directly impacted.

Lastly, to assure a positive economic impact on the city of Colón, we suggest that a monitoring plan for hiring is established providing the jobs to city locals or from surrounding areas.

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APPENDIX I

Questions presented to the Ministry of environment for written answers

Socio-economic	What is the predicted longevity of the PCCP?
	What will happen when it the operation will end?
	Is there a quota of employees that need to be from the city/province of Colon?
	How much autonomy will the panamanian government have over the project once it will be done? What are the expected economic benefits from it?
Environmental	In the EIA, there is no mention of zones impacted around the PCCP construction, like Punta Galeta or Nombre de Dios. What can you tell us about the biodiversity of these regions and the potential impacts that the port might have on them?
	In the EIA, it is stated that the boats can bring different types of sediments, and this could change the salinity of the one and bring different organisms. Could that have an affect on the organisms that are already present?
	Will an increase in the navigation increase the sedimentation? Could that affect the mangroves and corals?
	How does the indemnization work? Does it follow follow through? Is there money imposition? Whom are they paid to?
	The EIA affirms that for every tree cut, 10 trees will be planted. Is there a reforestation program done for this part of the project? Where would the trees be planted?
	What type of noise can disturb bird activities?
Logistics	What type of energy will be used to aliment the port's activity? From where will it come from?
	What company was responsible for realizing the EIA? Do we have access to other projects they have done?
	Is there public transport in the zone of the construction?
	Will there be additional roads constructed?
	How many years is the contract signed with China?

	In the public opinion investigation realized by the EIA, how much details did the people have about the project before answering the questions?

APPENDIX II

Questions from interview for Dr. Thomas Goreau and Dr. Wayne Sousa

Thomas Goreau

- What is the surface area of corals present in Punta Galeta, Isla Margarita, and Nombre de Dios?
- What could be the potential damages related to the construction of the new port?
- Would it be possible to approximate the number of animal species present in/using the corals in these areas.
- What are the harms of dredging in the area of Nombre de Dios and Isla Margarita?
- Is there any way to protect these ecosystems during the construction and after?

Wayne Sousa

- What is the surface area of mangroves present in Punta Galeta and Isla Margarita, and what could be the potential damages related to the construction of the new port?
- Would it be possible to approximate the number of animal species present in/using the mangroves forest in these areas.
- How many avian species are found in the area?
- Will noise pollution be a major impact on theses species? How could the impact be less harmful (decibel level limits, etc).
- Are there currently any other threats to mangrove cover in the area?
- Is there any way to protect these ecosystems during the construction and after?

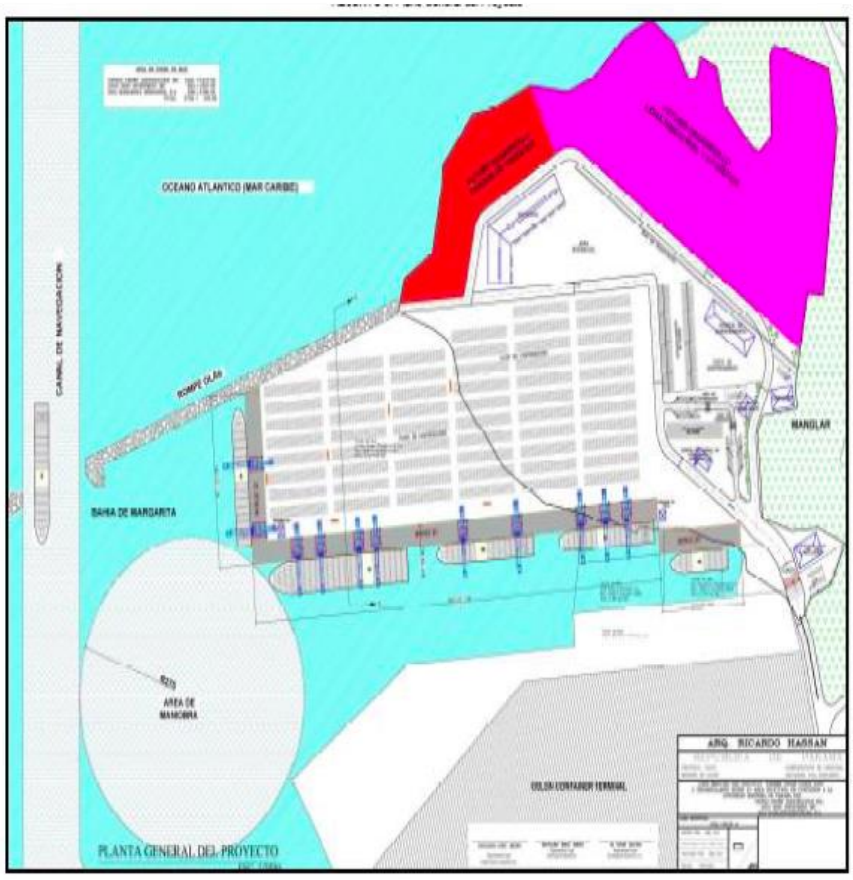
APPENDIX III

Questions from interview to Isaías Ramos from CIAM

- The port has advanced in 30% in construction? What has happened? What will happen?
- How is it permitted to build while there is a lawsuit against the project?
- What are your understanding on the modification of the EIA?
- What is the process of the EIAs?
- Who has the concession of Nombre de Dios?
- Is there an EIA for Nombre de Dios?
- How does ecological indemnisation works and what are the monitoring programs? Are they usually followed through?
- What is the historical influence of China in the country?

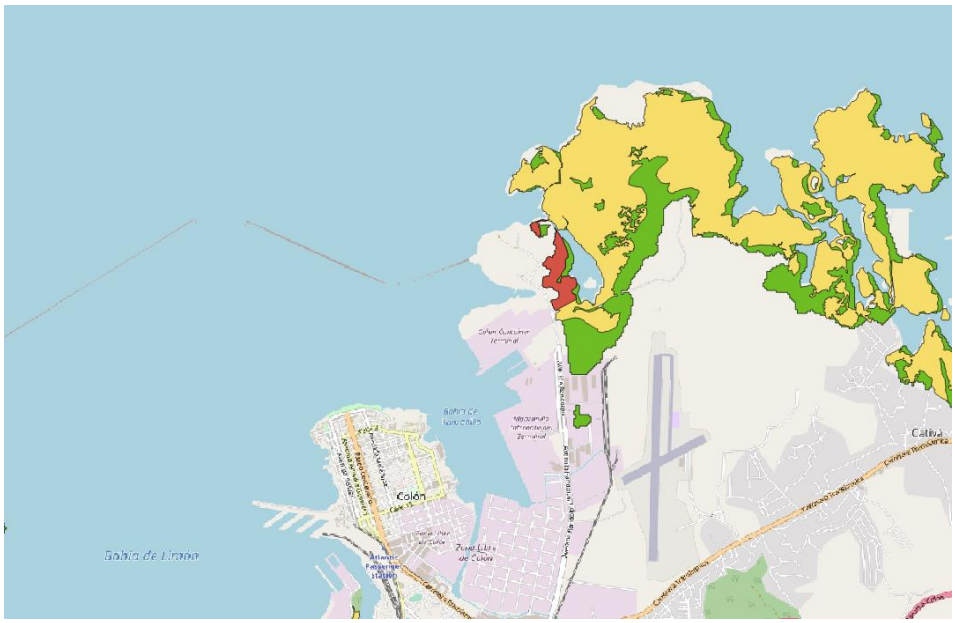
APPENDIX VI

Plans of construction of the PCCP provided by the EIA



APPENDIX V

Map of the mangrove cover in 2000 vs. 2012 of the province of Colón, and the area potentially affected by the construction of the port is 23.54 ha
Green: cover in 2000; yellow: cover in 2012; red: cover at risk



APPENDIX VI

Proofs of the presence of living coral health in Isla Margarita

APPENDIX VII

Drone image of the mangrove forest taken from Punta Galeta taken by Eduardo Estrada. We can attest mangrove presence in a very close proximity.

Isla Margarita, the construction site, is the area circled:

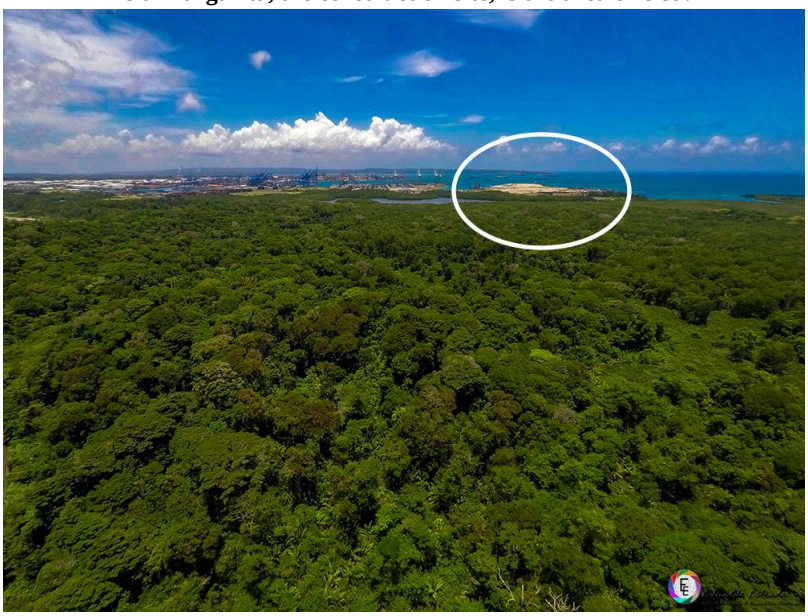
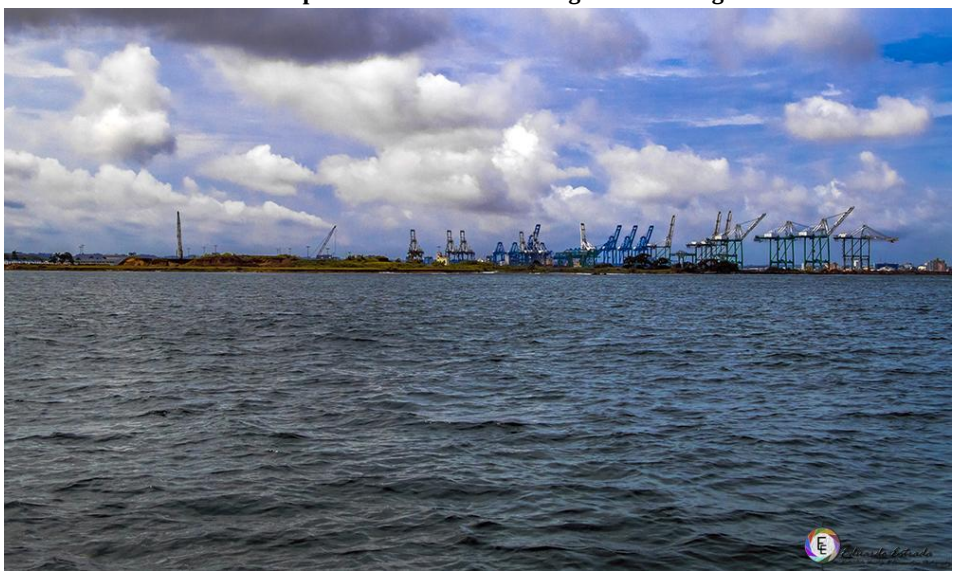


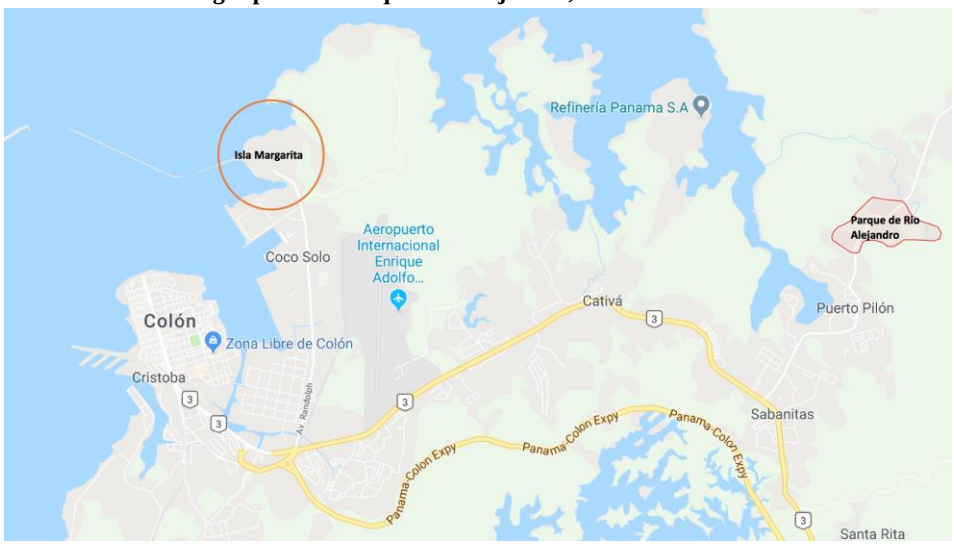
Image of the port's construction site taken by Eduardo Estrada from a boat. The proximity of other ports can be seen to the right of the image.



Examples of the fauna found in the protected area:

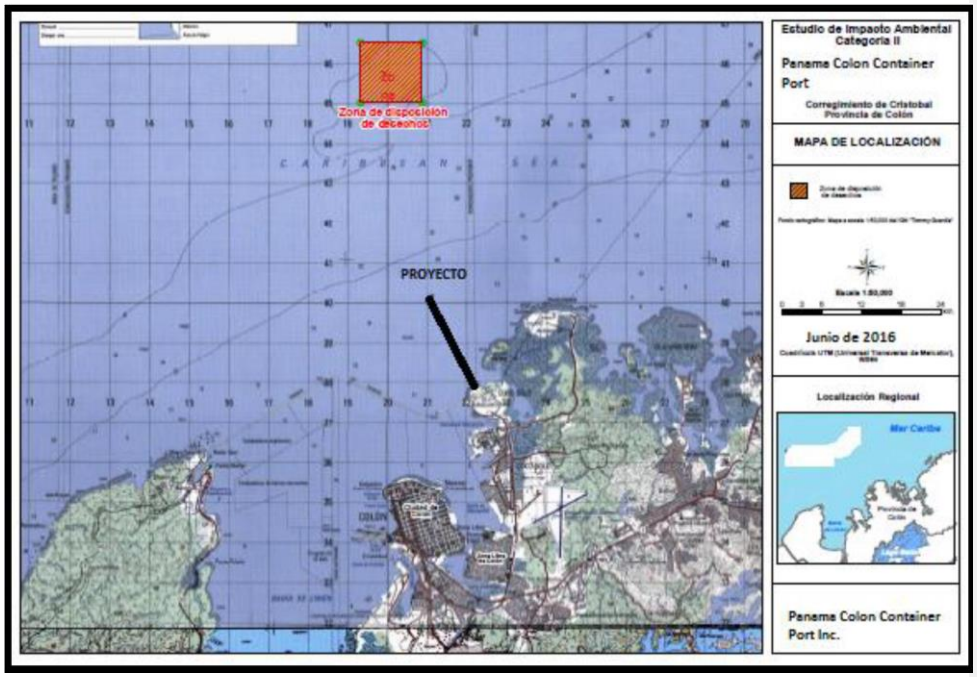
APPENDIX VIII

Location of the second part of the project involving the construction of a liquefied natural gas plant in Parque Rio Alejandro, in Puerto Pilón.



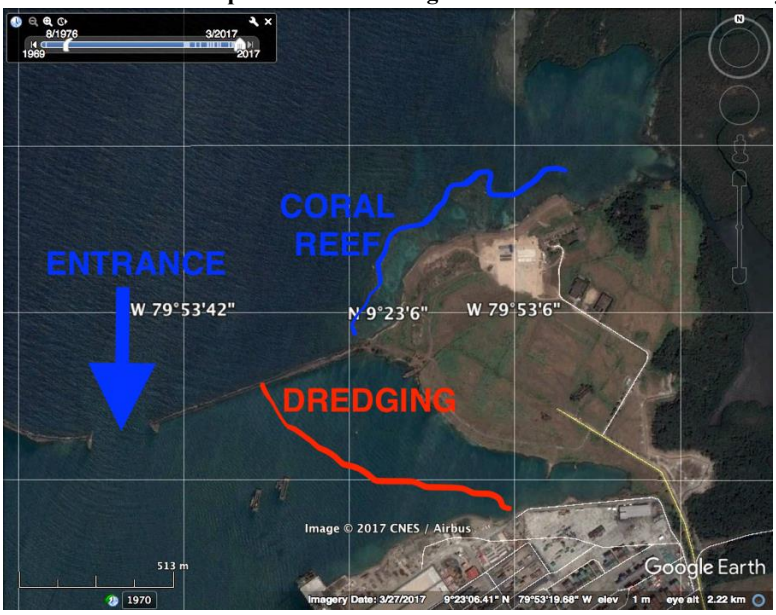
APPENDIX IX

Dredging area under the concession of the AMP provided by chapter 5 of the EIA, 2016.



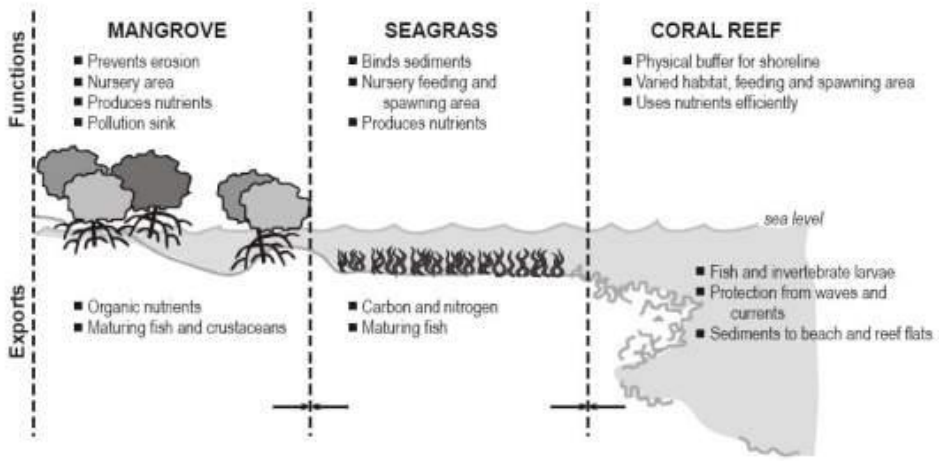
APPENDIX X

Location of coral reefs present in Isla Margarita found in Dr. Goreau's study



APPENDIX XI

Mangrove trees' services



Mangrove forest of Punta Galeta reserve

APPENDIX XII

Route of the Oranje Limassol dredging boat contracted by the PCCP company. The boat travels from Colón to Bahía Nombre de Dios and back.