Unraveling the Roots of Mangrove Governance: Sustainable Management and Evolving Policies in Panama

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August 2021

A thesis submitted to McGill University in partial fulfillment of the requirements of the degree of M.Sc. Renewable Resources – Neotropical Option

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Abstract

Mangrove forests fulfill essential socio-ecological roles, such as providing timber and other forest products, protecting coasts against erosion and rising sea levels, supporting healthy fisheries, and fostering biodiversity. Within Latin America, Panama has experienced the highest rates of mangrove deforestation since 1980, despite the inclusion of a large extent of their mangrove forests in the National System of Protected Areas. Reasons reported for mangrove loss include noncompliance with regulations, limited multi-actor coordination, limited public awareness of mangrove ecosystem functions, and growing trends of coastal development for industrial and commercial purposes. In response to these types of pressures, sustainable mangrove management (SMM) has emerged as an international policy objective, aiming to address mangrove degradation and empower all relevant stakeholders to participate in governance processes. This thesis aims to contribute to SMM scholarship, focusing on the challenges and opportunities associated with mangrove management in Panama. It begins with a literature review covering SMM approaches, associated regulatory frameworks, and recurrent policy gaps related to mangrove forests in Latin America, as well as in Panama more specifically. An exploratory case study of the protected mangrove forest ecosystem of Punta Galeta, located on the Atlantic coast of Panama, is then presented to better understand the extent to which international SMM principles can be applied to a local mangrove management context. Findings suggest that SMM could benefit from a greater focus on strategies to enhance communication, collaboration, and trusting relationships between diverse stakeholders, as well as from a more cohesive vision for the sectoral uses of coastlines. Building on these findings, an analysis of Panama's mangrove-specific policies is combined with insights drawn from key informant interviews with national-level mangrove policy actors to better understand the structural gaps and policy challenges. From the overlapping jurisdictions to competing management perspectives (conservation versus development), mangrove policies were found to be contradictory and fragmented. Potential SMM strategies to overcome these policy challenges are discussed, and future research needs identified.

Résumé

Les forêts de mangrove remplissent des rôles socio-écologiques essentiels : fournir du bois et autres produits forestiers, protéger les côtes contre l'érosion et l'élévation du niveau de la mer, soutenir les pêcheries et promouvoir la biodiversité. En Amérique latine, le Panama a connu les taux les plus élevés de déforestation des mangroves depuis 1980, malgré l'inclusion d'une grande partie de ces forêts dans le Système National d'Aires Protégées. Les raisons signalées de cette perte d'habitat naturel comprennent le non-respect des réglementations, une coordination multi-acteurs limitée, une mécompréhension du public par rapport aux bénéfices de ces forêts et les tendances croissantes de développement côtier à des fins industrielles et commerciales. En réponse à ces types de pressions, la gestion durable des mangroves (GDM) est devenue un objectif politique international, visant à lutter contre la dégradation des mangroves et à donner à toutes les parties prenantes concernées les moyens de participer aux processus de gouvernance. Ce mémoire vise à contribuer à la littérature sur la GDM en se concentrant sur les défis et les opportunités associés à la gestion des mangroves au Panama. Le mémoire commence par une revue de la littérature couvrant les différentes approches de GDM, les cadres réglementaires associés et les lacunes politiques récurrentes liées aux forêts de mangrove en Amérique latine, ainsi qu'au Panama plus spécifiquement. Une étude de cas exploratoire dans la forêt protégée de Punta Galeta, située sur la côte atlantique du Panama, est ensuite présentée pour mieux comprendre dans quelle mesure les principes internationaux de GDM peuvent être appliqués à un contexte de gestion locale des mangroves. Les résultats de ce mémoire suggèrent que la GDM pourrait se pencher sur des approches liées à la gouvernance collaborative entre les diverses parties prenantes, ainsi que sur une vision plus cohérente des utilisations sectorielles des côtes. Sur la base de ces résultats, une analyse des politiques spécifiques aux mangroves du Panama est combinée avec des entrevues d'informateurs clés sur le sujet des politiques nationales liées aux mangroves. Celles-ci permettent de mieux comprendre les lacunes structurelles et les défis politiques du Panama. Depuis les juridictions qui se chevauchent jusqu'aux perspectives concurrentes de gestion (conservation contre développement), les politiques liées aux mangroves se sont avérées contradictoires et fragmentées. Les stratégies de GDM potentielles pour surmonter ces défis politiques sont discutées et les futurs besoins de recherche identifiés.

Acknowledgments

I would like to thank my supervisor Dr. Gordon Hickey. From the first time we met, he had a head full of ideas and a full research toolbox to attain these. His noticeable enthusiasm for mangrove forests was contagious. Thank you for taking me along this fantastic research journey!

I am also grateful to my co-supervisor Stanley Heckadon-Moreno. He ensured that I understood the social, political, and historical context of the Colón region and insisted that I learned to speak "like a true *Colonense*". His transformation of the Punta Galeta research station as a hub for environmental education, amidst immense industrial pressures, was truly impressive.

While I was in Panama, I was lucky to count on the support of several people. The staff at the Punta Galeta station immediately made me feel at ease and went out of their way to help me out. I especially want to thank my research assistant, Gabriel Thomas Estrada, for his friendliness and support during the twists and turns of our fieldwork. I also counted on fellow students Alexis Heckley, Ilse Esparza, Helio Quintero, Julia Briand, MK Hickox, and Charlotte Steeves. Thank you, NEO students, for making my stay so memorable, for our impactful field trips, and for always saving your couch for me during my frequent visits to Panama City. I had a blast!

Back at McGill University, I would like to thank my labmates in the Sustainable Futures Lab: Oacia Fair, Nathan Badry, Tian Qi Che, Elson Galang, Dane Pedersen, Imogen Hobbs, Samantha Darling, Vivian Arguelles Gonzalez, Dr. Ashlee Pigford, Dr. Arlette Saint-Ville, and Dr. Rens van der Vegt. Thank you for teaching me what graduate studies are about and for always being willing to lend a hand. I could not have dreamed of joining a more supportive lab.

As an unapologetic tree-hugger, I wanted to at least acknowledge the beauty of the mangroves. As a Quebecer, I had not been in these forests before. I saw them teeming with life, full of noise, color, and shy creatures. I was awestruck and felt compelled to write about them.

Les derniers mais non les moindres, merci à mes amis et à ma famille. Un merci tout spécial à Walid et Marianne pour leur infini support et leur douceur. Et un merci final à ma mère, Patricia, pour m'avoir inculqué, très jeune, son amour délicat envers les plantes. Il y a un peu de toi dans ce mémoire.

Thesis Style and Contribution of Authors

This is a manuscript-based thesis containing four main chapters. Chapter 1 contains a general introduction, research objectives, general research methods, while Chapter 2 presents a brief literature review covering opportunities for sustainable mangrove management and associated policy challenges. Building on the literature review, Chapter 3 presents an exploratory case study on sustainable mangrove management on the Atlantic coast of Panama in the forests of Punta Galeta. Chapter 4 focuses on national policies addressing mangrove ecosystems in Panama, combined with key informant perspectives on policy implementation and potential gaps. Chapters 3 and 4 will be submitted for publication as standalone research papers in scientific journals. Chapters 5 and 6 conclude the thesis with a general discussion and future research directions. Due to the manuscript-based format, there may be some unavoidable repetition across different sections and references.

I am the lead author for all of the thesis chapters. Dr. Gordon Hickey, my supervisor, is a co-author on Chapters 3 and 4. Dr. Heckadon-Moreno, my co-supervisor, as well as my research assistant, Gabriel Thomas Estrada, are co-authors on Chapter 3. Dr. Hickey assisted me with conceptual framing, research design, interpretation, and editing on Chapters 3 and 4. Dr. Heckadon-Moreno assisted with conceptual framing and research design, while Mr. Thomas Estrada helped with data collection and interpretation.

Chapter 1 – General Introduction and Methodology

"I saw its periscope in the tide;
its torpedo-seed seeking the soft side
of the island, the grey mud-bank.
And, where it touched, it seemed the land sank
with its tree exploding from water; the green
mangroves' fountainhead of leaves bursting, seen
like a mushroom-top of detritus and spray. […]"

- John Blight, "Mangrove", 1954

1.1 Introduction: The Need for Sustainable Management of Mangrove Forests

Mangrove forests are a unique ecosystem adapted to saline intertidal environments. Although accounting for less than one percent of the tropical forest area worldwide, mangroves provide critical ecological roles, such as climate regulation, biofiltration, and coastal protection against storms and erosion (Duke et al., 2014). They also support the livelihoods of many people by strengthening food security and by providing seafood, timber, and other important forest resources (Van Lavieren et al., 2012). In coastal villages, case studies have revealed that mangrove resources act as a safety net for poorer communities, providing food and resources when other income streams fail (Glaser et al., 2003; Sarntisart & Sathirathai, 2004). Despite their social and ecological importance, mangrove forests are being relentlessly cleared and degraded. From 1980 to 2000, five million hectares of mangrove forests have been lost globally, which amounts to 25 percent of the total mangrove area in 1980 (FAO, 2007). Far from being constrained to specific regions of the world, mangrove loss is a global problem. Mangroves are found in 123 countries, nearly all of which have experienced extensive and rapid mangrove loss, at a rate three to five times greater than the average rate of forest loss (M. Spalding et al., 2010).

Under these circumstances, effective and sustainable management of mangrove forests is much needed. Sustainable forest management (SFM) emphasizes meeting multiple needs and objectives without degrading a forest resource, while also relying on accountable governance and

safeguarding the rights of forest-dependent peoples (ITTO, 2016). Yet little is known about how SFM is applied to the management of mangrove forests, which face specific threats and have a distinctive ecology. Mangrove forests are a challenging ecosystem to manage because they involve both marine and terrestrial resources and fall under overlapping governmental jurisdictions (Nunan, 2018). They are variably associated with plans and policies related to forestry, fisheries, coastal zones, the environment, and tourism (Nunan, 2018). In addition, a plethora of rules at the international, national, provincial, and local levels apply to mangrove protection and conservation (Bandaje et al., 2017). In a review of international case studies on mangrove management by Rotich et al. (2016), poor mangrove management was linked to weak cross-sectoral coordination, competition amongst agencies, and a lack of enforcement of established mandates. These findings outline management challenges but also raise questions on how to enhance the sustainability of mangrove management, which this thesis also aims to explore.

1.2 Research Questions and Objectives

The overarching objective of this thesis is to understand the challenges and opportunities associated with sustainable mangrove management (SMM) and related policies in Panama. Panama is an ideal site to study mangrove governance because of its extensive mangrove forest coverage – the largest in Central America – and, conversely, its growing trend of habitat loss and reported cases of problematic management (Suman, 2014; Tarté, 2013). To help address my broad objective, two more specific research questions were identified:

1. How could stakeholders better collaborate to enhance the sustainability of mangrove management in Punta Galeta (Panama)? (Chapter 3)
2. To what extent do national policies and policy actors address emergent challenges in the sustainable management of mangroves in Panama? (Chapter 4)

In Chapter 3, the first research question is addressed through an exploratory case study in the endangered forests of Punta Galeta, near the city of Colón. The case study analysis was based on key measures of sustainable mangrove management developed through the Bali Call to Action, an international policy framework on mangroves (ISME et al., 2017). Using key informant interviews from a diverse array of stakeholders, concurrent perspectives on mangrove management were gathered to assess the extent to which mangrove management was considered inclusive, collaborative, and effective in terms of addressing habitat degradation. The second research

question is examined in Chapter 4, where the legal and regulatory status of mangrove forests are described from the 1970s until current developments. Policy analysis is applied to understand how already known policy challenges (coordination, overlapping jurisdictions, contradictory coastal development priorities) are being addressed or perpetuated. In addition to policy data, key informant interviews with national policy actors are used to gather insights on structural and operational constraints and capture 'insider' perspectives on policy challenges.

1.3 General Methodology

1.3.1 Case Study Research

Chapter 3 seeks to better understand the challenges of sustainable mangrove management in Punta Galeta Panama through an exploratory case study. Case study research can be defined as "an empirical method that investigates a contemporary phenomenon (the 'case') in depth and within its real-world context, especially when the boundaries within the phenomenon and context may not be clearly evident" (Yin, 2018, p. 45). In other words, case studies investigate complex phenomena by examining multiple sources of evidence, as well as interactions between a bounded context and a unit of analysis (Baxter & Jack, 2008; Gerring, 2007). According to a typology of the case study by Thomas (2011), case studies must comprise two elements: a practical unit (whether it is individuals, programs, institutions, policies, processes) that represents the *subject* of the case study, in addition to an *object*, the analytical or theoretical frame within which the study is conducted. Subsequent methodological steps are based on the purpose of the case (intrinsic, instrumental, exploratory, evaluative), the analytical approach (theory-testing, theory-building, illustrative/descriptive), and further data collection techniques and methods (Thomas, 2011). An *exploratory* case study is useful in contexts where previous research is limited, and research aims to develop pertinent hypotheses and propositions for further inquiry (Baxter & Jack, 2008; Yin, 2018).

Case study research is well-suited for addressing our study question, whereby, first, social context is relevant to the phenomenon under study: mangrove management in the industrial landscape of Punta Galeta; and second, experimental manipulations are not appropriate (Crowe et al., 2011; Feagin et al., 1991). Case study methods have been previously employed to study mangrove management in a variety of contexts, including in India (DasGupta & Shaw, 2017; Dev

Roy, 2012), Indonesia (Damastuti & de Groot, 2017), El Salvador (Gammage et al., 2002), and Ecuador (Félix & Hurtado, 2019; Tanner et al., 2019). Our approach is exploratory because it aims to analyze a relatively new context in mangrove management, in which stakeholder interactions and sustainable mangrove management principles remain undocumented. The exploratory purpose of our research allowed us to adopt a more flexible and open-ended design, as we planned for unanticipated themes to emerge during data collection and analysis (Yin, 2018).

Case studies face criticism due to their flexibility and applicability to a variety of fields which may lead to a loss of rigor, or a "methodological limbo" state (Thomas, 2011). To counter this effect, we first ensured that our research objectives, sampling strategy, research design, and data analysis were internally consistent and coherent (Baxter & Jack, 2008). For instance, since the purpose of the case was to explore a new area of research, it would not be appropriate to attempt to explain social phenomena. Furthermore, many strategies have been developed to enhance trustworthiness and reduce the sources of bias in case study research. We relied on triangulation between different informants, as well as between different methods (interviews, participant observation, focus group) as a first strategy to build credibility and reliability (Baxter & Jack, 2008). Field journaling, peer examination of data and interview guides, and prolonged field exposure were also central to our research design (Baxter & Jack, 2008). More detailed information on methodology and study limitations can be found in Chapter 3.

1.3.2 Combined Policy Analysis and Thematic Analysis

Chapter 4 seeks to understand the emergent policies that govern mangrove forests in Panama through a 'hybrid' approach combining a policy analysis and thematic analysis. Policy analysis can be defined as the "study of the action of public authorities within society" (Mény & Thoenig, 1989, p. 9). More specifically, this study investigates forest policy, which exists at the confluence of public policy and the forestry sector (Krott, 2005). According to Krott (2005): "*Policy-making is a social bargaining process for regulating conflicts of interest. Forest policy is that social bargaining process which regulates conflicts of interest in utilizing and protecting forests according to the programs of the forest sector*" (p. 12). Forest policies can thus be analyzed by looking at forestry aspects (forest area, damage, degradation, etc.), as well as users, owners, interests and conflict, regulatory instruments, or the role of the state (Krott, 2005).

Currently, in Panama, there are numerous policies targeting mangrove forests (see A. K. Spalding et al., 2015; Suman, 2002; Tarté, 2013). We therefore employ a hybrid approach combining policy analysis and a thematic analysis similar to A.K. Spalding et al.'s approach (2015). This is similar to Srivastava & Thomson's (2009) applied policy research method, in that interview data are used to generate recommendations regarding a policy issue. Our data comprises both national policy documents (laws, decrees, Ministry guidelines) and semi-structured interviews with governmental managers and policy practitioners. Thematic analysis was based on mangrove policy challenges identified by Friess et al. (2016), as well as findings outlined by A. K. Spalding et al. (2015). Our approach had a "strategic" orientation (Srivastava & Thomson, 2009), as we identified avenues for policy improvement and new strategies, especially at the stage of policy implementation. More detailed information on methodology and study limitations can be found in Chapter 4.

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Preface to Chapter 2

Chapter 1 outlines the challenge of enhancing the sustainability of mangrove management globally. To better understand the context and priorities around sustainable mangrove management (SMM), Chapter 2 presents a literature review of SMM to identify how different institutions approached the topic and what can be learned from management practices in Latin America. It also discusses recurrent structural gaps and outlines the need for further research to understand how best to address mangrove management challenges.

Chapter 2 – Literature Review

2.1 A History of Sustainable Mangrove Management Through International Institutions

As mangroves have increasingly been recognized for their importance to coastal ecosystems, several international organizations have set the building blocks for their sustainable management. Arguably, the first international institution to become involved in mangrove management and conservation was the Ramsar Convention on Wetlands of International Importance, signed in 1971 in Iran. The Ramsar Convention is the pioneering international treaty on the "conservation and wise use of wetlands", which include mangrove forests (Ramsar Convention, 2014). This resulted in 171 signatory countries designating at least one wetland in their territory for addition to the list of Wetlands of International Importance and agreeing to preserve its ecological characteristics (Ramsar, 2014; Suman, 2019). Today, the list of Wetlands of International Importance comprises 2,331 sites, totaling 2.1 million square kilometers of wetland area (Finlayson & Davidson, 2018). The Ramsar Convention also developed management guidelines outlining several important elements: 1) preserving site-specific ecological and hydrological functions of wetlands; 2) promoting restoration for degraded wetlands; and 3) attaining the full participation of relevant stakeholders in management processes (Ramsar Regional Center – East Asia, 2017). Signatory countries have access to resources and support to attain their wetland management objectives, such as grants, scientific advising on management plans, capacity-building programs for wetland managers, and public education programs (Ramsar Convention, 2014). In Panama, policy actors related to the Ramsar Convention, such as the Ramsar Regional Center for Training and Research for the Western Hemisphere (CREHO), are among the most active and impactful concerning mangrove management (Ministerio de Ambiente & PNUD, 2018).

In 1994, the Food and Agriculture Organization (FAO) of the United Nations (UN) published the first management guidelines specific to mangroves. These guidelines mostly focused on silviculture, as they detailed the choice of a silvicultural system, pest control, yield regulation, harvesting, and extraction of resources (Food & Agriculture Organization & United States Forest Service Tropical Forestry, 1994). Yet a chapter was dedicated to framing the concept of sustainable mangrove management, defined as following: "*the application of biological, managerial, technical, economic and social knowledge, and manpower resources to manage the use of mangrove resources in a way that will provide sustainable benefits to the greatest number of*

people without impairing the environment." (Branch & Program, 1994, p. 142). To achieve that objective, the FAO made several recommendations, such as developing integrated management plans for multiple goods and environmental services and promoting the public participation of communities living near mangroves (Branch & Program, 1994).

These recommendations were subsequently extended by the International Tropical Timber Organization (ITTO), who pioneered the development of criteria and indicators for sustainable tropical forest management, which includes mangrove management (International Tropical Timber Organization, 2002). ITTO's criteria include good governance, indigenous rights, and institutional frameworks that foster sustainable forest management. ITTO emphasizes that forest governance should rely on strengthening local institutions and promoting appropriate financial resources, securing forest tenure, and undertaking extensive collaborations with local and indigenous communities (Blaser, 2016). ITTO's definition of sustainable forest management (SFM) will be used throughout this thesis, as follows: "*SFM involves the application of the best-available practices based on current scientific and traditional knowledge that allow multiple objectives and needs to be met without degrading the forest resource. SFM also requires effective and accountable governance and the safeguarding of the rights of forest-dependent peoples*." (Blaser, 2016, p. 11)

The International Society for Mangrove Ecosystems (ISME) has also developed management guidelines specific to mangroves (ISME & ITTO, 2004). These guidelines have taken a more science and conservation-oriented approach, as ISME identifies mangrove mismanagement as being a direct result of a lack of ecological data on, and monitoring of, mangrove forests (ISME & ITTO, 2004). In terms of practical measures and guidelines, ISME recommends instituting strict no-use zones alongside sustainable use zones, supporting community stewardship, and prohibiting the clearing of mangrove areas for commercial and industrial purposes, such as for aquaculture (ISME & ITTO, 2004). To implement these objectives, ISME is also involved in funding conservation projects, environmental education initiatives, and research on mangrove ecosystems, which are often focused on the restoration of mangrove sites (Ong & Gong, 2013).

These institutions have shaped sustainable mangrove management at the global level, as can be seen in the inclusion of many of the abovementioned principles in many national mangrove management plans (Slobodian & Badoz, 2019).

2.2 The Need for Sustainable Mangrove Management in Latin America

Latin America is home to abundant mangrove forests, which have considerable importance for artisanal and commercial fisheries, nature-based tourism, shellfish, and South American timber (M. Spalding et al., 2010). Similar to worldwide trends, mangrove cover is declining in Latin America and several mangrove species are threatened. Costa Rica, Colombia, and Panama have the highest proportion of threatened mangrove species in the world, with 25-40% species classified as threatened under the IUCN Red List (López-Angarita et al., 2016). While many countries in Latin America have mangrove management plans and strive to preserve this ecosystem, the implementation of sustainable mangrove management can be challenging.

A recurrent strategy to manage mangroves in Latin America is the use of protected areas. Many countries have a high proportion of mangrove forests placed in protected areas, such as Panama (51.9%), Brazil (roughly 60-70%), and Costa Rica (58.7%) (Borges, 2019; López-Angarita et al., 2016). However, protected areas have been found to lack enforcement. For instance, in the Amazonian mangrove forest of Northern Brazil, the protection granted to mangroves is composed of sustainable use areas, a category considered to deliver low levels of protection because of its lack of enforcement (Borges, 2019). Despite their protected status, many areas still lack a management plan, as well as documentation on forest governance structures (López-Angarita et al., 2016). Further, mangroves are still degrading and downsizing due to a political and economic landscape that favors resource use and development over environmental protection and a lack of observance of legislation (Borges, 2019).

In law, efforts to protect mangroves in Latin America began in 1866 in Puerto Rico with the enactment of the Law of Ports, which established a maritime-terrestrial zone (including mangroves) as part of the public domain (Pizarro et al., 2004). In subsequent years, other countries began to enact laws to manage mangroves: Costa Rica in 1884, Cuba in the 1920s, Panama in the 1960s (Pizarro et al., 2004; Tarté, 2013). In the 1970s and 1980s, a series of regulations granted further protection to mangroves, in response to the greater deforestation rates being associated with the development of shrimp farming (Pizarro et al., 2004). Currently, many Central American countries have a legal framework that limits destructive actions to mangroves, yet the ability to exercise controls and apply the law can be insufficient (Pizarro et al., 2004). For instance, in El Salvador, protection laws are considered unclear and indirectly promote deforestation:

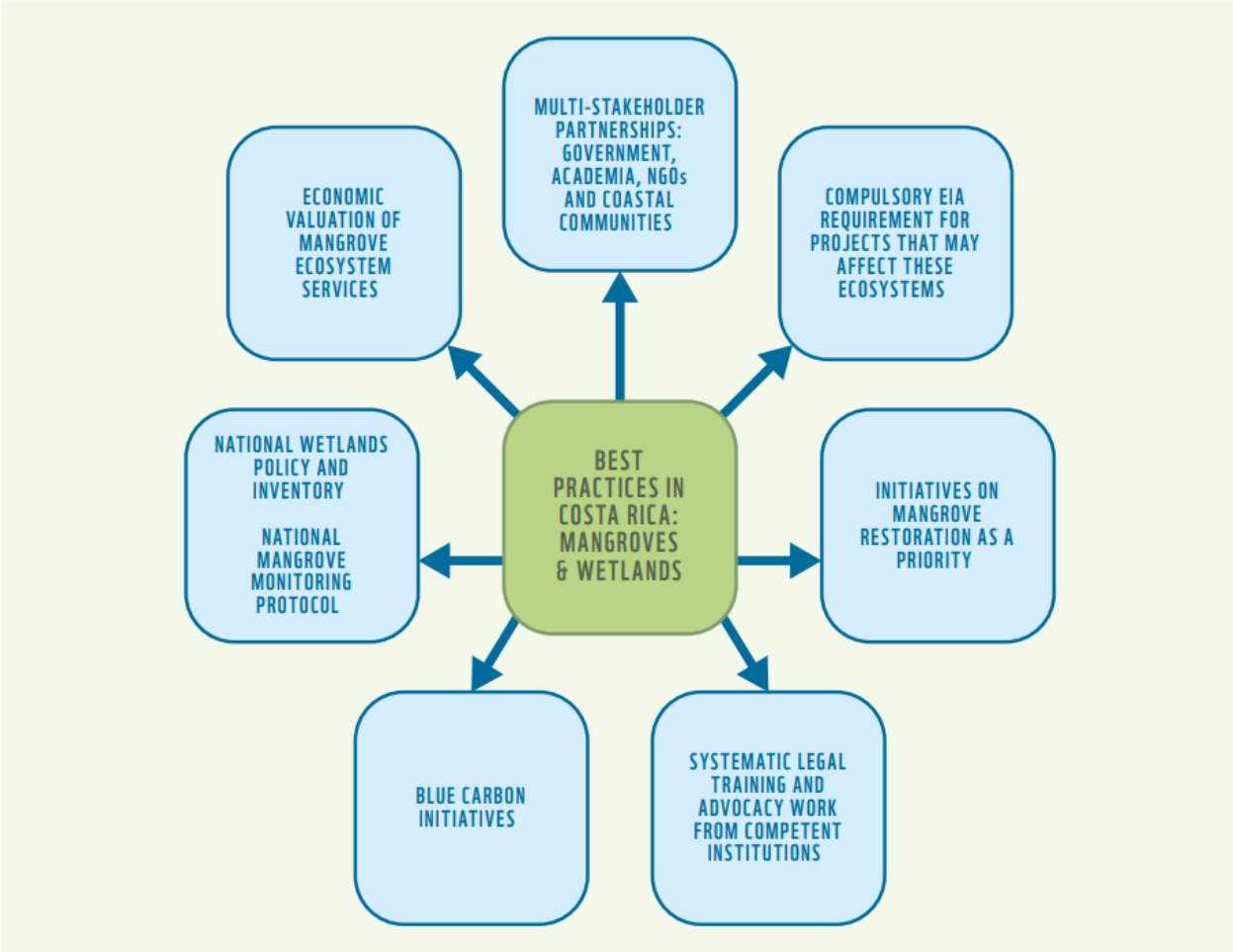
> "*The mangroves are defined in the current environmental law as 'ecological reserves in which no alteration will be allowed' […] Unfortunately, the concept of an 'ecological reserve' is not adequately defined in the environmental law, and no guidelines have been set for how such a reserve can be managed. Although the controlled extraction of mangrove timber and fuelwood is not permitted under the current environmental law, it is permitted under the existing forestry law. With both laws active, it is uncertain which takes precedence*." (Gammage et al., 2002, p. 292)

Similar circumstances have also been reported in Panama, where mangrove protection laws and the establishment of protected areas are in place but competing uses of mangrove forests are dominant. A system of permits and payments for land conversion is in place to allow for development to occur in coastal areas (Suman, 2019): "*What appears at first blush to be a highly protective regulatory scheme has eventually evolved into an increasingly lenient payment structure for allowed conversion of mangrove forests*" (Suman, 2019, p. 1070). Panamanian mangroves are mostly managed under the public domain, although the Constitution allows for private ownership of mangroves (Suman, 2019).

In Costa Rica, legal protections covering mangrove ecosystems are stricter, as mangroves "*are considered to be in the public domain and, consequently, they are inalienable and imprescriptible, and cannot be the object of occupation under any title*" (Slobodian & Badoz, 2019, p. 65). The National Wetlands Policy outlines five key areas for action: conservation of wetlands in protected areas, quantification of ecosystem services, rehabilitation of degraded wetlands, institutional strengthening, and inclusive participation (see Figure 2.1) (Slobodian & Badoz, 2019). Yet policies are not being implemented in full, partly due to a lack of financial resources, lack of coordination in multi-stakeholder partnerships, and administrative barriers (Slobodian & Badoz, 2019).

Figure 2.1 Best Practices in Mangrove Management in Costa Rica

(Retrieved from Slobodian & Badoz, 2019, p. 83)



In addition to legal frameworks, law enforcement can also be problematic. In Mexico, for example, poaching and illegal deforestation threaten the integrity of mangrove ecosystems, while law enforcement suffers from structural barriers in maintaining recurrent patrols (Carmona-Díaz et al., 2004). There is also evidence of persistent infractions in El Salvador, whereby wealthy landowners can illegally convert forests to other uses and evade prosecution (Gammage et al., 2002).

A different mangrove management model can be found in Ecuador, where there is less focus on strict conservation measures, law enforcement, and no-take zones. In 1999, the

government of Ecuador established a strategy to include local communities in mangrove management. This was done amidst trends of mangrove conversion to shrimp farming, which occupied a growing number of concessions (Bodero & Robadue, 1995). Local fishing associations can request a "Sustainable Use and Mangrove Custody Agreement", which is a form of community-based mangrove management guaranteeing exclusive access to the mangroves (Félix & Hurtado, 2019). Communities develop a management plan and are accountable for forest integrity, implementation of the management plan, reforestation, and participating in monitoring and evaluation jointly with the regional environmental authority (Coello et al., 2008). Although collaboration with local authorities for technical assistance and strengthening of community institutions may be challenging, many positive markers of this program have been brought to light by evaluators (Félix & Hurtado, 2019). Living conditions were reported to have improved, with socio-economic benefits being derived from mangrove resources, mangrove cover slowly recovering, and management plans showing progress (Félix & Hurtado, 2019). This initiative nicely illustrates the potential of participatory approaches to enhance the sustainability of mangrove management and generate benefits for local users. Some comparable potential has also been found in environmental education programs, which are widely used in Mexico as a strategy to raise awareness for future mangrove users about the benefits of this ecosystem, although data is lacking to evaluate long-term impacts (Carmona-Díaz et al., 2004; Linares Mazariegos et al., 2016).

2.3 Sustainable Mangrove Management Performance

Despite the existence of numerous effective policy tools and management approaches for sustainable mangrove management, their field application is often challenging. A review of international case studies by Rotich et al. (2016) revealed that mangrove management performance is hindered by several challenges: 1) overlapping jurisdiction and a lack of coordination among government agencies responsible for mangroves; 2) failure to recognize customary practices of management in local communities and insecure land tenure; 3) lack of enforcement of laws and policies on mangrove protection; and 4) failure to engage in multi-stakeholder partnerships involving non-government organizations (NGOs), international organizations, and community-based management systems.

Most laws and policies are not developed specifically with mangroves in mind; therefore these challenges often remain unaddressed (Rotich et al., 2016; Slobodian & Badoz, 2019). Mangrove management is context-specific and requires careful attention to local specificities. In a review of conflicting policy objectives in mangrove conservation in Southeast Asia, Friess et al. (2016) described many context-specific challenges that can hinder performance. A lack of coordination between governmental agencies is a recurring theme across countries, as responsibilities can be ill-defined and sometimes conflicting. Donors and permit-granting agencies can favor development projects (e.g. aquaculture or real estate), while central state policies promote conservation and community access to forest resources (Friess et al., 2016). To address this complexity, mechanisms, and frameworks to enable multisectoral and multi-level coordination are necessary. Yet these mechanisms are uncommon, and where they exist, they are difficult to put into practice (Cann, 2018). Incentive structures, internal motivation, and mutual trust have been reported as lacking in collaborative mangrove management contexts and have hindered coordination objectives (Partelow et al., 2018).

2.4 Supporting Factors and Conditions

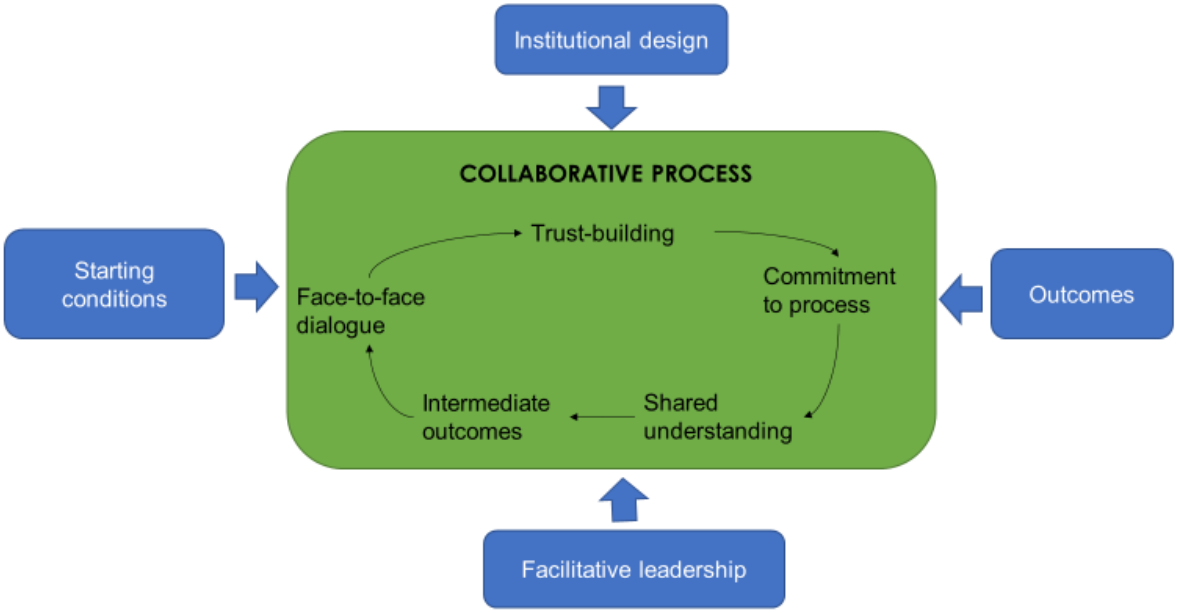
In the face of performance-hindering issues such as a lack of coordination and overlapping jurisdictions, collaborative governance offers the potential to strengthen mangrove management. As argued by Djosetro & Behagel (2020), collaborative processes can be sought through multiple avenues, including the starting conditions, institutional design, and facilitative leadership (see Figure 2.2).

Starting conditions (basic levels of trust, conflict, social capital, suspicion) can facilitate or discourage cooperation, but a careful institutional design can effectively build the ground rules that foster subsequent collaboration:

> *"These include rules about who should be included in this collaborative process, the organization of transparency, the formalization of governance structures, the setting of realistic deadlines, and consensus-oriented processes... Differences in perspectives and knowledge are inputs for the process of deliberation which is important when dealing with problems of multiple and competing objectives"* (Djosetro & Behagel, 2020, p. 2)

Figure 2.2 Collaborative Governance Model

(Adapted from Djosetro & Behagel, 2020)



Such a collaborative approach can also be formalized in legal frameworks and through mangrove management plans. At the level of legislation and policies, a greater emphasis on regional responsibilities and flexible management strategies has been identified as a way for more collaborative management to emerge, as well as greater consideration for local specificities (Cann, 2018). While countries such as Brazil work on unifying mangrove legal frameworks, such initiatives can also address the institutional designs that support integrated action through coordination (Cann, 2018). In addition, recent resource management trends [e.g., integrated coastal zone management (ICZM)] have the potential to support a dual focus on human sustainability and ecosystem quality, in a social-ecological systems approach (Carter et al., 2015). Guidelines have already been created to apply ICZM to the context of mangrove forests, with key elements including conflict mediation, creation of mangrove educational programs, development of a unified mangrove policy, and the use of multiple-use zoning plans or multi-sectoral urban planning (Carter et al., 2015; ISME & ITTO, 2004)

Further, the inclusion of actors such as local communities and non-governmental organizations is increasingly shaping more sustainable approaches to mangrove management (Djosetro & Behagel, 2020). The participation of local communities could enhance the equitable

distribution of mangrove benefits and improve compliance with conservation measures, providing that these measures support local livelihoods (Van Lavieren et al., 2012). Since community members have an interest in the sustainable use of mangroves and depend on them for their basic needs, they are often the best protectors of mangrove forests:

> *"Their social and cultural norms and concepts of land tenure have evolved with the adjacent mangrove ecosystem. As a result, local communities with their traditional ecological knowledge should be central to any attempt to sustainably manage or rehabilitate mangrove ecosystems. Moreover, conversation efforts must provide for diversification of livelihood options for adjacent communities. Without their support and involvement, conservation efforts are doomed to fail."*
> (Suman, 2019, p. 1060)

To effectively include communities, supporting institutions can employ a wide array of strategies, ranging from tools of consultation and public participation, and regular monitoring to ensure local-level inputs feed into multi-level governance processes (Borges, 2019). Further, many forest management paradigms target community involvement, such as community-based management (CBM). As an alternative to state-governed forest management, CBM promotes community participation in all stages of a project, from developing priorities to enforcing management practices (Berkes, 2006). Despite its popularity, CBM faces challenges, such as acquiring legitimacy to enforce rules and resolving power differentials in the community (Cann, 2018). These shortcomings have been previously addressed by adding external scientific assistance, as well as reinforcing and continuously monitoring local institutions (Damastuti & de Groot, 2017). A similar paradigm is co-management, which allows for power-sharing in resource governance between many actors, most typically local communities and the government (Kepe, 2008), aiming to enhance the legitimacy of community claims and providing funding opportunities (Cann, 2018).

2.5 Research Gap

Relatively few studies in mangrove management focus on Latin American contexts, compared with regions such as Southeast Asia (Friess et al., 2016). There is therefore a knowledge gap in understanding country-specific challenges in mangrove management in the region, including Panama. Despite the concept of sustainable forest management being well-defined and well-

studied in many contexts, the same cannot be said of sustainable mangrove management (SMM). Factors contributing to SMM, and mangrove-specific barriers remain poorly documented (Rotich et al., 2016), although the existing literature does point to the central importance of collaboration in the context of effective mangrove management. These ideas will be further explored in this thesis.

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Preface to Chapter 3

After reviewing the history and performance of sustainable mangrove management (SMM), potential knowledge gaps were found in describing mangrove management practices across Latin America and understanding context-specific opportunities and challenges for SMM. Chapter 3 aims to bridge these knowledge gaps by delving into the empirical case study of Punta Galeta, a mangrove forest located on the Caribbean coast of Panama. Chapter 3 will address the effectiveness of international SMM measures in a Latin American context, barriers to their implementation, and challenges affecting each stakeholder around Punta Galeta. This chapter further considers collaborative governance as a key driver of SMM and uncovers strategies and potential research avenues to enhance coordination, trust, and shared visions amongst diverse stakeholder networks.

Chapter 3 – Enhancing the Sustainable Management of Mangrove Forests: The Case of Punta Galeta, Panama

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Abstract

Sustainable mangrove management (SMM) aims to address mangrove degradation and reverse trends of mangrove loss while empowering local stakeholders to participate in governance processes. Recognizing the challenge posed by the uniqueness of mangrove biology and their geographical location on coastal lands, the International Society for Mangrove Ecosystems (ISME) developed the Bali Call to Action in 2017, a non-negotiated policy framework that includes a set of key measures considered essential for international SMM action. This paper applies this framework to the case of Punta Galeta, a protected mangrove forest in Panama that is well-known for its environmental education programs but imperiled by industrial development happening in the Colón District, near the Atlantic entrance to the Panama Canal. Our primary objective was to understand the challenges and opportunities associated with SMM in Punta Galeta and to identify insights of relevance to Panama and Latin America. We identified several successful SMM strategies, such as local awareness-raising on the socio-ecological benefits of mangrove forests and corporate sponsorship of mangrove restoration. However, several facets of SMM remained challenging, such as implementing and enforcing management plans and fostering regular communication and collaboration between all stakeholders. Findings suggest that SMM policy tends to focus heavily on developing the structural elements of governance (e.g. organizational structures, codified roles and responsibilities, financing), potentially at the expense of the relational aspects and drivers of multi-actor collaboration (e.g. commitment, leadership, trust, sense of purpose).

Keywords: *Sustainable forest management; Collaborative governance; Mangrove forests; Environmental Policy; Protected Areas; Latin America*

Once viewed as unproductive, distasteful environments, mangroves are increasingly recognized worldwide as critical habitats for endangered and commercially significant species, as well as for their ecological and aesthetic value.

(Outterson, 2014, p. 4)

I think that Galeta is a piece of the hidden treasure that this province houses. […] Its translucent waters reflect perspectives that we have, as the nature lovers that we are. Let's hope it stays that way. That depends not only on the protection that is given to the place but also on the conscience of all Panamanians.

(Quoted from a member of the ecological police working at our study location)

1. Introduction

Mangrove forests are a unique ecosystem adapted to saline intertidal environments. They provide critical ecological roles and support the livelihoods of many people by providing seafood, timber, and other forest resources (Duke et al., 2012). Yet mangroves are increasingly deforested and contaminated. In Panama, 68.2 percent of mangrove cover has been lost since 1980, the highest rate of loss in Latin America (López-Angarita et al., 2016). Causes include logging, commercial development, forest conversion to shrimp farming, and contamination from industrial and agricultural inputs (Tarté et al., 2013). Along the Caribbean coast of Panama, industrial development is the leading cause of mangrove deforestation (Schmidt, 2008). Previous research aiming to quantify the ecosystem services yielded by mangrove forests in Panama has estimated that each hectare performs ~11,300 balboas (at parity with US dollars) worth of services per year (Salem & Mercer, 2012). Multiplied by the total mangrove area in the country (approximately 170,000 hectares estimated in 2007), annual services could be as high as 2 billion balboas, which is roughly equivalent to the annual revenue from the Panama Canal (Tarté et al., 2013).

Despite the significance of mangroves to sustainable development, relatively little is known about mangrove management in Panama. The case of Panama Bay, near Panama City, has been the main site of management research to date. Results have illustrated weak enforcement of Protected Areas legislation and a general lack of understanding of the conservation value of mangroves (Castellanos-Galindo et al., 2017; Suman, 2014). Although a large extent of remaining mangrove forests is included in the National System of Protected Areas (approximately 70,000 hectares), these areas are still considered vulnerable to coastal pollution and illegal deforestation processes (Tarté et al., 2013). Illegal deforestation of protected mangroves by private companies operating in complicity with government agencies has been reported (Castellanos-Galindo et al., 2017; Suman, 2014), leading some scholars to suggest that mangroves protection laws in Panama are "impotent" (Castellanos-Galindo et al., 2017).

Facing the complex challenges associated with unsustainable mangrove management requires a better understanding of how existing management systems function. According to the International Tropical Timber Organization (ITTO) (Blaser, 2016), sustainable tropical forest management should incorporate multiple objectives and needs without degrading the forest resource, with a particular focus on ensuring accountable governance and respecting the rights of forest-dependent people. International case studies have shown that mangrove forests are a particularly challenging ecosystem to manage because they involve both marine and terrestrial resources and often fall under overlapping governmental agency jurisdictions (Nunan, 2018). Mangrove management also occurs at multiple scales, at different sites, and typically involves many stakeholders, creating a need for cross-sectoral coordination, while also giving rise to competition among agencies (Bandaje et al., 2017; Datta, Chattopadhyay, & Guha, 2012; Rotich et al., 2016). As a result, the sustainable governance of mangrove forests generally requires sophisticated inter-sectoral coordination plans, recognizing the overlapping tenure dimensions of various stakeholders, and including actors such as NGOs that can serve as intermediaries with community groups and scientists (Rotich et al., 2016). There remains, however, limited empirical evidence available to support sustainable mangrove management, policy, and governance strategies in Panama.

This study aims to contribute to existing understandings of sustainable mangrove management and governance issues, focusing on the endangered mangrove ecosystems of Punta

Galeta in Panama. Punta Galeta offers a unique mangrove management case study because of its long and rich history of conservation, contrasting with its current trajectory towards degradation.

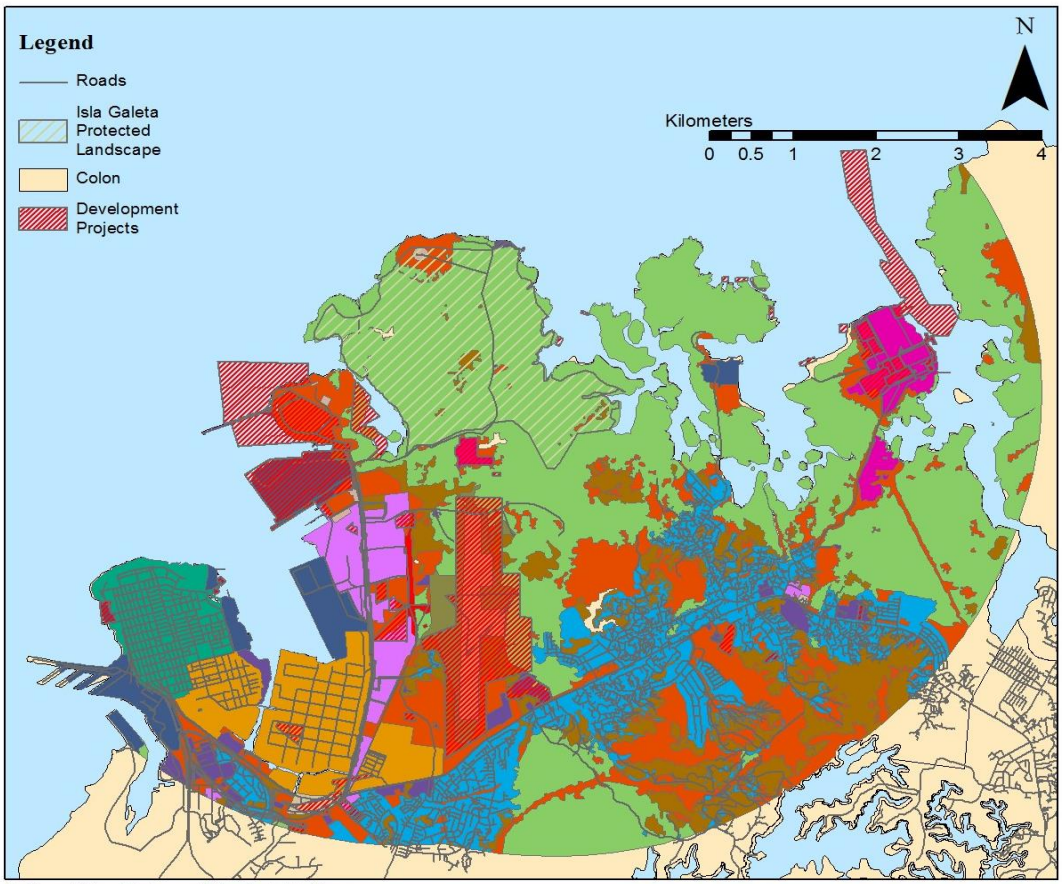
2. Study Setting: Punta Galeta

> "*Once the proud Atlantic gate of the Panama Canal and a vibrant logistics, commerce, and tourist hub blessed with a mix of colonial buildings, a booming economy, and a fast-growing population, Colón City experienced a slow-but-steady decline into disrepair that […] has transformed it into a basket case for urban crime and social conflict."* (Bernardez et al., 2012, p. 43)

Punta Galeta is located on the Caribbean coast of Panama in the protected area of Isla Galeta, less than 10 kilometers away from the city of Colón (see Figure 1), considered the second most important city in Panama due to its commercial activity and transactional focus (Louis Berger Group, 2010). Because of its strategic location at the North entrance of the Panama Canal, Colón has become characterized by its large ports, and logistics and commerce sectors (Louis Berger Group, 2010). Despite promises of prosperity and economic opportunities for all residents resulting from the Canal, living conditions in Colón City have historically been precarious (Bernardez et al., 2012). While Colón City was infamous for gang wars, gun violence, high unemployment, and dwellings described as "vertical slums" (Bernadez et al., 2012), poverty levels have lowered in recent years due to effective social policy interventions (Performance Improvement Institute, 2019).

Figure 1. Map of the Punta Galeta Area and Nearby Land-Use Zones

(Retrieved from Debyser & Hoffmann, 2014, p.56)



Author: Chloe Debyser & Frederic Hoffmann.
Data Sources: IGNTG, ANAM, STRI GIS Lab.
Coordinate System: WGS_1984_UTM_Zone_17N

New Projects and Land Use / Land Cover of Study Zone in 2014

Legend

Land Use/Land Cover

- Airport - Aeropuerto
- Airport Fringe Clearing - Area Abierta del Aeropuerto
- Colon Free Zone - Zona Libre de Colon
- Commercial - Comercial
- Decommiss... Military Infr. - Infr. Militar Decomision...
- Deforested Area - Area Deforestada
- Disturbed Forest - Bosque Modificado
- Forest - Bosque
- Industrial Lot - Lote Industrial
- Logistics Platform - Plataforma Logistica
- Other - Otro
- Port Development - Desarrollo Portuario
- Railway - Ferrocarril
- Residential - Residencial
- Urban Center - Centro Urbano

Punta Galeta was the site of a naval communication and intelligence facility situated near the Coco Solo Aviation and Submarine Field in Colon. During WW2 and the Cold War, the base was strategically located to protect the Panama Canal (see Figure 2 for a historical timeline). In 1964, the site became a research station administered by the Smithsonian Tropical Research Institute (STRI). Today, the objective of the station is to study tropical ecosystems of mangrove forests, seagrass beds, coral reefs, and the many creatures that live in them (Castillo, 2011). Punta Galeta is considered an important point of reference for mangrove forests and biodiversity changes on the Caribbean coast because it has been continuously studied by scientists for over 30 years (Outterson, 2014).

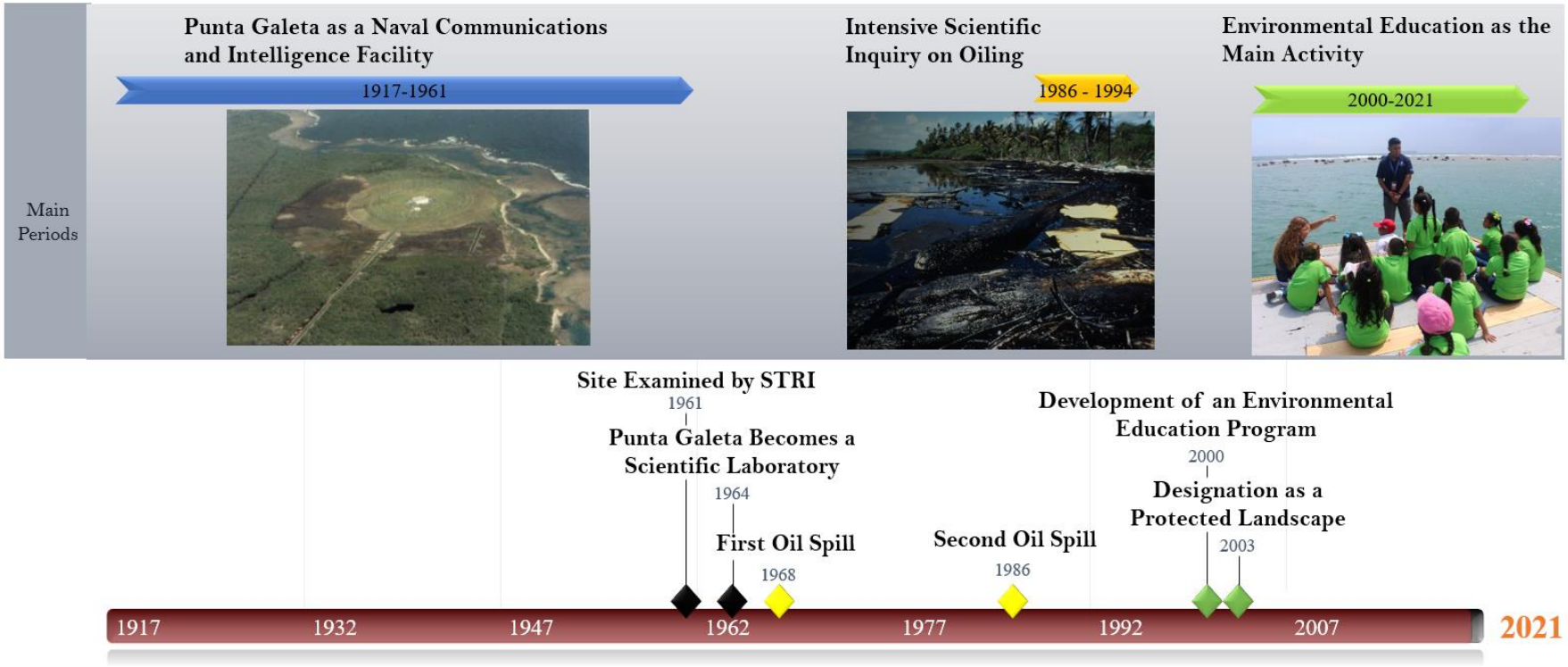
Situated in the larger area of the Bahía Las Minas mangroves, Punta Galeta's 605 hectares of mangrove forests are a home to many species: over 150 bird species, crabs, spiny lobster, and penaeid shrimp (McKinley & Piette, 2007), as well as coral reefs (Jackson et al., 1989), and 200 species of fish, many of which are commercially harvested (Phillips, 1981). Despite their high conservation value, the ecosystems at Punta Galeta are not pristine. In 1968, an oil spill from the wreck of the *Witwater* ship occurred near Punta Galeta, releasing 3.2 million liters of oil into coastal ecosystems (Jackson et al., 1989). In 1986, Texaco Oil Refinery caused the largest oil spill ever to have occurred in the tropical Americas, involving over eight million liters of crude oil and contaminating the Bahía Las Minas mangroves once again (Burns et al., 1994). Mangrove ecosystems subsequently developed significant dead zones and many coral reefs did not recover from mass mortality (Jackson et al., 1989). In an attempt to counter mounting industrialization, the Punta Galeta station director started an environmental education program, whose goal was to communicate the importance of coastal ecosystems to the public (Castillo, 2011). This program evolved to be the most important environmental education initiative happening in the province of Colón (Castillo, 2011). At the time of writing, the station was hosting around 15,000 visitors per year and training ~40 schoolteachers in coastal sciences to further impact youth awareness of mangrove ecosystems.

Management of Punta Galeta's mangrove forests revolves around its protected area status. Isla Galeta (Galeta Island) was formally designated as a nationally protected landscape in 2003, which divided forest management responsibilities between STRI, leading the research and environmental education program, and Ministerio de Ambiente (the Environment Ministry)

(Autoridad Nacional del Ambiente (ANAM), 2003). A management plan was then developed in the same year to assign management responsibilities and allocate resources (ANAM, 2003). Yet environmental protection objectives have been increasingly threatened, as land pressures from megaprojects associated with the Canal have continued to increase. The station is currently an immediate neighbor to the largest shipping terminals in Latin America, namely the Manzanillo International Terminal and Evergreen's Colón Container Terminal. Many other facilities are located around the station, such as an international airport, import and export companies, the Colón Free Zone, and the newly built Los Lagos residential complex. Significant industrial expansion is likely to continue in the area, particularly as the neighboring island, Isla Margarita, has been purchased by China Landbridge to build a mega port (GCR, 2017). As a result, Punta Galeta's surroundings are characterized by tremendous mangrove forest conversion. Impacts of habitat loss and industrial expansion remain unpublished, although decades' worth of reports from the research station document changes in Colón landscapes. These unpublished reports suggest that industrialization has negatively impacted Punta Galeta's environment and neighboring communities through a higher incidence of flooding throughout Colón city due to mangrove loss, relocation of residents, weak Environmental Impact Assessment reports, and high local deforestation rates (Chirchikova et al., 2006; McKinley & Piette, 2007; Bragg et al., 2008; Pease & Swick-Coryell, 2010; Debyser & Hoffmann, 2014).

Figure 2 Timeline of Main Events Throughout Punta Galeta's History

(Adapted from the Smithsonian Tropical Research Institute, 2016).



3. Methods

We followed an exploratory case study research design (Yin, 2018). This approach is considered best for studies investigating context-specific, novel circumstances because it allows for unanticipated themes to emerge during data collection and analysis (Yin, 2018). While doing exploratory research, there was a need to channel data collection and analysis through a conceptual framework (Stebbins, 2001). In doing so, researchers were able to adopt an inductive-deductive approach, grounding deductive thinking in a conceptual framework rather than within a set of hypotheses (Stebbins, 2001).

3.1 Conceptual Framework

A central concept to this study is sustainable mangrove management (SMM), which is generally distinguished from broader sustainable forest management in the scientific literature because of mangroves' unique characteristics. Mangroves tend to be included as both tropical forests and wetlands in international policy initiatives, for example in conservation efforts by governing bodies such as the International Tropical Timber Organization (Blaser, 2016) and the Ramsar Convention on Wetlands (Ramsar, 2020). Recognizing the challenge posed by their peculiar biology and their geographical location on coastal lands, the International Society for Mangrove Ecosystems (ISME) developed the Bali Call to Action in 2017, a non-negotiated policy framework that includes a set of key measures considered essential for international SMM action (ISME et al., 2017). The measures are as follows: 1) prioritizing SMM in national policies, laws, and regulations; 2) developing sound land-use planning and local community empowerment; 3) promoting effective mangrove restoration and science-based decision-making; 4) facilitating access to international financing, as well as public and private financing; and 5) generating and disseminating knowledge on mangrove ecosystems (ISME et al., 2017). We applied this international framework to structure our case study analysis because of its relevance to policy and its broad scope covering many aspects of SMM. Th Bali Call to Action focuses heavily on the necessary governance elements, while also recognizing the importance of environmental education and ecosystem health.

3.2 Data Collection

To ensure that our data collection was reliable, we employed a triangulated data collection strategy centered on semi-structured key informant interviews, a focus group discussion, document analysis, and participant observation. A pre-test of the interview guide was completed with non-participating stakeholders to verify comprehension and to minimize bias, checking to ensure questions were not leading to a pre-conceived answer (Chenail, 2011). For the interviews and focus group, research participants were purposively selected using a reputational approach, whereby relevant informants name individuals who have the greatest insight into the problem at hand (DasGupta & Shaw, 2017). Individuals who were frequently recommended or who had a stake in managing and accessing mangrove forests were invited to participate.

Data collection occurred between February and April 2020 with the support of a local research assistant. A semi-structured approach was favored during interviews, which enabled interviewees to discuss new themes and topics as they arose. Individual interviews were conducted in Spanish or English with 30 key informants, including Panamanian government officials, NGO staff members, academic experts, conservation guards working at the Punta Galeta research station, community leaders, artisanal fishermen from neighboring areas, and industry representatives. This provided us with perspectives from a diversity of actors in the Punta Galeta mangrove management network. A focus group was also conducted with five members of Punta Galeta's staff to gather additional insights from stakeholders interacting with the mangrove forests daily. Table 1 summarizes the interviewed stakeholders, their sector, their role in mangrove management, and the number of stakeholders per sector.

Participant observation was mainly conducted at the Punta Galeta station and involved informal observations of environmental education initiatives, ecological patrols, staff member meetings, and meetings with industry representatives. In addition, documents were collected for analysis, such as Isla Galeta's protected area management plan, Panamanian forestry laws, regional forestry directives, NGO program reports, land-use plans for the greater area of Colón, and unpublished student research reports.

All field research protocols were reviewed and approved by the McGill University Research Ethics Board (REB File #: 19-11-046) prior to data collection. The project also received a local research permit from the STRI Ethics Board (Protocol # HS20005).

Table 1 Overview of Interviewed Stakeholders (Individual Interviews and Focus Group Combined).

Sector	Stakeholder	Role in the management of Punta Galeta	Distribution per sector
Government	Ministry of Environment, Division of Protected Areas (local and head office)	Official management authority of Isla Galeta	9
	ARAP (local office)	Authority responsible for fisheries	
	Panama Ecological Police	Station patrol team	
	Environmental guards	Ministry-appointed guards	
	Urban planner	Developing plans for the Colon District	
Scientists	Tropical biologists Monitoring expert Anthropologist Laboratory manager	Conducting research projects in the station	6
Non-governmental organizations	Centro de Incidencia Ambiental (CIAM)	Supporting environmental protection and conducting strategic litigation	1
Private sector	Environmental project experts	Private sector partners and EIA specialists	5
Community groups	Fishermen	Resource users around Punta Galeta	7
	Residents of Los Lagos	Living next to Punta Galeta mangroves	
Punta Galeta employees	Environmental education specialists	Administering the education program	7
	Station managers	Overseeing the education program and scientific activities	
TOTAL			**35**

3.3 Data Analysis

Interviews were transcribed, translated, and then imported into the MaxQDA software for manual coding. Coding was performed following emergent ideas and themes in the transcripts, following a 'hybrid' inductive-deductive approach (Fereday & Muir-Cochrane, 2006). While the Bali Call to Action framework served as our initial coding manual, data were also analyzed

inductively, whereby recurrent themes emerging were added to our coding manual (Green & Thorogood, 2004). This approach was useful to reveal broader analytical narratives while avoiding forcing data into preconceptions (Denzin & Lincoln, 2018).

3.4 Validity

We followed Yin's recommendations for maximizing internal validity, external validity, construct validity, and reliability in case studies (2018). Although internal validity is mainly a concern for explanatory case studies (Yin, 2018), we addressed this concern by including informants from various roles and experiences to portray the case of Punta Galeta. Triangulation was central to our research protocol, as we employed different methods (focus groups, interviews, observation, and documentary analysis) and encouraged the participation of informants from diverse backgrounds (Baxter, 1997). External validity was addressed by using a well-established and internationally agreed framework on sustainable mangrove management to guide our data analysis (Johnson, 1997). We also shared the results of our study with key informants to receive feedback and enhance construct validity, in addition to using multiple sources of evidence (Yin, 2018). Case study reliability was encouraged through peer debriefing and journaling in the field to keep track of experiences and research proceedings (Baxter, 1997).

4. Results

Results are presented according to each of the five key measures for SMM identified in the Bali Call to Action framework. An additional sixth measure was added because it represented a central aspect of SMM that was not included explicitly in the framework, that is, stakeholder collaboration.

4.1 Key Measure 1: Law and Law Enforcement

The first key measure concerns the inclusion of SMM in laws and policies, as well as effective law enforcement. In Panama, mangroves have a complex protection status. Panama's Authority on Aquatic Resources, Autoridad de los Recursos Acuáticos de Panamá (ARAP), passed a resolution in 2008 (Resuelto ARAP 1) to grant protection to all mangrove forests and prohibit logging, use, commercialization, and deterioration of these habitats, except those under

administrative concessions or subjected to special regimes by other institutions (ARAP, 2008). Yet the same resolution established that the cost of mangrove clearing for commercial uses was 150,000$ per hectare and that illegal mangrove logging for non-commercial uses was fined 300,000$ per hectare (ARAP, 2008). Commercial projects in mangroves must first be approved through an EIA process. In 2012, amendments were made to lower both costs to 10,000$ and 40,000$ per hectare, respectively (ARAP, 2012). Many of our key informants mentioned the incongruency between formal protection status and permissions to clear mangroves for commercial purposes, as this was identified as one of the greatest barriers to SMM. The EIA process for development projects around Punta Galeta was reported to consistently lead to project approval and permission to clear mangroves. Private companies were viewed as having little incentive to avoid deforestation because financial penalties were considered a minor cost by multinational companies.

Further, the lack of enforcement of Punta Galeta's protected area status was raised as a major barrier to sustainable mangrove management. One striking example of this was the reported deforestation of a large portion of the protected area's buffer zone in 2016. Although the buffer zone is protected by both mangrove protection laws and the protected landscape designation, it was illegally logged to start the construction of a new port. Informants documented the event through aerial pictures and social media posts, but no prosecution ensued. This situation nicely illustrates the difference between *de jure* and *de facto* mangrove protection.

Other policies related to managing Punta Galeta's mangroves appeared to not be implemented. The management plan developed in 2003 had not been enacted in full, primarily due to financial constraints and a lack of stakeholder engagement. Key aspects of the plan included the provision of eight conservation guards by the Ministerio de Ambiente, Panama's Environment Ministry, to protect the forest from poaching and illegal harvesting. At the time of data collection, Galeta was protected by three conservation guards (one per shift), who struggled to patrol the whole area while attending to their other duties. This creates a law enforcement issue, whereby some areas of the forests are not adequately patrolled, especially at night. Local fishers were well-aware of this situation:

"I go back at night because I have found a time that [other fishermen] have told me there is no one. I bring my fishing gear." (Fisher)

Another barrier to implementing SMM in Punta Galeta was a lack of knowledge on SMM among governmental officials, politicians, and private sector employees. Most public sector and private sector key informants we interviewed admitted their ignorance of policies or guidelines on mangrove management. For instance, many were unclear about the protection status of mangroves. When asked what policies or laws were related to mangroves, they did not know, even when these policies were directly related to their tasks as forest managers or corporate environmental experts. Without adequate familiarity or expertise on this topic, law enforcement measures can be described as lacking.

4.2 Key Measure 2: Sound Land-Use Planning

Effective land-use planning is considered essential to sustainable mangrove management. In the case of Punta Galeta, the management plan for Isla Galeta has never been fully applied. Stakeholders reported having never seen a copy of the plan, much less working with it. This lack of plan availability and implementation affects the capacity of managers and staff of the Punta Galeta station to formulate a long-term vision for the station's future.

"You ask me right now as a protected area where we are going? I do not know that there is a plan to guide where this protected area wants to go. If you ask me how or what I think of my program, I know where I want to go. As an institution, I know where I want to go. But […] I have no idea where this protected area wants to go because there is no clear objective." (Punta Galeta staff)

Moreover, the plan is no longer considered valid. It was enacted in 2003, renewed (but not updated) in 2008 for five additional years, and has not been renewed since. This happens despite publicly available Environment Ministry guidelines stating that plans should be updated every five years, or at the most every ten years. Many informants expressed noticeable enthusiasm for plan implementation, but they lacked the financial resources to do so.

Reported difficulties in respecting forest management plans in Punta Galeta reflect broader barriers to sound land-use planning in the region. As raised by an urban planning informant working in Colón, there is a general lack of interest in long-term planning.

> *"It's very difficult to do long-term planning […] because of the way the economy is structured on behalf of special interests who, as far as they're concerned, see no economic benefit to it. It's pretty much a dog eat dog world."* (Urban planner)

ARAP informants reported that municipalities around Punta Galeta also do not have long-term environmental management plans, resulting in a lack of water treatment plants and intermittent garbage collection. Trash and wastewater were observed accumulating in mangrove patches near residential areas.

However, sound land use planning initiatives have occurred in the past. In 2010, a land-use plan for the District of Colón (*Plan de Ordenamiento Territorial del Distrito de Colón*), better known as the POT, was developed by planning consultants (Louis Berger Group, 2010). The plan was financed by the Inter-American Development Bank and commissioned in Panama by Conades, a national council of sustainable development. The POT had a strong sustainability focus, which includes conservation and expansion of green areas such as Isla Galeta, as well as a reduction of urban expansion encroaching upon these areas (Louis Berger Group, 2010). With the support of the director of the Punta Galeta station, the POT suggested the creation of an extended protected park, connecting the Galeta Island to the Portobello National Park, over 50 kilometers away. While the POT was never adopted by the Ministry of Housing, the agency responsible for translating land use plans into Panamanian law, it represents a will to integrate best practices from planning in Colón. Instead of drawing inspiration from the POT, the District of Colón became more industrial across time (Debyser & Hoffmann, 2014). Many informants expressed discontent:

> *"Panama has to decide when is enough, enough? How many ports does Panama need? How many sets of locks does it need? How many ships have to go through the country? […] There is a very popular idea, it's that you need to keep building and building and building and building. And the mangroves are in the way, so sorry. After all, our motto is Pro Mundi Beneficio. We wouldn't be Panamanians*

if we didn't just say that we'll benefit from everybody else [building in our country]." (Urban planner)

Aside from corporate projects, recent public projects in Colón also illustrate the lack of interest in SMM. A 2016 "city renovation" plan was developed to build a residential area near Punta Galeta called Alto Los Lagos directly over mangrove forests. It has been built to house 5,000 family units for ~20,000 people, or around half the population of the city of Colón. While the imperative for relocating residents is justifiable due to crumbling infrastructure in Colón's city center, the rationale for the relocation to occur in mangrove forests is not clear.

"*Colón has a very low level of population density within urbanized areas. There is room to meet all population demands for 50 years within areas that are already urbanized. There's no need to build in green areas. […] People need better housing, that's for sure. You know, better housing could easily have been provided in the center. There are plenty of opportunities to build in between high-intensity housing. But that requires another kind of institutional framework."* (Urban planner)

The example of Alto Los Lagos illustrates the tendency to clear mangrove forests whenever a large development project is proposed. This shows a lack of understanding of the social, cultural, and ecological value of these forests, even though there is evidence that mangrove loss in Colón has impacted the city through a greater incidence of flooding and biodiversity loss (Bragg et al., 2008).

4.3 Key Measure 3: Promoting Effective Mangrove Restoration, Monitoring, and Science-Based Decision-Making

The third principle of the Bali Call to Action focuses on mangrove restoration and the use of science to inform mangrove forest management. Reforestation efforts started in Punta Galeta in 2010 as a test phase but since then have evolved into a fruitful mangrove plantation (Outterson, 2014). 15 hectares of mangrove forest have been restored on an old US Navy communications site inside the protected area. Funding for this mangrove restoration effort was provided in part by Manzanillo International, a private company, as a mitigation measure for the construction of their

shipping terminal, neighboring the protected area. Partnerships with private companies for mangrove restoration appear to be uncommon in Panama, as most reforestation efforts rely on partnerships with ITTO (Parker et al., 2004), the UNDP (UNDP, 2018), or the Environment Ministry. In 2018, an additional 5.4 hectares of white and red mangrove forest were restored in Punta Galeta through a partnership with Wetlands International (Wetlands International, 2018).

Despite recent restoration efforts, the extent of the reforested area is not sufficient to counterbalance mangrove loss from industrial expansion. While no available scientific studies are documenting the ecological effects of mangrove loss due to industrial expansion in Punta Galeta, many key informants suggested profound ecological disruption. They remember crossing a "river of blue crabs" during crabs' mating season in the early 2000s and sighting "six iguanas per day", while wildlife sightings now grow scarcer.

> *"We saw the entire area near the protected area was a mangrove forest. Then, we experienced the deforestation of mangroves in a very dramatic way, a terrifying way. To see how many animals died every day because the trees fell with them. We saw sloths, many dead sloths, and snakes. We saw dead crocodiles. This area changed in a very abrupt way in such a short time."* (Punta Galeta staff)

Most importantly, habitat loss is not the only ecological threat that Punta Galeta faces. The development of megaprojects around the protected area has created profound ecological change and habitat contamination due to oil spills in 1968 and 1986 (Jackson et al., 1989). Oil caused the mortality of 18% of mangrove trees in the vicinity of the spill (N. C. Duke et al., 1997). Oil toxicity was also maintained in mangrove sediments for 20 years after the oil spill due to anoxic conditions (Corredor et al., 1990; Burns et al., 1994; Levings et al., 1994).

Today, Punta Galeta is still exposed to numerous sources of pollution, such as the Panama Refinery S.A., shipping terminals, incessant shipping traffic from the Panama Canal, and household waste accumulating in nearby communities that lack access to garbage collection services. All key informants from local communities and the Environment Ministry highlighted water pollution as a serious health concern for humans and ecosystems. Contamination has affected artisanal fisheries, an important primary and secondary income source and food source in

communities around Colón (ARAP, 2019). Participants reported heavy pollution in the waters where they fish:

> *"Very soon we will not be able to consume the fish ourselves, because the water will be too contaminated[...]. There is too much pollution, one finds all things in this sea."* (Fisher)

> *"My [fishing] trammel catches oil, plastic, and grease."* (Fisher)

Fishermen also linked the presence of contaminants to a decline in fish catch. This decline is most likely due to environmental degradation and not to overfishing, since fishing in the region is mostly artisanal (ARAP, 2019). All fishermen participating in our study reported concerns for their future food security and fishing income.

> *"I fished a lot from 1985 to 2005. I went out at 6:00 in the morning. […] Out to sea, I took an hour, or an hour and ten minutes, and I came back home around 1:00 or 2:00 in the afternoon. I had 300-400 pounds of fish. Now, it's something like 50 pounds. Maximum 50 pounds of fish for two people who also have to pay for gasoline and ice. That is not enough to be sustained."* (Fisher)

Although there are clear socio-economic consequences, the effects of modern-day contaminant exposure in Punta Galeta remain unstudied. There are also no decontamination efforts aiming to restore the mangroves and surrounding brackish water from their altered condition to their previous healthy state. This represents an opportunity for research in Punta Galeta, where historical mangrove quality data are available to inform restoration practices and reduce the effects of long-term habitat degradation.

4.4 Key Measure 4: Facilitating Access to Financing Mechanisms

The Bali Call to Action stresses that access to financing, both from national and international sources, is a key aspect of sustainable mangrove management. The Punta Galeta station has a complex financing arrangement, displaying both a diversification of funding sources and chronic underfunding of mangrove management. As both a protected area under the jurisdiction of the Environment Ministry and a research station administered by the Smithsonian,

the two institutions each fund separate activities. The Environment Ministry focuses on elaborating a management plan and providing one conservation guard per shift to oversee the protected area and report back to the Ministry. The Smithsonian provides staff to manage the comings-and-goings of scientists and ensure their safety by providing their own team of guards from the ecological police, a police force specialized in protecting wildlife against poaching. However, these funding sources do not cover all the station's expenses, nor its outreach and environmental education initiatives.

Punta Galeta staff have subsequently worked to uncover new funding sources. As part of an environmental and social responsibility plan, neighboring corporations have become the station's main donors. They have funded the construction of a library, which is the most complete library documenting coastal ecosystems in the province of Colón; an auditorium to sit visitors; a pavilion to welcome visitors; an aquarium; dormitories and a kitchen for scientists; a terrace with binoculars; and a mangrove boardwalk (Castillo, 2011).

> *"Manzanillo has been our best and greatest ally, although they are also responsible for the deforestation of a large area [of mangroves] to set up a port terminal. Evergreen also granted scholarships for undergraduate and Master's students."* (Punta Galeta staff)

In addition to local partners, international NGOs have supported educational initiatives. For example, the International Community Foundation, based in California, has been paying the costs of the annual teacher's training program for 14 years.

We identified financing strategies encompassing both cash payments and in-kind contributions. Punta Galeta managers have established partnerships with Ministries and utility companies to maintain their road and telecommunication network, electricity grid, water system, and waste management system. In exchange, visits and stays are offered to workers and managers as a form of in-kind payment.

Despite these efforts to access funding, the Punta Galeta station was still reported to be underfunded. Many of our interviewees (9) mentioned the lack of personnel as a major barrier to project management. Despite Punta Galeta's success at disseminating knowledge on mangrove

ecosystems to the community, funds are insufficient to expand and, in some cases, maintain the environmental education program. Educational initiatives have been canceled due to insufficient budget, such as a mobile outreach team sent to schools, and the repair of a small aquarium considered as the station's main attraction for children. Lack of personnel is also negatively affecting forest monitoring. As specified in the management plan, a specialist is needed to ensure the protected area cultivates healthy mangrove forests, but funding is insufficient to support that position.

Lastly, the number of assigned conservation guards from the Environment Ministry was observed to reach less than half the recommended amount in the management plan. This creates challenges with administrative proceedings in the event of an environmental crime. Additional issues related to financial resources include an inability to adequately maintain and repair essential equipment, such as the patrol boat and patrol vehicle, promptly.

4.5 Key Measure 5: Generating and Disseminating Knowledge On Mangrove Ecosystems

Awareness raising and knowledge generation on the importance of mangrove ecosystems are central to SMM (ISME et al., 2017) and a core concern of the Punta Galeta research station. In what follows we divide our results into 'knowledge generation' and 'knowledge dissemination' because of their distinct features.

4.5.1 Knowledge dissemination

Punta Galeta gradually became a regional hub for education on mangrove ecosystems. When the educational program started in 2000, there was one guide and no installations to hosts the initial 200 visitors per year (Castillo, 2011). Today, the station hosts 15,000 visitors per year and employs 11 nature guides, in addition to the participation of 20 volunteer guides. The construction of an auditorium and mangrove boardwalk allows visitors to attend an interactive presentation, followed by a scientific tour of the forest. Environmental education also extends to the publication of educational material. For younger audiences, a coloring book and posters featuring fauna such as corals, crabs, and endangered species from Punta Galeta are handed out in local schools and at fairs. At the time of writing, the "Friends of Punta Galeta" coloring book remained one of the Smithsonian Tropical Research Institute's bestselling publications.

A more recent addition to the education program is the teacher's training program, which was inaugurated in 2006. Delivered via an intensive two-week course based at the station, the program is offered to local primary school and high school teachers to enhance their knowledge of scientific inquiry and coastal ecosystems. Scientists from STRI and Panamanian universities directly engage with participants, who usually have no scientific background, through conferences and hands-on activities. The course runs in partnership with the Ministry of Education, which requires teachers to engage in continuing education. On average, 40 teachers have been trained per year, for a total of 450 teachers since inception. The program has been universally well-received by participants and was assessed by an independent evaluator as being the pinnacle and most innovative part of the station's environmental education program (De Gracia, 2019).

> *"In Panama, […] these courses are never offered. Teachers do not have the possibility that a doctor or that a person who has worked with animals educate you."* (Scientist)

Overall, Punta Galeta is an example of how education on mangrove ecosystems can be effectively carried out. Study participants (7) reported a lasting impact on visitors, for example:

> *"I think we have made some changes in people's mentalities. The mangrove is no longer seen as a place with a bad smell and full of mosquitoes, but rather as a place that provides a service to the community, that protects us in a city that is at sea level."* (Scientist)

Yet the same informants also emphasized that existing education initiatives are passive and therefore insufficient to impact the larger population of the city of Colón. According to them, the general population of Colón still does not appreciate the value of mangroves and remains unaware of the existence of tours at Punta Galeta. Outside of mandatory school outings, few residents of Colón reportedly visit the station, although reasons for this remain undocumented. Outreach programs where educators would visit schools and public spaces around Colón have been proposed to address this issue. Such initiatives have occurred in the past, such as monthly science talks in the city, but have been canceled due to logistical difficulties and lack of personnel. Similarly, an internal evaluation of the education program conducted in 2011 raised points for further management consideration, including the need for innovation in the daily presentations being

offered, the limited size of the mangrove boardwalk, and a lack of security when venturing into the mangroves (Castillo, 2011). These issues are connected to budget and personnel limitations.

4.5.2 Knowledge generation

As the oldest functioning marine lab in the Caribbean, the researchers of Punta Galeta have made important contributions to the marine, climatic, and biological sciences (McKinley & Piette, 2007). During its 56 years of operation, Punta Galeta has produced over 450 peer-reviewed publications and pioneered research fields such as the impact of oil spills on tropical ecosystems. As a mangrove forest managed by a leading international scientific institution (STRI), Punta Gunta offers a unique opportunity to enhance forest management with scientific input. Throughout the 1980s and 1990s, scientific activity and publications at the station reached their peak and helped inform the protected area's management plan (ANAM, 2003). Today, the station's research activities have slowed down, with only two scientists making regular use of the station and neither studying mangrove ecosystems. Collaboration with scientists mostly pertains to their participation in environmental education initiatives. While key informants felt that the 'golden days' of science at Punta Galeta were bygone, many pertinent scientific questions related to anthropogenic impacts on mangrove forests remain unanswered, such as ecological and health effects of contamination, impacts of deforestation on species composition, and causes of substantial fish loss. These questions were raised by residents and Galeta employees as being important for the community.

4.6 Additional Key Measure: Stakeholder Relationships

Our data analysis revealed that a central aspect of sustainable mangrove management in Punta Galeta was not explicitly captured in the Bali Call to Action framework: fomenting positive relationships and collaboration among stakeholders. While the Bali Call to Action considers the effective involvement of communities as a component of their "sound land-use planning" criteria, other indicators of positive stakeholder relationships are absent.

Evidence from Punta Galeta paints a complex picture of collaboration. On the one hand, some stakeholders appear to have maintained positive collaborative relationships over decades. Examples include the ecological police, the Environment Ministry conservation guards, and the Punta Galeta staff. The director of the station also transformed relationships with neighboring

companies into productive partnerships involving the sponsorship of many environmental education initiatives and infrastructure needs, after years of antagonism due to deforestation. Results suggest that through these relationships, station staff expect that new development projects being proposed by private sector partners will be communicated to the station and that mitigation measures will be decided jointly. These are examples of relationships characterized by regular communication, exchange, and a level of mutual trust.

Not surprisingly, STRI was found to be a central actor leading to respectful relationships with other stakeholders. Many informants (13) mentioned that because STRI is a foreign (US) institution, it confers an image of respect, authority, and credibility to the station. Participants from all backgrounds (governmental, private sector, community) emphasized the importance of the Smithsonian as an esteemed foreign actor, whose presence can leverage the support of other local actors.

> *"The Smithsonian has a track record, a high degree of respect from other actors, and has an outreach program. In other words, the information that is generated here does not stay here. The institute manages to go out into the community. Twenty years ago, Dr. Wayne Sousa, [an eminent mangrove ecologist], we didn't know what he was doing. […] Today, the students here [in Colón] know who Wayne Sousa is."* (Scientist)

On the other hand, collaboration could be fruitfully enhanced with other key stakeholders. Participants identified the municipality and city councilors as being the least concerned stakeholder group regarding mangrove conservation and its socio-economic importance. Interviews with this group of actors confirmed that, while employees were aware of the importance of mangroves and even support conservation, municipal plans and projects did not reflect those beliefs.

The involvement of regional actors in Punta Galeta is also lacking. While the station communicates with national offices of the Environment Ministry for questions related to research and protected area management, the provincial office of the Environment Ministry has a more limited role. They provide the Ministry's conservation guards to Punta Galeta, whom they regularly communicate with, but are not involved in other aspects of environmental management.

In addition, ARAP, the authority responsible for aquatic resources and fisheries, and the Colón Municipal Government reportedly have limited interactions with the station, despite their geographical proximity and common interests. While these actors view knowledge dissemination and community projects as part of their mandate, they rarely partner with Punta Galeta for these purposes. Partnerships with these three actors would be mutually beneficial to maximize the impact on Colón residents and the station's educational outreach. Nevertheless, local partnerships were attempted in the past. In 2003, a co-management board was proposed, involving the Smithsonian and the Environment Ministry, as well as local actors such as the Town Hall and the Foundation for Investment and Development of Colón (cite PPIG, 2003). One year later, the board was dissolved due to a lack of stakeholder engagement and leadership. Informants included in this co-management initiative mentioned that no actor took the initiative to organize meetings and reunite all actors. Even though Punta Galeta staff members and the director are still interested in a co-management structure, their lack of personnel is a major barrier to governance change.

Based on our interviews, collaboration with communities has the potential to be enhanced. For example, community members we interviewed (7) were appreciative of the conservation initiatives at Punta Galeta and the environmental education program, even though none had visited the station. However, they reported profound concern for environmental contamination in their surroundings.

> *"My vision for the future is that we don't have a future around here."* (Community member)

> *"I'm telling you the truth, look, I'm ruined. Tomorrow, I can go by boat and I don't think there will be much fish. It will be contaminated. This is going from bad to worse."* (Fisher)

All interviewed fishers (5) wished that mangrove cover, acting as a fish nursery, be expanded. There appeared to be many opportunities for increased collaboration with Punta Galeta researchers working on issues of local relevance, such as contamination and the potential for mangrove expansion and restoration.

3.4 Discussion and Conclusion

Our case study suggests that the Bali Call to Action framework is highly relevant for sustainable mangrove management in Panama. Indeed, all five key measures from the Bali Call to Action applied to the case of Punta Galeta and revealed essential features of the sustainable mangrove management challenge, such as effective knowledge dissemination. However, our case study highlights a potential policy gap: the central need for collaborative governance across mangrove management boundaries. Collaborative governance can be defined as consensus-oriented decision-making, which is built on trust, member commitment, and regular communication between stakeholders (Ansell & Gash, 2007). Our case study suggests that collaborative governance underpins all aspects of mangrove management and deserves a greater focus in international SMM frameworks. For instance, partnerships with private sector actors were reported as being central to achieving mangrove restoration projects, as well as to expanding the protected area's operating budget. In contrast, the municipal government, ARAP, and the central offices of the Environment Ministry struggled to consistently engage with the Punta Galeta management team, which fueled land-use planning conflicts and inconsistent application of agreed management plans. Although focused on Panama, these findings are consistent with recent research on SMM which has revealed the usefulness of collaborative mangrove management strategies in Suriname (Djosetro & Behagel, 2020), Brazil (Partelow, Glaser, Solano Arce, Barboza, & Schlüter, 2018), and various countries of Southeast Asia (Friess et al., 2016; Putri, Zahra, Syafii, Adhuri, & Nadjib, 2019; Martínez-Espinosa, 2020).

Drawing from Wondolleck & Yaffee's 'brick and mortar' analogy (2017), structural elements supporting collaborative governance (organizational structures, codified roles, and responsibilities, policies) can be seen as 'bricks', while relational elements (commitment, leadership, trust, sense of purpose) are the 'mortar' holding the bricks together. While the Bali Call to Action promotes the need for the foundational 'bricks' of sustainable mangrove management, comparatively little attention is devoted to the social support system for these structural policy elements. In other words, there is a lack of mortar holding the brick wall (sustainable mangrove management) together. Stakeholder reconciliation and improved coordination are issues that can be observed in Panama's land-use conflicts, weak enforcement of Protected Areas, and unenforced management plans (Spalding, Suman, & Mellado, 2015; Suman, 2014). Yet evidence of

collaborative management of mangrove forests is limited throughout Latin America (López-Angarita et al., 2016). The case of Punta Galeta highlights some interesting considerations for collaborative mangrove management, particularly its complex relationship with neighboring private sector actors. These actors were responsible for local mangrove deforestation from the 2000s onwards, which initially forged a rivalry with the conservation-oriented Punta Galeta research station. However, this adversarial relationship was reportedly transformed into a more cooperative over time due to relational elements, including leadership and trust-building through mutually beneficial arrangements, such as corporate sponsorship of environmental education initiatives in compensation for past environmental damage (Friess et al., 2016). Such a situation illustrates the mechanism of 'small wins' described by Ansell and Gash (2007), which can support a "virtuous cycle of collaboration" through small positive outcomes that deepen trust and shared understandings (Djosetro & Behagel, 2020). Instead of picturing rivalry and conflict antithetical to collaboration, Ansell and Gash (2007) describe it as a powerful incentive for collaborative governance. Through sustained face-to-face interactions and small wins, positive relationships can be rebuilt. This point is especially pertinent for the Latin American context, which is characterized by a long history of natural resource conflicts that set the stage for ongoing environmental governance challenges (De Castro, Hogenboom, & Baud, 2016). Our case study also highlights the potential role of non-local actors to act as mediators, with STRI seen as mitigating potential power imbalances between multinational companies and local authorities to shape interactions in favor of trust and commitment. Future mangrove policy initiatives could place greater emphasis on collaborative governance strategies to improve the sustainability of mangrove forest management (Ansell & Gash, 2007; Djosetro & Behagel, 2020). This is an area that would benefit from further field research.

A recent coastal management case study by Djosetro & Behagel (2020) states, "local support for protected areas and awareness of environmental impacts of resource use by local communities can result in a more complete conservation approach that includes multiple actors and combines conservation and social objectives". Participation may, for example, empower citizen groups to monitor and manage environmental change more easily (Reed, 2008), which relates to key issues in our case study. While policymakers who participated in our study reported that few residents around Punta Galeta depended on mangrove forests for their livelihoods, field observations suggested otherwise. Fishermen and community members living near Punta Galeta

conveyed a growing concern for environmental quality, citing contamination and low fish catches while acknowledging the role of mangrove forests in mitigating these effects. Yet these concerns were not being communicated to local authorities, while protected area managers were aware that community members harvest fish and invertebrates illegally in the protected area. This situation suggests poor recognition of the interdependencies that exist between local resource users and conservation authorities in mangrove ecosystem protection. Potential lessons may be learned from the participatory management of mangrove systems in Ecuador, where mangrove custody agreements with fishing associations have been used since 1999 (Félix & Hurtado, 2019). However, even though participatory processes are considered essential to collaborative performance, they can still be hindered by a lack of genuine interest by the local government in devolving power to local communities (Colfer & Pfund, 2011). Further, even with positive collaborative dynamics, continued industrial pressure will undermine sustainable mangrove management unless significant investments in human and financial capacity to protect and monitor these forests are made (Djosetro & Behagel, 2020). The key question is who should be making these investments and what capacities are required? Further experimentation with and documentation of different forms of social organization in support of sustainable mangrove forest conservation and management are needed.

3.5 Acknowledgments

We would like to thank the Smithsonian Tropical Research Institute and the Punta Galeta Station staff for their logistical support and their active help and friendliness during fieldwork in Colon. We are also grateful for the participation of all interviewees in the study for their time and effort.

This research was carried out with the financial support of McGill University through the Natural Resource Sciences Department and the Neotropical Option program, as well as the Smithsonian Tropical Research Institute. The Social Sciences and Humanities Research Council of Canada (SSHRC) and the Fonds de Recherche Société et Culture du Québec (FRQSC) also funded this research. A special thanks to Dr. Owen McMillan from the Smithsonian Tropical Research Institute for his generous support of this research project and funding of a research assistant position.

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Preface to Chapter 4

Chapter 3 focuses on the context-specific barriers to sustainable mangrove management (SMM) in Punta Galeta and outlines drivers of multi-actor collaboration as potential keys to enhance SMM. While best practices in SMM include laws and effective law enforcement, Chapter 3 identifies a weak implementation of regulatory frameworks to protect mangrove forests. Building on these findings, Chapter 4 presents a policy analysis of legal frameworks governing mangrove forests at the national level in Panama. This chapter further delves into policy implementation challenges, issues of inter-agency coordination, and competing state priorities to assess policy and management opportunities in support of SMM.

Chapter 4 – Tangled Roots and Murky Waters: Piecing Together Panama's Mangrove Policy Puzzle

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Abstract

Mangrove forest policies are often characterized by their fragmented nature, as multiple sectors, disciplines, and institutional structures interact to affect mangrove conservation and management. This study analyzes mangrove forest policies in Panama, a country known for its rich mangrove coverage, and also for its high rates of mangrove loss, urban expansion, and coastal development. To complement the policy analysis, key informant interviews with national mangrove policy actors are used to gather insights on policy implementation challenges and potential multi-actor collaboration opportunities. Results suggest that despite the development of multiple policies targeting wetlands and formally conferring a high conservation status to mangroves in Panama, mangrove protection is challenged by competing governmental agendas and policy implementation gaps. Efforts to strengthen mangrove conservation and initiate participatory management processes were also found to conflict with institutional structures that struggle to include local communities and foster collective action.

Keywords*: Mangrove Forest Policy; Sustainable Mangrove Management; Latin America; Coordination; Collaborative governance; Deforestation*

4.1 Introduction

As outlined by many global conservation reports, mangroves are one of Earth's most productive, resilient, and biodiverse ecosystems, but also one of the most poorly protected (Duke et al., 2014; Slobodian & Badoz, 2019; Van Lavieren et al., 2012). Mangroves are often a 'blind spot' in environmental policy because they cross multiple boundaries, partly coastal habitats, forests, and tropical wetlands. Despite their unique ecology, few countries have passed a law specifically designed for mangroves (M. Spalding et al., 2010). Instead, many of the national legal regimes

governing mangrove ecosystems are fragmented and complex (Slobodian & Badoz, 2019). For example, mangroves are often managed under legal frameworks intended for the environment, forests, water, wetlands, and fisheries, which can fall under many governmental jurisdictions and sectoral responsibilities (Rotich et al., 2016). Policy tools to protect mangroves can take multiple forms, such as direct protection of mangrove species, protected areas, logging permits, Environmental Impact Assessments, integrated land-use planning, and collaborative management approaches (Friess et al., 2016; Slobodian & Badoz, 2019). Although many policy tools exist, legal effectiveness and compliance with mangrove policies are often found to be deficient, leading to accelerated mangrove loss (Rotich et al., 2016).

As the Central American country with both the largest area of mangrove cover and the highest variety of mangrove species, Panama is a compelling site to study mangrove-related policies (M. Spalding et al., 2010). A large extent of Panama's mangroves are included in the National System of Protected Areas (approximately 70,000 hectares), but mangroves continue to deteriorate rapidly (Tarté, 2013). Panama has lost more than 68 percent of its mangrove forests since 1980 due to its growing infrastructure sector, among other reasons (López-Angarita et al., 2016). The greatest proportion of mangrove destruction in Panama has occurred around Panama City, where the space occupied by wetlands competes against numerous projects of urban expansion (Kaufmann & Miró, 2012). Mangroves' prized location on coastal lands with high economic value generates pressure on their conversion due to other land uses (e.g., aquaculture, commercial, industrial, residential, ports) (M. Spalding et al., 2010). However, losing mangrove ecosystems has also revealed their considerable socio-ecological importance, especially in supporting local fisheries. Mangrove losses have been associated with a decline in fisheries, as 70% of fish caught along the coasts of Panama depend on mangroves at the early stages of their life (Parker et al., 2004). In a country with abundant coastlines and fisheries, mangrove forests are recognized as being an essential ecosystem to protect.

Suman (2002) and A. K. Spalding et al. (2015) carried out comprehensive reviews of Panama's coastal management policies, which include mangrove-related policies. Their work identifies that coastal policies face several administrative and structural gaps. For example, since the 1990s, a major institutional reorganization has been occurring in Panama leading to coastal management responsibilities becoming fragmented among many government agencies. Suman

(2002) found that interagency coordination was deficient, as no formal coordination mechanism existed. In 2015, A. K. Spalding reiterated that coordination was challenging and that the responsible agencies lacked a cohesive vision, also reporting that policies were aggravating insecure property rights on Panama's coasts, as local communities struggled to own land and to secure access to coastal resources and economic activities (such as fisheries and tourism). While there has been no comprehensive analysis of the policies specifically related to mangroves in Panama, Suman (2002) and A. K. Spalding et al.'s (2015) findings provide many insights. Building on their work, this study aims to understand how national policy and legal instruments relate to mangroves in Panama and how responsible authorities are subsequently structured and operate to coordinate mangrove management.

4.2 Methods

Similar to A. K. Spalding et al.'s (2015) combined approach to coastal policy analysis, we employ a hybrid approach combining policy analysis and a thematic analysis of qualitative interviews. For the policy analysis, we reviewed all existing policies related to mangroves at the national level in Panama, excluding soft laws and municipal council decisions. Data for this review were obtained by scanning the scientific literature and soliciting legal documents from government offices. Further, many mangrove policies were obtained via searches in InfoJurídica, a Panamanian legal database comprising detailed expression of laws' impacts, validity, and unconstitutionality (*Infojurídica*, 2020).

To complement the information contained in policy documents, we conducted eight semi-structured interviews lasting approximately 45 minutes with key informants involved in mangrove policy and management in Panama, including scholars, policymakers, members of mangrove advisory bodies, and non-governmental organization (NGO) experts (see Table 4.1). These actors were purposively selected based on their involvement in mangrove policymaking and their participation in mangrove management groups, such as the National Committee on Wetlands (Palinkas et al., 2015). Interviews allowed us to gather deeper insights into the stakeholder interactions supporting policy objectives, in addition to better understanding the application of existing mangrove-related policies. Interviews were conducted in Spanish and English in Panama between February and March 2020, and online through password-protected video-conferencing platforms in April 2020. All field research protocols were reviewed and approved by the McGill

University Research Ethics Board (REB File #: 19-11-046) prior to data collection. The project also received a local research permit from the STRI (Protocol # HS20005).

Table 4.1 Overview of Interviewed Stakeholders.

Stakeholder group	Informant's organization	Organization's role	Distribution per stakeholder group
Government	Ministry of Environment (various divisions) ARAP	Develop policies on the management of mangrove forests, manage protected areas, and allocate funding to projects in mangrove forests (restoration, education, protection) Manage the impact of mangrove forests on artisanal fisheries, and payments for mangrove clearing	4
Scientists	Smithsonian Tropical Research Institute International Maritime University of Panama	Provide scientific insight on mangrove management and policy	2
Non-governmental organizations	Centro de Incidencia Ambiental de Panamá (CIAM) Sociedad Audubon de Panamá	Support environmental protection and conduct strategic litigation Support the protection of mangrove ecosystems through community engagement and government partnerships to support bird populations	2
TOTAL			**8**

Interviews were fully transcribed and analyzed in MaxQDA, a qualitative analysis software that enabled data to be classified (coded) into themes (Guest et al., 2011). Coding of recurring themes was performed manually following an inductive-deductive approach (Fereday & Muir-Cochrane, 2006). Deductive reasoning was used to build a coding matrix based on recurrent mangrove policy challenges. These were identified by Friess et al. (2016) and by A. K. Spalding et al. (2015), yielding the following broad themes: conflicting policy objectives, overlapping jurisdictions, implementation of protected areas, collaborative governance, increased role of the private sector in management, and coastal property regimes. In order to identify any relevant additional themes, we complemented our analysis with inductive reasoning, where new themes and categories emerged directly from the data through careful examination and constant comparison of interview transcripts and policies (Wildemuth, 2017).

Limitations of this study include its small sample size. Due to the 'hybrid' data collection approach, interviews are mainly used to identify and scope for potential management issues, which could be further assessed in subsequent studies. Furthermore, according to the information power model in Malterud et al. (2016), our study's design is compatible with small samples sizes: "*A study will need the least amount of participants when the study aim is narrow, if the combination of participants is highly specific for the study aim, if it is supported by established theory, if the interview dialogue is strong…*" (p. 4). Content validity in this study was ensured by conducting a pre-test of the interview guide with non-participating stakeholders and by using peer-reviewed frameworks on mangrove management (Brod et al., 2009). In addition, we employed a triangulation strategy in our research protocol by combining different methods (semi-structured interviews, participant observation, and documentary analysis) and by encouraging the participation of stakeholders from diverse backgrounds (Baxter, 1997).

4.3 Results

4.3.1 The Legal Framework of Mangrove Protection in Panama and its Recent Developments

Even though Panama does not possess a law specifically designed for mangroves, many laws are used to govern mangroves and tropical wetlands (see Table 4.2). At first glance, Panama's laws and policies appear to support the preservation and sustainable management of natural resources; the most striking example of this being the strong environmental protection language used in the 1972 Constitution. Within the General Law for the Environment (Law n° 41, 1998), which regulates the use of natural resources and promotes the pursuit of environmental preservation, mangroves are given a high conservation priority. Panama also signed the Ramsar Convention on Wetlands of International Importance in 1989. The implementation of the Convention was supported by the creation of the National Committee on Wetlands in 2007 and the Política Nacional de Humedales in 2018 (National Wetlands Policy) (Ministerio de Ambiente & PNUD, 2018). Yet these efforts appear to be undermined by weak compliance with mangrove protection standards, as highlighted by our key informant interviews.

> *"Panama is a country where there are enough, if not too many laws. There are laws for everything, for everyone. But the problem is, in my opinion, compliance with these laws. There are many, many laws, but they are not enforced. […] Whether I am a*

businessman with a lot of money or that I am a common citizen, I must develop a feeling that I must comply with the law because otherwise I will be punished by the authorities." (Scientist)

Environmental protection laws appear to be clouded by the dominant mangrove policy created in 2008 by the Autoridad de los Recursos Acuáticos de Panamá (ARAP), Panama's Authority on Aquatic Resources. Through the mechanism of Environmental Impact Assessments (EIA), ARAP requires authorization for any activities affecting mangrove ecosystems (ARAP, 2008). However, our research participants reported flaws in the EIA process that lead to consistent approval of projects related to tourism, industry, and ports in coastal areas, even when they take place in endangered habitats. This has led to mangrove forests being converted and exploited for commercial purposes, to the point where it is cited as the main source of mangrove loss in Panama (Kaufmann & Miró, 2012; López-Angarita et al., 2016)

The evolution of ARAP policies related to the penalties for mangrove logging and deforestation appears to support this claim, revealing a clear discounting of mangrove benefits. For example, ARAP passed a resolution (J.D. 1, 2008) describing mangrove clearing fees, where permit fees for commercial projects reached 150,000 balboas (at par with US$) per hectare, while illegal logging of mangroves was fined 300,000 balboas per hectare. In 2012, coinciding with a suspension of the Panama Bay Wildlife Refuge for suspected reasons of urban expansion (Suman, 2014), commercial permit fees were reduced to 10,000 balboas per hectare, and illegal logging fines were reduced to 40,000 balboas per hectare (ARAP, 2012). Panama Bay is a site known for its rich biodiversity, migratory species, and importance for local fisheries and it is esteemed by conservation NGOs working in Panama (Romero Hernández, 2016). Faced with the imminent threat of deforestation, more than 50 NGOs and community groups from across the country joined and participated in advocacy work to reverse the aforementioned court decision (Romero Hernández, 2016). Protection status was reinstated in Panama Bay in 2013 due to pressure from civil society. However, illegal deforestation for luxury properties, golf courses, and shopping malls has continued to be reported in the protected area (Castellanos-Galindo et al., 2017). According to some scholars, the Panamanian government had a clear interest in facilitating mangrove conversion to commercial and residential developments (Suman, 2014). The Supreme Court of Panama reached analogous conclusions. ARAP's 2012 resolution was declared unconstitutional and was

voided by the Supreme Court in 2016, citing that the resolution did not respect the State's will to guarantee a healthy environment and to avoid the destruction of ecosystems (Corte Suprema de Justicia, 2016).

While this Supreme Court decision points to an appreciation for the value of mangroves, mangrove policy frameworks remain nebulous. As raised by informants involved in developing new coastal management policies, mangrove policies are confusing: "*Two streams of regulations were kept moving forward, which today has brought us management problems deciding what standard should be applied"* (participant from the Ministry of Environment). As shown in Table 4.2, regulations developed by different institutions are overlapping and remain in effect. For instance, ARAP no longer has policy jurisdiction over mangrove management, but some of their regulations apply. Meanwhile, the Ministry of Environment developed recent policies (Decree-Law n° 8, 2015; Executive Decree n° 127, 2018) with themes of sustainable use of mangrove resources by local communities, reduction of mangrove threats, and integrated management of wetlands, which competes with the other policy theme of commercial development on mangrove coasts. The internal contradictions in mangrove legal frameworks remain a major challenge in Panama. To resolve issues of inconsistent legal standards, the Ministry of Environment is developing a proposed law to unify current legislation on marine and coastal zones and to create appropriate rules that address the reality of mangrove loss and degradation (personal communications, 2020). The proposed legislation intends to create mangrove-specific protection measures and promote new standards of departmental coordination to effectively implement policies. Other measures include the creation of new mangrove restoration areas to counteract extensive habitat loss, and the implementation of Strategic Environmental Assessments to comprehensively analyze proposed projects in mangrove ecosystems. Fines for mangrove logging would return to the level described in ARAP's 2008 resolution (J.D. 1, 2008). The adoption of this law and the effective compliance with its new standards remain to be seen.

Legislation relating to land tenure in mangrove forests also adds to the confusion. The National Assembly passed a law in 2009 (Law n° 80) to permit individuals who occupy land within the coastal zone to obtain a title from the government, although land titling processes could not include mangroves or protected areas (A. K. Spalding et al., 2015). Due to the preemptive nature of this law, previously titled mangrove land remains private property and can continue to be

developed (Tarté, 2013). As pointed out by A. K. Spalding et al. (2015), Law n° 80 facilitates the sale of coastal land for investment and creates imbalances where land sales will mostly benefit elites and disempower local communities. Prior to the development of Law n° 80, private properties existed in mangrove areas. Legislation stating that these lands are public was established later (Agrarian Code, 1962; Decree-Law n° 12, 1964), thereby creating exceptions for private owners. . Questions about the competence and willingness of public institutions to implement mangrove zones, as well as the validity of legislation are relevant (Suman, 2002), with issues of unclear land titles and noncompliance with laws reported by our key informants:

> *"The Constitution states that the mangrove and all these wetlands belong to the government and not to private owners, but it doesn't apply to all people. So, it's a little bit contradictory. All the people that have owned land before the Constitution in the 1970s, they are not subjected to these clear regulations for the protection of mangroves. So, they are allowed to ask for permission for cutting and taking down the mangrove. […] This is a big issue."* (Government official)

> *"Panama has signed the [Ramsar] Convention on Wetlands and was supposed to protect wetlands, but we have a big issue with private mangrove ownership. […] Every time you have been forced to make a law to protect mangroves, it doesn't continue because of this."* (Scientist)

Table 4.2 Summary of Main National Laws and Policies on Mangroves in Panama Since the 1941 Constitution.

Law/Policy/Norm	Number and date of the norm	Institution	Key features	Current validity
Constitución Política de la República de Panamá	1941	Asamblea Nacional	• Before the 1941 Constitution, private property rights were recognized over coastal land, including mangroves. The Constitution declared that all coastal land was the property of the State.	A new Constitution was passed in 1972.
Constitución Política de la República de Panamá	1972	Asamblea Nacional	• The 1972 Constitution declared all coastal land and seas as public goods that are open to the public are free from privatization (article 258). The use of these public properties was granted via administrative concessions (Suman, 2002). • The State and all the inhabitants of the national territory must prevent pollution of the environment, maintain ecological balance, and avoid destroying ecosystems (Article 119). • The State guarantees that the use and exploitation of forests, lands, and waters are carried out rationally, to ensure their preservation, renewal, and permanence (article 120).	Amended in 1983, 1993, 1994, and 2004 without changing articles relating to mangroves.
Por la cual se aprueba la Convención Relativa a los Humedales de Importancia Internacional	Law n° 6, 1989	Asamblea Legislativa	• Panama approved the Ramsar Convention on Wetlands of International Importance and ratified it in 1992. Through the Convention, Panama commits to preserving the wetlands designated as Wetlands of International Importance: Bahía de Panamá, Golfo de Montijo, Damani-Guariviara, Punta Patiño, and San San Pond Sak. Many of these wetlands comprise mangrove forests. Panama also commits to improving the conservation and wise use of wetlands across time through collaboration with Ramsar offices.	Still in effect.
Por medio de la cual se dictan medidas para el uso y protección del manglar	Resolución J.D. 08-94	Instituto Nacional de Recursos	• Mangroves are recognized as essential natural resources and their use becomes regulated. Logging by individuals is permitted, but a fee between 0.2 and 5 balboas is incurred.	Replaced by Resolución J.D. 1, 2008 (ARAP).

		Naturales Renovables (INRENARE)	Logging for private purposes is also allowed, although an Environmental Impact Assessment and authorization are required first. Mangroves must be restored after logging.	
Ley General de Ambiente	Law n° 41, 1998	Asamblea Legislativa	• Mangroves are declared to have a high conservation priority because of their high biodiversity and productivity (article 95). • The Autoridad Nacional del Ambiente (ANAM) is created as the entity responsible for natural resources and the environment.	ANAM's responsibilities regarding mangroves are later transferred to ARAP.
Norma que crea la Autoridad de los Recursos Acuáticos de Panamá (ARAP)	Law n° 44, 2006	Asamblea Nacional	• ARAP is created and has the responsibility to manage coastal resources such as mangroves, in addition to establishing coastal management areas and ensuring compliance with the Ramsar Convention. ARAP also monitors water quality and all fisheries activities. • Mangroves are given a high conservation priority.	Management responsibilities over coastal resources are transferred to Ministerio de Ambiente in Law n° 8, 2015
Por la cual se establece el Comité Nacional de Humedales	Resolución AG-0038, 2007	Autoridad Nacional del Ambiente (ANAM)	• The National Committee on Wetlands is created as the inter-institutional organization bridging the Government and civil society to implement national wetland policies and support the Ramsar Convention. Its participating entities are enumerated, which include NGOs, universities, and governmental agencies.	Still in effect.
Que reconoce derechos posesorios y regula la titulación de tierras en zonas costeras e islas	Law n° 80, 2009	Asamblea Nacional	• Land titling processes cannot include mangroves or protected areas. However, this law is not retroactive. This explains why there are currently private projects in mangroves (Tarté, 2013).	Still in effect.
Por medio del cual se establecen todas las Áreas de Humedales Marino-Costeros, particularmente los manglares de la República de Panamá, como zonas especiales de manejo marino-costero	Resuelto 1, 2008	Autoridad de los Recursos Acuáticos de Panamá (ARAP)	• The responsibility to grant special permits for the sustainable use of the mangrove and collect fines in compensation for its damage is transferred to ARAP. • All mangrove areas are designated as marine-coastal management areas, where logging, use, commercialization, and deterioration are prohibited, with the exceptions of projects that receive approval according to other ARAP regulations.	Complemented by Resolución J.D. 1, 2008 (ARAP)

Law/Policy/Norm	Number and date of the norm	Institution	Key features	Current validity
Por la cual se aprueban algunas tasas y cobros por servicios que presta la Autoridad de los Recursos Acuáticos de Panamá	Resolución J.D. 1, 2008	Autoridad de los Recursos Acuáticos de Panamá (ARAP)	• Permit fees for artisanal mangrove logging are established at 3 balboas per hectare per year. Commercial projects are subjected to fees of 150,000 balboas per hectare and illegal logging to a fine of 300,000 balboas per hectare.	Fines were reduced in Resolución J.D. 20, 2012.
Por la cual se modifica la Resolución J.D. n° 01 de 26 de Febrero de 2008, que aprobó algunas tasas y cobros por los servicios que presta la entidad	Resolución J.D. 20, 2012	Autoridad de los Recursos Acuáticos de Panamá (ARAP)	• Permit fees are reduced to 10,000 balboas per hectare, in addition to a requirement to reforest 2 hectares of mangroves per logged hectare. Fines for illegal logging are reduced to 40,000 balboas per hectare.	This resolution is declared void and illegal by the Supreme Court of Panama in 2016.
Que crea el Ministerio del Ambiente, modifica disposiciones de la Autoridad de los Recursos Acuáticos de Panamá	Law n° 8, 2015	Asamblea Nacional	• The Ministry of Environment is created, and all responsibilities for environmental protection, conservation, and management of coastal resources and transferred to this entity.	Still in effect.
Que establece la Política Nacional de Humedales del Estado en la República de Panamá	Decreto Ejecutivo 127, 2018	Ministerio de Ambiente (MiAmbiente)	• A new, more ambitious national wetlands policy is created. It is based on many principles: the precautionary principle, integrated ecosystem approach to wetland management, public participation, respect for cultural diversity, and adaptive management. This new approach aims to enhance the participation of civil society in wetland management and conserve wetlands to attain multiple Sustainable Development Goals. • The policy is enacted until 2050 and must be updated and evaluated every 5 years.	Still in effect.

4.3.2 Sectoral Responsibilities, Management, And Coordination

Mangroves have been under the jurisdiction of several government agencies. Table 4.2 shows the range of agencies that have mangrove management responsibilities or have developed mangrove-related legislation, such as the Instituto Nacional de Recursos Naturales Renovables (INRENARE), Autoridad Nacional del Ambiente (ANAM), Autoridad de los Recursos Acuáticos de Panamá (ARAP), and the Ministerio de Ambiente (MiAmbiente). Shifting institutional structure has led to an 'institutional maze', where a lack of institutional memory has created high levels of confusion for the government and the public.

The Ministry of Environment (MiAmbiente) holds the central coordinating role in mangrove protection and inter-institutional collaboration. It exercises this authority employing the EIA process in which it must approve development projects across all sectors. However, current legislation fails to mention coordination between MiAmbiente and ARAP, who oversees the fisheries aspect of mangrove management. Some informants mentioned that coordination and communication are successful throughout the divisions of MiAmbiente that share responsibilities over mangrove forests: Dirección Forestal (Forestry Division), Dirección de Áreas Protegigas y Biodiversidad (Biodiversity and Protected Areas Division), and Dirección de Costas y Mares (Coasts and Ocean Division). Yet informants working for MiAmbiente did not mention coordinating with ARAP employees, and ARAP informants reported distrust with MiAmbiente's communication of information, in that little was shared with their institution:

> *"It is hard to know how far their responsibility as an institution reaches and how far mine as an institution reaches, precisely because of this issue with the fishermen [who depend on mangroves]. We are the governing authority on the subject of fishing. How is it possible that they don't tell me anything?"* (ARAP informant)

Moreover, many of the most central actors in mangrove management and policy in Panama focus on the Ramsar Convention on Wetlands of International Importance, ratified in 1992. Panama purposefully created two institutions to advance the agenda of this convention, such as Ramsar-CREHO in 2003 (the Regional Ramsar Centre for the Western Hemisphere), and the National Committee on Wetlands (created through Resolución AG-0038 in 2007). Through

concerted actions of academics, NGO leaders, government policymakers, as well as international cooperation with other Ramsar offices, these advisory bodies have multiple mandates: to manage wetlands, provide technical support to the National Government on wetland science and inventories, implement the National Policy on Wetlands, and promote outreach programs related to wetlands (Resolución AG-0038, 2007). Despite these mandates, many barriers reportedly slow their fulfillment. First, participants from the National Committee on Wetlands and Ramsar-Creho outlined a need to develop new regulations specifically designed for mangrove forests. Yet, due to their ties to the government and their position as an advisory board, they were not in a suitable position to propose new legislation in the National Assembly. Instead, non-governmental actors were relied on to perform that task, in spite of coordination with non-governmental actors being considered slow and laborious. These observations point to a possible lack of leadership in convening all actors and agreeing or delegating tasks. Second, an important but sometimes overlooked barrier was a reported lack of long-term financing. The Ministry of Environment's Division of Coasts and Oceans, who also has a central role in wetland advisory boards, was reported to have a deficient operations budget and a lack of technical personnel. Monitoring of coastal habitats and patrolling are crucial operations amidst trends of illegal deforestation, but they are also costly. While international funding is provided for sporadic initiatives, such as the 'blue carbon' project that quantifies ecosystem services performed by coastal ecosystems (MiAmbiente, 2020), funding for monitoring and enforcement is generally lacking and intermittent. This situation can create significant power imbalances when facing corporate stakeholders, who may have a competing interest in mangrove management. More attention to the potential for public-private partnership models may be useful.

Our participants also described a general reluctance among government agencies to protect wetlands and a lack of political interest in that theme, aside from those governmental stakeholders directly involved in wetland advisory bodies. Some informants related this to the private business of elites, which allegedly interfere with State decisions:

> *We are talking about mangroves and suddenly someone comes with machinery. It is the tragedy of the commons, in the sense that generally mangroves are common lands of the State and many times there are the private interests of someone in particular who uses their economic or political influence to influence*

decisions, degrade the mangrove, and derive gain from those wetlands. (Informant from a non-governmental organization)

Every time you do something about wetland protection, there is somebody trying to stop it. (Government informant)

These observations echo those of A. K. Spalding (2013) and Thampy (2014) in that the Panamanian government has evolved a regulatory system that fosters economic growth through foreign investment in coastal zones, at the cost of environmental change. For some informants, refusing to gain an advantage when economic opportunities arise is often viewed as "un-Panamanian", even when the alternative involves the protection of key ecosystems.

4.4 Discussion and Conclusion

4.4.1 Unclear or Conflicting Policy Objectives and Antagonism with Private Sector Actors

Mangrove policies in Panama are characterized by their multiplicity and internal contradictions. Because of the variety of institutions that shaped policy, multiple 'streams' of policy have been developed over time, even though they are not consistent with one another. Cross-sector links between decree-laws also appear deficient (Suman, 2002). This 'divergent evolution' of mangrove policies creates conflicting policy objectives and can eventually lead to policy implementation failures. According to policy implementation theory (Hudson et al., 2019), policy failure in Panama's mangroves has occurred in the first stage of policy implementation, which is policy design. Faulty policy design can stem from many causes: poor understanding of the problem; insufficient knowledge of the implementation context; unclear and even contradictory goals; and absence of political backing (Hudson et al., 2019). In Panama, many causes appear to be present. International NGOs and agencies, as well as many environmental scientists, appear to have shifted their discourse in recent years, claiming that conservation and development goals need to converge (Ioris, 2014; Ministerio de Ambiente & PNUD, 2018). Yet the discourse of wetlands as a conservation priority does not seem to appeal to elected officials. For the Panamanian government, economic development has historically been prioritized over environmental conservation. While mangrove benefits are known and celebrated in key national policy documents (Kaufmann & Miró, 2012; Ministerio de Ambiente & PNUD, 2018; Romero Hernández, 2016), shared understandings

between all stakeholders and by the public were observed to be lacking. Environmental conflicts opposing private sector actors and civil society are common in Panama's mangrove management context (Mejía, 2020) and are mirrored by these conflicting directives from governmental agencies. Numerous laws have been developed to address ecosystem preservation and establish a high conservation priority for mangroves, but they remain ineffective because they are not fully utilized. Legal exceptions to mangrove protection for approved development projects create competition with conservation policies and effectively dominate the policy discourse. Furthermore, compliance with mangrove protection laws is challenging. Faced with the superior bargaining power of actors associated with coastal development, proposed development projects can be approved while established protected areas and international agreements, such as the Ramsar Convention, are ignored (Suman, 2014). This incapacity to deliver on commitments made under Conventions, combined with the subsequent lack of trust in governmental institutions responsible for wetlands displayed by civil society, are signs of weak forest governance (Irland, 2008). Results from this study emphasize that mangrove mismanagement in Panama appears closely connected with competing agendas within government and pro-development politics that conflict with conservation policies, as argued by other authors (Castellanos-Galindo et al., 2017; Suman, 2014). These factors, combined with inadequate human and financial resources, mean further stages of policy implementation in Panama (tracking, implementation support, evaluation, policy review) have not yet been attained and could be further examined (Hudson et al., 2019).

In a systematic literature review on sustainability policy failure, Howes et al. (2017) found that recurring causes of implementation failure include the preference for economic outcomes over environmental ones, concern with market failure, and the lack of market instruments to address environmental issues. These findings apply to the context of mangrove management in Panama. To move beyond the expected environmental versus development trade-off, several studies have highlighted opportunities for greater private sector engagement in mangrove management. Private sector participation could, for example, strengthen the idea that conservation and development are not necessarily antagonistic and can foster more cooperative relationships between stakeholders (Friess et al., 2016; Nickerson, 1999). Private-sector approaches to mangrove management include traditional unilateral donors, corporate social responsibility initiatives, and market-based ecosystem service instruments (Friess et al., 2016). Of particular interest to Panama is the payment for ecosystem services (PES) tool, which can "address overlapping or conflicting policy objectives

by […] allowing stakeholders from community to national levels to coalesce around a clear PES objective" (Friess et al., 2016, p. 941). Due to heavy investments in Central America for 'blue carbon' projects that require ecosystem service quantification, Panama appears well placed to engage in PES with private sector actors. This approach could also help generate much-needed funds for mangrove conservation.

Alternative approaches to private sector engagement could also focus on stricter legal frameworks, an approach favored by many mangrove-bearing countries (Slobodian & Badoz, 2019). Environmental law 'slippage', whereby compliance with laws is deficient and regulators fail to act on transgressions (Farber, 1999), was observed in our study and other mangrove management studies in Panama (Castellanos-Galindo et al., 2017; Suman, 2014). Lessons may be offered by Costa Rica and Chile's approach, having established an Environmental Administrative Tribunal as a mechanism enforcing environmental regulations (Slobodian & Badoz, 2019), imposing sanctions, and applying interim protection measures after legal transgressions of different stakeholders, including land-use change in urban areas. Similar tribunals adjudicating for sustainable mangrove management cases are also present in Kenya and India (Slobodian & Badoz, 2019). Nevertheless, in contexts where the government is complicit with transgressions, stronger enforcement measures and focus on compliance may be misguided and ineffective. Greater emphasis could be put on devolving more power to institutions like the National Committee on Wetlands, who are already dedicated to aligning policies with international discourses on habitat conservation, ecosystem services, and nature-positive cities. By including new actors in this committee, such as community representatives, such institutions would be positioned to promote a more sustainable – and participatory – approach to wetland management.

4.4.2 Collaborative Management

Policy implementation failure can also be related to a lack of continuous collaboration between the multiple stakeholders at the political, policymaking, managerial, and administrative levels as well as the lack of engagement of end-users and local communities (Hudson et al., 2019). This connects with Panama's history of agency overlap, confusing institutional landscape, and multiple policy 'streams' (A. K. Spalding et al., 2015). Mangroves have been governed by at least twenty laws and policies, overseen by six institutions (Tarté, 2013). These complex governance environments are common in mangrove forests but are known to impede coherent policy formation

and leave agencies with conflicting aims and responsibilities (Friess et al., 2016). Due to recent policy updates, Panama has central coordinating agencies that oversee mangrove management: The Ministry of Environment, in addition to the Ministry of Housing and Land Use Planning (MIVIOT) who is responsible for municipal land use plans. However, coordination and regular communication beyond the Ministry's divisions and across agencies were still reported to be challenging. Collaborative management strategies could help to address some of the issues identified, while also opening forest management discussions to other stakeholders.

Most importantly, more attention may be devoted to the influence of multiple parties in mangrove management: "*The success of multi-party planning depends not only on the nature of interactions among participants but also hinges on who is not participating and how they may be influencing management activities outside of formal collaborative processes."* (Safford, 2012, p.180). Multi-stakeholder partnerships could include actors within the academia, NGOs, coastal communities, and the private sector. Industry and business sector organizations have substantial influence over mangrove management, as seen in the case of Panama Bay (Castellanos-Galindo et al., 2017; Suman, 2014), but they are peripheral players in multi-party management efforts, such as the National Committee on Wetlands. Political lobbying combined with an absence from multi-party processes have possibly impeded the development of shared understandings on the use and conservation of wetlands (Safford, 2012). As argued by Safford (2012), wetland managers could better acknowledge the political nature of management activities and illustrate to politically engaged actors that multi-party planning does not undermine their interest. Yet, when reuniting actors with vast power asymmetries, collaborative and equitable outcomes may be hindered, especially since lasting antagonism between land developers and coastal communities has led to environmental conflicts in the past (Mejía, 2020). Bringing these groups together and applying conflict resolution and mediation techniques can diffuse the tension between these actors and build a foundation for greater consensus (Safford, 2012).

Currently, local communities are also peripheral actors in Panama's mangrove management. Mangrove-dependent communities are closely intermeshed with ecosystem-level outcomes for reasons of resource use and poverty alleviation. The inclusion of local communities is likely to be particularly important to avoid restricting community use of mangroves (DasGupta & Shaw, 2017; Dev Roy, 2012; Félix & Hurtado, 2019), as well as to address underlying issues of

illegal logging and poaching, which are often connected to unresolved property rights (Amacher et al., 2009; Clarke et al., 1993). The needs of local communities in Panama's coastal management have been given scarce attention, as shown by evidence of unfair property rights and access to coastal zones (A. K. Spalding et al., 2015), deforestation of habitats that support artisanal fisheries (Suman, 2014), and absent community representation in management boards such as the National Committee on Wetlands. Collaborative management has the potential to reorient conversations about mangroves back to its primary users amidst trends of privatization of coastal land (A. K. Spalding et al., 2015). Recent policy developments such as the National Policy on Wetlands identify objectives of integrated coastal zone management (ICZM) and participatory approaches, yet mechanisms to devolve power to communities and move beyond mere consultation are unspecified (Ministerio de Ambiente & PNUD, 2018). To ensure participation is effective and inclusive, participatory management in mangroves can require rigorous incentive design (DasGupta & Shaw, 2017). This is especially relevant due to historical inclinations of top-down forest management, strict control, and patrol of forests, which may create path-dependency and strong inertia towards institutional change. Without clear roles for local communities in existing institutions, Panama risks further antagonizing its mangrove users.

Further research efforts could address strategies of fishermen groups, local resource users, and NGOs to face power imbalances with private sector actors who interact frequently with natural resource management professionals and apply coercive pressure. In multi-actor management boards such as the National Committee on Wetlands, research could also clarify the relationships between all participating actors, level of internal consensus, effective coordination strategies, shared recognition for the utility of collaborative inputs, consistent participation, and power differentials. Insights into these collaborative processes could clarify avenues for a more sustainable approach to mangrove management, whereby multi-actor committees and civil society are given a more active role.

4.5 Acknowledgements

We would like to thank the Smithsonian Tropical Research Institute for their logistical support during fieldwork around Panama. Thank you to our research assistant, Gabriel Thomas Estrada, for his precious help and insight during data collection. We are also grateful for the participation of all interviewees in the study for their time and effort.

This research was carried out with the financial support of McGill University through the Natural Resource Sciences Department and the Neotropical Option program, as well as the Smithsonian Tropical Research Institute. The Social Sciences and Humanities Research Council of Canada (SSHRC) and the Fonds de Recherche Société et Culture du Québec (FRQSC) also funded this research. A special thanks to Dr. Owen McMillan from the Smithsonian Tropical Research Institute for his generous support of this research project and funding of a research assistant position.

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Chapter 5 – General Discussion

5.1 General Discussion on Collaborative Governance

Based on the findings outlined above, potential areas for improving sustainable mangrove management and related policymaking will be described.

In natural resource management, there is a common line of reasoning that points to a broadening of non-state activity in the policy process, in a way that favors more equitable, participative, and politically engaged forms of decision-making (Fish et al., 2010). According to Fish et al. (2010, p. 5624), the role of the state has evolved across time:

> "*Since the 1980s […], the historically central role of the state and its bureaucracies in activities of planning, regulation, policy implementation, monitoring, and evaluation has been recast under the ascent of more liberalized economic regimes. As a consequence, it is claimed that regulatory and institutional decision-making increasingly involves actors operating beyond the boundaries of formal government as well as traditional state-based agencies and bureaucracies. In an era of 'governance', then, distinctions and boundaries that previously defined state-market-civil society relations are thought to have increasingly blurred."*

As a response to adversarial relationships between interest groups, collaborative governance emerged to consolidate social relations and the 'downstream' implementation of regulations (Ansell & Gash, 2007). Collaborative governance is touted as a solution to complex – at times *wicked* – environmental and social challenges because of the highly interactive and adaptive processes of collaboration that can be fostered, considered capable of transforming social relations across time (Fish et al., 2010; Nikolakis & Hotte, 2020). There is rising demand for collaboration as "knowledge becomes increasingly specialized and as institutional infrastructures become more complex and interdependent" (Ansell & Gash, 2007, p. 544). Our research suggests that collaborative governance is well suited to the practice of mangrove management, which often combines diverse actor groups displaying significant power asymmetries and discordant value judgments (Djosetro & Behagel, 2020). Since conflicts over land and marine resources are often common, collaborative dialogue and enduring interactions can be useful to create shared understandings, provided that groups begin to appreciate their interdependence and build trust

(Djosetro & Behagel, 2020; Fish et al., 2010). The need to enhance coordination (one important aspect of collaboration) among stakeholders is particularly clear in the context of mangrove management (Bandaje et al., 2017). Stakeholders from the village level, different levels of government, scientific research agencies, the private sector, and NGOs must be able to work together and keep up with evolving institutional arrangements and ecosystem changes (Bandaje et al., 2017).

In Chapter 3, collaboration was found to be a driver of success in all previously identified measures to advance sustainable mangrove management (financing, restoration, education, planning, and law enforcement), to the point where it should be considered an essential measure of its own. In Punta Galeta, we observed a situation where repeated interactions and "small wins" between conservation officials and neighboring companies drove mutually acceptable conservation outcomes, all the while enhancing corporate social and environmental responsibility (Ansell & Gash, 2007). However, it was also clear that such collaboration could be strengthened. For instance, a co-management board was created to facilitate multi-actor coordination, yet it failed due to a lack of stakeholder engagement. In the absence of a defined mechanism for coordination, actors at the community level, municipal level, and district-level reportedly were reported to not hold joint meetings. As a result, government officials responsible for mangrove protection and management may have overlooked the potential of collaboration to address a complex problem that no actor can solve alone.

Building on these findings, Chapter 4 supported the potential for collaborative governance to be useful in Panama to better manage and regulate mangroves. The challenges of multi-actor coordination were found to be even more pervasive at the national level, where governmental agencies, NGOs, private interests, and community interests coalesce in such a way as to create an "institutional maze". Existing multi-party platforms such as the National Committee on Wetlands do not include all concerned stakeholders, such as community-level and business actors. Greater interest in collaborative approaches and institutional reinforcement could ensure that necessary levels of inclusivity, regular communication, participation during meetings, and internal consensus can be better addressed (Safford, 2012).

While collaboration typically aims for shared power (Crosby et al., 2005), the need to address and account for power asymmetries appeared to be a secondary consideration in mangrove

management. Dengler (2007) illustrates the importance of this issue and argues that organizations bestowed with different degrees of power can collaborate to achieve agreed policy outcomes: "*Applying the Foucauldian adage that 'knowledge is power' to a shared-power world means that no individual or organization possesses absolute power in decision-making"* (p. 429). Stakeholders affecting and affected by Panama's mangrove management face divergent levels of power, resources, knowledge, and influence over decision-making, especially since elite business-sector actors are decried to exercise overt control over coasts (Castellanos-Galindo et al., 2017; Spalding et al., 2015). In addition, reported community exclusion from management committees further exacerbates their lack of power and sufficient credibility to merit membership. The influence of community actors in decision-making processes remains uneven, which risks perpetuating community-level problems such as contamination, lack of access to mangrove forests, and weak compliance with conservation measures.

Although collaborative governance is pertinent to mangrove management, it is not a 'silver bullet'. Amidst persistent lobbying by social elites, the government is disinterested in devolving more power to communities and investing in more tedious deliberative processes (Colfer & Pfund, 2011). In Panama, approaches based on coordination and collaboration have been proposed by multiple authors without triggering genuine interest from authorities (Spalding et al., 2015; Suman, 2002). This can be seen as a fundamental management problem, whereby there are only symbolic attempts by government elites and by peripheral actors to be integrated into development strategies. While a lack of political interest in collaboration is plausible, there may also be persistent path-dependency of previous management approaches: "*Perhaps most significantly, the obstacles of making a full transition from old systems of governing and policy-making to a new ethic and regime of collaborative governance should not be underestimated. Other models of policymaking, which rely more on political influence, technocratic tools, and bureaucratic structures are deeply embedded in the institutional systems […] and will not easily be removed or reformed"* (Fish et al., 2010, p. 5626). In both cases, critical groups and grassroots mobilization efforts can use current events as opportunities to formulate critiques of unfair and unsustainable management and promote greater public participation (Ioris, 2010).

5.2 References

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Chapter 6 – General Conclusion

6.1 Key Findings

This thesis presents novel findings on the challenges and opportunities leading to sustainable mangrove management (SMM) in Panama. In Chapter 2, SMM was defined by various international institutions, and key barriers to SMM performance were reviewed in Latin American contexts and beyond. Chapter 3 presents a case study of the mangrove forests at Punta Galeta, analyzing local-level SMM issues through the five key measures identified by the Bali Call to Action, a non-negotiated international policy framework on SMM. The results revealed the central importance of collaboration to bind all aspects of mangrove management together, suggesting that a key measure may be missing from international mangrove discussions. Collaboration was found to underpin many of the reported successful SMM initiatives, from the development of environmental education programs to corporate sponsorship of mangrove restoration and conservation. Meanwhile, a lack of collaboration was associated with a lack of engagement by municipal authorities and absence of community participation. Drawing on the concept of collaborative governance, findings suggest that further emphasis on multi-stakeholder partnerships, trust-building, and consensus-oriented decision-making could enhance the sustainability of mangrove management in Punta Galeta.

In Chapter 4, we investigated the policies and laws in place to protect mangrove forests at the national level in Panama. Recognizing previously identified mangrove management challenges (Castellanos-Galindo et al., 2017; Suman, 2014), policies and key informant interviews were analyzed to identify avenues for improvement in policy implementation. Findings outline a central issue of competing governmental agendas, which leads to a lack of implementation of mangrove protection policies. This is mirrored by institutional structures that favor private interests and relegate civil society and multi-stakeholder decision-making bodies to less empowered positions. In this context, collaborative governance once again offers potential avenues for the empowerment and expression of all stakeholders' perspectives.

6.2 Future Directions

This thesis points to the need for further research in several fields connected to sustainable mangrove management (SMM). First, SMM remains to be formally described in scientific

frameworks, as SMM currently relies on literature developed for sustainable forest management and wetland management (Slobodian & Badoz, 2019). Specificities of SMM adapted for mangroves' peculiar biology and geography would be helpful for policymakers, managers, and researchers alike.

While our research supports the need for collaborative governance, future research endeavors could investigate more systematically the process of collaboration, encompassing the six steps outlined by Nikolakis & Hotte in 2020 (starting conditions, institutional design, facilitative leadership, collaborative process, systems context, and outcomes). Since our approach was exploratory, collaborative management of mangrove forests in Panama can be further analyzed in all stages of the decision-making process. Of particular interest are issues of institutional design in multi-actor boards on mangrove management, encompassing participatory inclusiveness, assigned roles, clear ground rules, and process transparency (Ansell & Gash, 2007). Knowing that large power asymmetries are a characteristic of Panama's mangrove stakeholder network, researchers could further clarify how these factors constrain participation and how mediation techniques might transform power structures (Ozawa, 1993). Diversifying stakeholder networks can also lead to trade-offs between competing objectives and reconciling different values regarding the use of land (Fish et al., 2010). These competing values could be further analyzed and tied to state objectives, using an approach similar to Safford's (2012).

Building on the policy analysis in Chapter 4, legal instruments could be further investigated using a framework based on collaboration. Collaborative governance literature has paid little attention to the influence of legal approaches (Nikolakis & Hotte, 2020). The central role of the state in shaping mangrove policy and management can also be further assessed in terms of organizational change, and adaptability when faced with socio-ecological challenges (Ioris, 2012). In Panama, policies could clarify how mangrove conservation objectives will be implemented and what roles will be devolved to each actor, as Panama's current path towards being a transactional society seems to lead away from many environmental targets. Sustained effort and institutional strengthening are needed to avoid losing mangroves – biological monuments deemed national heritage – to political and institutional malaise.

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Appendices

Appendix 1. Participant Consent Form (in Spanish)

Formulario de consentimiento del participante

Investigadores
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Título del proyecto: Mejoramiento de la gestión sostenible de los manglares a través de perspectivas compartidas de los grupos de interés: el caso de Punta Galeta, Panamá

Patrocinador (es): Beca STRI-McGill-NEO (Instituto Smithsonian de Investigaciones Tropicales en colaboración con McGill); McGill Graduate Excellence Award.

Usted ha sido invitado a participar en esta investigación porque estamos interesados en conocer sus experiencias relacionadas con el acceso o la gestión del manglar de Punta Galeta.
Esta página es para brindarle información que lo ayudará a decidir si desea participar. Haga preguntas al equipo de investigación.

¿De qué trata el estudio y cuánto durará?
El objetivo de este estudio es comprender las perspectivas de las partes interesadas en la gestión de los manglares de Punta Galeta (las personas que tienen interés en los bosques de Punta Galeta, por ejemplo, residentes, administradores, responsables políticos, etc.). Esto ayudará a mantener prácticas sostenibles de manejo de manglares. Lo entrevistaremos por aproximadamente una hora. Nuestro equipo permanecerá en Panamá durante tres meses, hasta abril de 2020. No dude en hacernos cualquier pregunta o pedirnos que nos veamos en persona.

¿Cuáles son las razones clave por las que podría elegir ser voluntario para este estudio?
Esperamos que esta investigación lo beneficie al brindarle información y conocimientos sobre el manejo de los manglares en Panamá. Nuestro equipo también espera proporcionar recomendaciones sobre cómo hacer que la gestión de manglares de Punta Galeta sea más sostenible.

¿Cuáles son los riesgos involucrados en participar en este estudio y qué estamos haciendo para minimizar los riesgos?
Le haremos preguntas a los residentes sobre su uso de los recursos de manglares y en qué área se encuentran estos recursos. Esta información puede ser delicada porque los participantes pueden no querer que se publique la ubicación de los recursos de manglares. Para reducir los riesgos, no publicaremos ni compartiremos información sobre la ubicación de los recursos de manglares utilizados por los miembros de la comunidad. No se transcribirá ninguna otra información que los participantes no acepten compartir.

Además, reconocemos que la información sobre el manejo de los manglares puede estar relacionada con tensiones entre los miembros de la comunidad y empresas privadas. Para proteger a los participantes, nos aseguraremos de que todos los datos sean confidenciales. Todos los datos serán analizados por grupos de partes interesadas (residentes, empresas, ministerios, etc.). Nadie, aparte de Sarah Chamberland-Fontaine y el Prof. Gordon Hickey, podrá identificar a los encuestados individuales. Los participantes pueden solicitar ser identificados, pero solo enumeraremos su posición profesional.

¿Tienes que participar en el estudio?
Si decide participar en el estudio, debe ser porque realmente quiere ser voluntario. Puede detenerse en cualquier momento u omitir preguntas que no desea responder. No perderá ningún servicio, beneficio o derecho que normalmente tendría si elige no ser voluntario o si se detiene temprano o se salta preguntas.

¿Qué pasa si tiene preguntas, sugerencias o inquietudes?
La persona a cargo de este estudio es Sarah Chamberland-Fontaine, investigadora de McGill-Smithsonian, en el Instituto Smithsonian de Investigaciones Tropicales. Si tiene preguntas, sugerencias o, inquietudes con respecto a este estudio o si desea retirarse del estudio, mi información de contacto es:

sarah.chamberland-fontaine@mail.mcgill.ca
514-797-2702 (Canadá)
507-6043-9723 (Panamá)
Departamento de Ciencias de Recursos Naturales, Universidad McGill

Si tiene alguna pregunta, sugerencia o inquietud sobre sus derechos como voluntario en esta investigación, comuníquese con el personal de la Oficina de Cumplimiento del Smithsonian entre las 8 am y las 5 pm, de lunes a viernes al 202-633-7110. También puede comunicarse con el Gerente de ética de McGill en Canadá al 514-398-6831 o lynda.mcneil@mcgill.ca.

Procedimientos de estudio

Este estudio se basa en la observación participativa, entrevistas y grupos focales. El investigador observará actividades relacionadas con el manejo de manglares en Punta Galeta. También observará interacciones entre grupos de participantes. Tomaremos notas sobre nuestras observaciones y, en algunos casos, haremos grabaciones de audio y fotografías, con el

consentimiento de los participantes. Las fotografías mostrarán la participación de la comunidad y otros actores durante las actividades en Punta Galeta.

En entrevistas no estructuradas, los investigadores entrevistarán al participante sobre un tema específico relacionado con la interacción o manejo de los manglares durante aproximadamente una hora. Los datos serán grabados en audio, con el consentimiento de los participantes, nuevamente. Los grupos focales involucrados tendrán discusiones grupales sobre temas específicos.

Consentimiento:

Puede negarse a participar en cualquiera o todos estos métodos y en cualquier momento. También puede negarse a responder cualquier pregunta y retirarse sin ninguna consecuencia. Los datos, podrán ser divulgados, pero nunca cualquier información que identifique a los participantes, más bien estarán a disposición de otros investigadores como requisito para publicar los resultados de la investigación. Si se retira de este estudio, sus datos se eliminarán de futuros análisis y publicaciones. Las grabaciones de audio solo se utilizan para complementar las notas escritas a mano y puede rechazar en cualquier momento la grabación. La fotografía solo se realizará con personas que den su consentimiento, incluidas aquellas tomadas en espacios públicos. No se tomarán fotografías de menores. Tenga en cuenta que 7 años después de la publicación de los resultados, todos los datos serán completamente anonimizados, y los datos de los participantes individuales ya no podrán ser retirados. Las grabaciones de audio y las fotografías serán destruidas 7 años después de la publicación.

Compensación:

No se ofrecerá compensación monetaria a los participantes.

Confidencialidad:

Para nosotros es muy importante que su participación sea confidencial. Su nombre y el nombre de su empresa u organización no se asociarán con su entrevista, a menos que usted nos permita hacerlo. Sin embargo, la región en la que se encuentra puede aparecer en publicaciones y presentaciones. Cuando transcribamos los datos de las entrevistas, se le identificará con un código de identificación en lugar de su nombre. Solo Sarah Chamberland-Fontaine y el Prof. Gordon Hickey tendrán acceso a los datos de materiales identificables (esto incluye grabaciones de audio, notas escritas a mano y su formulario de consentimiento). El Dr. Stanley Heckadon - Moreno tendrá acceso a transcripciones no identificadas. Todos los documentos se almacenarán de forma segura en un archivador cerrado y/o archivos de computadora protegidos con contraseña.

Los resultados de esta investigación se difundirán en una tesis de maestría, en publicaciones académicas, en presentaciones de conferencias y en reuniones con socios y colaboradores. A medida que avance esta investigación, los resultados se difundirán a los miembros de la comunidad a través de presentaciones y debates para garantizar que las interpretaciones de los datos sean similares a las aportaciones de los participantes.

Si elige participar en grupos focales (entrevistas grupales) o mapeo participativo, debe comprender que las entrevistas grupales se grabarán en audio y que otros miembros del grupo focal escucharán lo que usted dice y lo verán. Otros miembros del grupo focal serán residentes locales de la comunidad del residencial Los Lagos y La Playita. El mapeo participativo combinará participantes como los residentes locales y el personal de Punta Galeta y los coadministradores forestales que trabajan para STRI. Si no desea hablar libremente sobre el manejo de los manglares frente a otros o ser grabado en audio, no debe participar en un grupo focal o en un ejercicio de mapeo participativo.

Indique si acepta que se grabe en audio y / o se fotografíe (si corresponde), y si acepta ser identificado en la investigación. No consentir la identificación no lo descalifica de esta actividad de investigación.

Acepto ser grabado (si corresponde): SI____ NO____

Acepto ser fotografiado (si corresponde): SI____ NO____

Acepto ser identificado en los informes: SI____ NO____

Acepto que se use el nombre de mi organización en el informe: SÍ ____ NO____

Preguntas:

Si tiene alguna pregunta o necesita más información con respecto a este proyecto, puede comunicarse con Sarah Chamberland-Fontaine en sarah.chamberland-fontaine@mail.mcgill.ca o 507 212-8068.

Si usted tiene algunas preocupaciones éticas o quejas acerca de su participación en este estudio, y desea a hablar con alguien que no en la investigación del equipo, por favor, póngase en contacto con la McGill Ética Gestor al 514-398-6831 o lynda.mcneil@mcgill.ca. .

Por favor, firmar a continuación si usted ha leído la anterior información y el consentimiento para participar en este estudio. Estando de acuerdo a participar en este estudio y no renuncia a ninguna de sus derechos a liberar los investigadores de sus responsabilidades. Una copia de este formulario de consentimiento le puede ser entregado y el investigador va a mantener otra copia.

Nombre del participante: (en letra de imprenta)
Firma del participante: _____
Fecha: _____

¡Gracias por participar en este proyecto!

Appendix 2. Semi-structured Interview Guide

The following is a guide for interviews and/or focus groups with stakeholders around Punta Galeta. Both of these methods will be unstructured and will evolve from a prompt or series of prompts related to the participant's experiences and the research questions. The participants will then have a great deal of control over the direction of the interview. This schedule serves as a description of both interviews and focus groups because both with unfold in the same manner, with the exception being interview data will be created through discussion between the researcher and participants, and focus group data will be created mainly through discussion between participants.

1) Explanation of the process

We explain who we are and what is the rationale for this study. We also go through the consent form point by point and explain what will be done with this information. Participants will be allowed to ask any questions they may have. Participants will then either consent or not consent to participate and to be audio-recorded.

We explain that we are here to learn from them, and that data collection will occur in a conversational format. We clarify that the purpose of the focus group is not to achieve consensus. Rather, it is to discuss questions together and gain as much information as possible from everyone's different perspectives, ideas, and insights.

2) Questions on background information

- Ask for the participants to introduce themselves and their organization
    - Is their work related to mangrove forests? If so, what are their responsibilities?
    - Do they live near mangroves?
- Do you find mangrove forests important? Why?
    - Preservation versus sustainable use
    - Any experiences related to using resources found in mangroves (timber, fish, scrap metal, invertebrates, hunting)?

3) Questions on system context

- Have you noticed changes in the mangroves?
    - How has that affected you?
- Do you think that mangrove conservation in Punta Galeta is beneficial to you and your family?
    - How does your community perceive the Punta Galeta area?
- What are the challenges that mangroves face around here?
- What is your vision for the future of this area?
    - Are there any coastal development projects that you and your family find concerning?

4) Questions on access to resources (if the participant harvests resources)

- What limits your access to mangrove resources?
    - What are the factors that prevent you from fishing/metal recycling in mangroves?
    - What are the factors that help you do so?
    - What do you think could help you access the resources you want?
- Have you noticed changes in the rules related to accessing mangrove forests since you were a child?
    - Why do you think this is?

5) Questions on partnerships and management

- How is the mangrove forest managed?
    - What could be improved?
    - What works well?
- Do you partner/interact with other organizations around Punta Galeta?
    - How would you describe your relationship with them?
    - How are partnerships with other organizations established?
    - How do you consult with the people, groups, and communities around mangroves?
- Do you interact with the Smithsonian and the Environment Ministry for your activities?
    - What facilitates your work together?
    - What is a challenge in your work together?
- Do you think Punta Galeta is well respected by other stakeholders?
    - Why?
    - What makes it important? Is it the science, the educational programs, Stanley?
- Who do you think should be responsible for mangrove protection or sustainable management?
- Is there someone I should talk to next?

6) Conclusion

The participant or participants are given the opportunity to provide feedback on the research activity. The researcher thanks the participant(s) for contributing to the research. The researcher will share upcoming opportunities for the participant to take part in 'member checking' of the conclusions and workshops/presentations based on the results.