

Improving Wetland and Shorebird Protection in Panama Bay, Panama

Advanced Conservation Strategies

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0. Introduction

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About this Publication

This publication is a result of a Conservation Landscape Assessment in Panama Bay, Panama conducted by Advanced Conservation Strategies in 2015 for the David & Lucile Packard Foundation. It is a result of primary and secondary research, including interviews conducted in Panama City. The research team consisted of natural scientists, social psychologists, architects, and land use planners. The goal was to assess the state of shorebird habitat protection in Panama Bay and how it fits into the larger landscape and dynamics surrounding the Panama City metropolitan area. We provide a series of broad, forward-looking recommendations that resulted from the assessment.

This publication and supporting materials are available online at <http://www.panama.advancedconservation.org>

Recommendations from the Conservation Landscape Assessment.

As the environmental community focused on the Panama Bay moves into a more proactive phase to define and implement management actions for the Panama Bay Protected Area, increasing the number of active stakeholders will be important. Working beyond the boundaries of the Protected Area will also be important as potential impacts are largely from surrounding development. More science is needed focused on shorebirds and shorebird habitat, and mechanisms are needed to build in-country scientific capacity.

In this report, we provide five broad recommendations that are focused on increasing the science and stakeholders inside and outside of the Panama Bay Protected Area.



Seasonal upwelling, which brings nutrient-rich waters to the surface, combined with the seven-meter tides of Panama Bay are likely major factors contributing to the large expanses of mudflats, which are an important food source for millions of shorebirds.

1 Scope

Shorebirds are declining worldwide. They are migratory, traveling as much as 30,000 km a year and spending up to two-thirds of the year at wintering grounds. Panama Bay is one of those places. Wintering grounds are important because they provide abundant food so that shorebirds can build fat reserves for long distance migration. While the reasons for shorebird declines are many, wetland degradation at wintering sites is a driving factor. Shorebird habitat has been impacted globally due to coastal development and other human activities. Sand mining and pollution have also been linked to shorebird declines. In India, for example, many wetlands now have such high levels of pollution that the resulting eutrophic habitat is unsuitable for shorebirds.

Little is known about the wintering shorebirds of Latin America. However, for most imperiled species that breed in the Americas, initiatives such as the Ramsar Convention and the Western Hemisphere Shorebird Reserve Network (WHSRN) have identified the most important wintering areas¹. The WHSRN network includes 90 sites in 13 countries. The Panama Bay is the only WHSRN site in Central America.

Researchers conducting shorebird surveys in the late 1990s documented the massive number of shorebirds that use Panama Bay. They observed up to 370,000 birds in one day, which represents 10% of all neotropical wintering shorebirds. Seasonal upwelling, which brings nutrient-rich waters to the surface, combined with the seven-meter tides of Panama Bay are likely major factors contributing to the large expanses of mudflats, which are an important food source for millions of shorebirds. At least 33 shorebird species are known to use Panama Bay. Some species are in decline². The most abundant are small shorebirds like Western Sandpipers (*Calidris mauri*), Semipalmated Sandpipers (*Calidris pusilla*) and Wilson's Plovers (*Charadrius wilsonia*). Researchers believe that over 1 million Western Sandpipers use Panama Bay, which represents 30% of the world's population. The majority of shorebirds in Panama Bay are concentrated along the shoreline closest to Panama City.

¹ The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty for international cooperation for the conservation and wise use of wetlands and their resources.

² For a list of shorebirds of Panama Bay and their conservation status, see <http://panama.advancedconservation.org>

1. Scope

While we know the species and relative numbers of shorebirds that rely on Panama Bay, less is known about their health. There are grounds, however, for concern. In addition to the mudflats, shorebirds rely on mangroves as roosting sites—areas which they use for rest and shelter. Development around Panama Bay over the past two decades has negatively impacted some mangrove areas. While the results are preliminary, ongoing research by University of Panama Professor Ricardo Pérez suggest a 25% decline in Western Sandpipers over the past decade. More research is needed on the health of Panama Bay's shorebirds. Yet, information on shorebirds is just one of the limiting factors for improved habitat protection in the Panama Bay.



Barriers to Shorebird Habitat Protection in Panama Bay

There are five limiting factors that are barriers to improve habitat conservation for the shorebirds that utilize Panama Bay. There are signs, however, of increasing momentum and resources—both inside and outside the government—to potentially overcome these barriers.

01 Shorebird geography is highly localized

Shorebirds appear to use Panama Bay differentially depending on body size. The highest densities and numbers of shorebirds consistently feed and roost along a 30 km stretch of coastline directly east of Panama City. Shorebirds tend to have high fidelity—they tend to return to the same locations throughout their annual cycle. Some species return to the exact wintering locations every year, where they can be extremely faithful to their roosting and foraging areas. Species with strong site fidelity are at higher risk to impacts that may be caused by changes in their food base, habitat loss, or disturbance. Protecting land or minimizing disturbance elsewhere in Panama Bay in hopes that shorebirds are flexible with respect to any loss of their current feeding and roosting areas is a high risk strategy and likely to have limited success—given the current state of knowledge.

02 Important areas of Panama Bay are highly urbanized

Shorebird habitat protection is limited in Panama Bay by the past, current, and future momentum of urban development. Panama City is one of the fastest-growing urban areas in the world. Sixty percent of the 20 tallest high-rise buildings in Latin America are located there. Government interventions and structural adjustments starting in the 1970s has fueled the development that is responsible for Panama City's skyline today. This development boom took place largely with disregard for existing urban planning instruments, and without a consistent legal framework to regulate land use. Today, urban growth and ongoing infrastructure upgrades continue with little planning. Growth, however, is market-driven. Residential property prices in Panama City rose 10% in 2013. The current and future urbanization of the greater Panama City area, along with a history of poor land use planning and enforcement, will pose significant challenges to stakeholders with interest in shorebird protection.

Species with strong site fidelity are at higher risk to impacts that may be caused by changes in their food base, habitat loss, or disturbance.

03 Information is limited

Little is known about how shorebirds use Panama Bay, including factors explaining why species tend to prefer the coastline closest to Panama City. Shorebird densities up to 10,000 km² exist in the tidal flats adjacent to Panama City. Factors related to food are likely important, yet little data exists to inform potential impacts from recent and future developments. Roost-site selection is generally determined by local conditions, particularly environmental conditions and human disturbance—two factors we know little about in Panama Bay. There is anecdotal information suggesting that key roosting sites were lost with coastal developments like *Costa del Este*.

Little is known about the potential shorebird impacts from on-site stressors. All seven rivers of Panama City have pollution levels that are unfit for human recreational use. Eutrophication in coastal ecosystems has complicated consequences: some marine invertebrates benefit from increased nutrients, but continued nutrient discharge can eventually lead to negative impacts from anoxic conditions. For example, improvements to wastewater treatment have been linked to negative impacts on some shorebirds, presumably via a reduction in food resources. Net impacts of nutrient pollution and the current efforts to reduce it in Panama Bay will depend on complex interactions of multiple factors, such as species composition, sediment characteristics, nutrient loading, and shorebird ecology. While data is limited, heavy metal contamination has been documented in Panama Bay. Little is known about the state and local dynamics of nutrient pollution and contaminants and how they might be affecting shorebirds—despite conditions that suggest possible effects.

There is little science-based information on the dynamics between mangroves and mudflats. The Panama Bay wetlands are diverse in habitat types. The hydrology of the rivers closest to Panama City has been significantly altered due to decades of development. As a result, rivers are a source of sediment, as well as nutrients and contaminants. Channelization and increased sedimentation tend to influence the dynamics between mangroves and mudflats. Because they can aggressively colonize bare tidal flats, mangroves can transform diverse habitats into homogeneous mangrove forests—which can result in the loss of shorebird feeding habitat. These changes can be exacerbated with increased sedimentation and sea-level rise. In response, mangrove removal programs have been implemented in Hong Kong, Hawaii, and elsewhere in attempts to restore coastal ecosystems. In Taiwan, a mangrove removal program restored a mudflat-tidal creek-mangrove mosaic,

resulting in an increase in shorebird diversity. The dynamics between mangrove and mudflat habitats in Panama Bay are unknown. Satellite images show significant increases of mangroves in certain areas. In front of Costa del Este, for example, mangroves have replaced approximately three km² of mudflat habitat. A preliminary analysis by *Centro de Incidencia Ambiental de Panamá* suggests there has been little absolute changes in areas of mudflats and mangroves across the entire Panama Bay Protected Area since 1984, but drastic changes within watersheds, particularly in the west with the highest densities of shorebirds. Understanding these dynamics, along with the effects of channelization and hydrological changes from development, will be important to the long-term protection of Panama Bay shorebirds.

The current and future urbanization of the greater Panama City area, along with a history of poor land use planning and enforcement, will pose significant challenges to stakeholders with interest in shorebird protection in Panama Bay.

Recommendation #1: Create A Multi-Institution Shorebird Research Facility.

The lack of place-based scientific information on Panama Bay shorebirds and wetlands is a barrier to increased protection. We recommend establishing a Shorebird Research Facility that would bring together institutions and scientists to research priority questions for the Panama Bay and shorebirds. The Facility would provide a structure to strategically disperse research funds and integrate activities into the broader context of international shorebird conservation. It could be used as an instrument to concentrate shorebird expertise throughout Latin America (e.g., CALIDRIS and *Unidad Académica Mazatlán*) and to build scientific and leadership capacity of Panamanian biologists at all levels. It would also provide a structure to leverage potential co-financing

04 Resources are limited

Two are not unique to Panama Bay: socio-political capital and funding. The former relies on public support for wetlands, which is generated from environmental awareness and other strategies. Public support in turn can translate into political capital via voting and other public participation processes. There is a sense that the urban communities of Panama City have yet to develop a strong relationship with wetlands. Despite the developed coastline, Panama City is not particularly oriented toward the coastal environment—physically or culturally. Political decision-making over the past decade has favored development over any long-term planning approach that includes environmental protection. Decision-making has also been tainted by government corruption. The corruption of the past administration suggests that incentives for personal gain were heavily influencing how political capital was being spent, which can prevent social capital from being converted into political capital. There are signs, however, that the new administrations is reducing corruption and integrating environmental protection into public policy.

Land and scientific capacity are two other resources that are limited. Given the local geography of shorebirds in Panama Bay, absolute land available for protection is scarce. There are few options for protecting private land outside of the Panama Bay Protected Area: either through outright purchase or a land easement approach. There is no policy for the latter, and the former is likely to be limited due to the high cost of real estate and development pressure. Ultimately, policies that include positive incentives for habitat protection and restoration instead of business as usual development would help balance development with coastal protection. There are few local scientists actively working on shorebird and wetland ecology. Relatedly, there are insufficient opportunities in Panama for young biologist to receive training in ornithology and wetland ecology. However, there is sufficient scientific capacity within Panama to supervise and facilitate targeted research in Panama Bay.

05 The fragmentation and history of institutions

The history and inherent complexities of institutions connected to Panama Bay influence the ability to increase shorebird habitat protection. While the Panama Bay Protected Area has been a Ramsar site for over a decade, no management plan exists. The environmental impact assessment process has largely served to justify wetland conversion. Environmental impacts have been understated, and cumulative impacts have been ignored. Zoning regulations have not been enforced. Economic interests and the powerful commercial sectors have largely been driving decision-making. Institutional complexity and fragmentation will also be a barrier. There is long history of confusion around the jurisdiction and management responsibilities of Panama's coastal areas between the MiAmbiente and ARAP³. Other government agencies have and will continue to influence the Panama Bay Protected Area: MIVIOT, MINSA, MOP, and municipalities⁴. No interagency body exists to promote coordination and consistent planning across these institutions. Without such coordination and planning, controlling development and protecting shorebird habitat will be challenging. Institutional complexity combined with skewed political and economic incentives has long been known to be a major driver of urban sprawl.

Understanding mangrove-mudflat dynamics, along with the effects of channelization and hydrological changes from development, will be important to the long-term protection of the shorebirds and wetland ecosystems of Panama Bay.

³ *Ministerio de Ambiente de Panamá, Autoridad de los Recursos Acuáticos de Panamá. For consistency, we refer to ANAM (Autoridad Nacional del Ambiente de Panamá) as MiAmbiente even in times prior to the institution being raised to ministerial status.*

⁴ *Ministerio de Vivienda y Ordenamiento Territorial, Ministerio de Salud de la República de Panamá, Ministerio de Obras Públicas de Panamá.*

The Panama Bay Protected Area

At the center of efforts to protect the Panama Bay wetlands is the Panama Bay Protected Area. Its history dates back to the 1980s when MIVIOT passed a resolution that declared all mangroves in the *Juan Díaz* Township an ecological reserve. The 1998 General Environmental Law declared the wetlands of Panama Bay an area of importance, and included them within the National System of Protected Areas. That same year, the wetlands were designated an Important Bird Area by Birdlife International. After initial support from Panama Audubon Society, MiAmbiente submitted a proposal to the Ramsar Convention in 2003 to include the Panama Bay wetlands as an official Ramsar Site, which was approved. The site includes 48,919 hectares and extends along 75 kilometers of coastline between the mangroves of *Juan Díaz* to the estuary of the *La Maestra* river in the *Chimán* District. In 2005, the Ramsar site became part of the Western Hemisphere Shorebird Reserve Network.

In 2009, MiAmbiente passed a resolution that redefined the 1998 law and officially designated the Panama Bay wetlands as a protected area. In April 2012, a petition from an unknown stakeholder was approved by the Supreme Court to nullify this resolution, citing that it lacked the required consultation process. In December 2013, a coalition of environmental organizations successfully made arguments to the Supreme Court to uphold the 2009 resolution. In May 2014, the *Comisión Población, Ambiente y Desarrollo* proposed a new law that would have reduced the Panama Bay site by 750 hectares. In anticipation, *Centro de Incidencia Ambiental de Panamá* presented an appeal to the Supreme Court arguing that any changes to the 2009 resolution were unconstitutional. In June 2014, the Supreme Court ordered the National Assembly to suspend all current and future considerations of any law that would reduce the size of the Panama Bay site. In July 2014, a newly formed *Comisión Población, Ambiente y Desarrollo* submitted a bill to the National Assembly that defined the Protected Area as it stands today. In February 2015, President Varela signed the bill into law.

Since the establishment of the Protected Area, developments have been dynamic and uncertain. The *Alcaldía* identified 21 projects in close vicinity to the Protected Area that are responsible for flooding and damages, and suspended activities connected to the Metro Park development in order to minimize impacts to the buffer zone. The *Alcaldía* has signed a cooperation agreement with the Dutch Embassy to reduce flooding risk. In late May, Panama City Mayor Jose Blandon presented a draft agreement to the city council to declare a one-year moratorium on any construction activities that could

impact the Protected Area. The law requires a management plan be developed within two years. Meanwhile, illegal sand extraction and dumping continue.



Policies that include positive incentives for habitat protection and restoration instead of business as usual development in critical areas would help balance development with coastal protection.

Recommendation #2: Support the Panama Bay Protected Area Management Plan Process.

Creating, let alone implementing, the Management Plan will be challenging, especially given the urban-dominated influence in the western part of the Protected Area and the rural livelihood dependences in the eastern part. This challenge is further exacerbated by Panama's minimal experience with integrated coastal management, and the general lack of scientific information on the Protected Area. Five important activities that would support the Panama Bay Protected Area Management Plan process include,

- Define the management structure,
- Develop a long-term financing strategy,
- Establish environmental baselines, and
- Build strategic and broader public support.

2 Making connections

Fisheries and Mangroves

Despite Panama's large Economic Exclusive Zone and productive waters, it was not until the mid-twentieth century when fisheries began to play a prominent role in the national economy. Ninety-five percent of Panama's fishing activity occurs on the Pacific coast. The entire fisheries sector employs about 325,000 people. In 2006, the total gross value of fisheries production was \$420 million, with \$381 million in exports. Decreases in both fishery and aquaculture production occurred in the mid-2000s.

Shrimp and small pelagics dominate Panama's commercial fisheries. The shrimp fishery is concentrated on the Pacific coast in the Gulfs of Panama and Chiriquí. Around 150 vessels actively trawl for shrimp. Between 2000-2006, the annual value of the shrimp fishery ranged from \$22-42 million. Approximately 50% of shrimp exports go to the United States, followed by the European Union and South Korea. Total shrimp landings in Panama have been declining since the late 1990s; however, the reasons are uncertain. The Panama small pelagic fishery developed into a lucrative fishmeal industry during the 1960s. This fishery, which consists of about 30 vessels, is banned from operating in the upper Panama Bay in an effort to protect artisanal fisheries. Between 2000-2006, anchovy and herring landings had an average annual value of \$34 million. Landings of both anchovy and herring appear to be declining. Artisanal fisheries include a variety of species; all are poorly monitored and information is scarce. Artisanal vessels have increased over the past decade, with the latest estimate around 8,600. Both vessels and landings are considered to be underreported. Overexploitation has occurred for several species, including lobster, shark, and scallop.

Fisheries are influenced by the health of wetland ecosystems. The outwelling hypothesis was first proposed in the early 1970s: the idea that the high productivity of mangroves is partially exported to marine systems and thereby supports nearby fisheries. While this hypothesis has turned out to be too simplistic, there is consistent evidence that fisheries landings correlate with areas of intact mangroves and tidal wetlands. In Mexico, for example, mangrove habitat has been shown to be particularly important in supporting artisanal fisheries, with one hectare of mangrove providing an average annual value of \$37,500 to fisheries. Over 50% of mangroves in Panama have been converted to other uses. Artisanal and subsistence fishing is permitted and occurs inside the Protected Area, while a white shrimp fishery is active in the waters beyond the border. Commercial white shrimp landings have dropped over 80% since 1967. While the cause is likely multifactorial, mangrove loss and coastal pollution have been hypothesized as playing a role. *Concha negra* is both a symbolic and economically important

resource for many rural communities. Little is known about this resource and its current state within the Protected Area. In the Pearl Islands, however, the fishery may be collapsing, where catch per unit effort is down 50-90% compared to a decade ago. The Panama Bay Protected Area is an important resource for many stakeholders connected to the fisheries sector. Yet, there has been little involvement of the sector within the network of organizations focused on the protection of Panama Bay. This connection should be strengthened, and fisheries stakeholders should be included within the broader effort to protect and manage the Panama Bay Protected Area.

No interagency body exists to promote coordination and consistent planning across institutions with respect to the Panama Bay Protected Area.



Panama Bay and Development

Of the half billion people that live in Latin America, 80% live in cities. Panama is no exception. Development in Panama City accelerated in the 2000s, and it shows no signs of slowing. Land use planning has failed to keep pace with development, which has caused and will continue to cause significant infrastructure and environmental challenges for decades to come. A major challenge will be balancing development with the protection of the Panama Bay.

There are four immediate, direct, and known threats to shorebird protection within the Panama Bay Protected Area:

- Current and future impacts of the expanding wastewater treatment plant in *Juan Díaz*,
- The unknown outcome of *La Marina*, a planned development by Grupo Lefevre adjacent to and potentially inside the Protected Area,
- The current expansion of the Tocumen International Airport, and
- The planned development Panatropolis, which is adjacent to the airport and partially inside the Protected Area.

In addition to direct threats, shorebird protection is threatened by overall development creep in a business as usual scenario that includes weak enforcement of existing laws and planning instruments. This is particularly the case in the western part of the Protected Area closest to Panama City. But, development is likely to be an increasing threat towards the east as Panama City expands in the coming decades. An additional potential threat is the displacement of important mudflat habitat by expanding mangroves.

Panama's first wastewater treatment plant came online in 2013—it is the largest biological nutrient removal plant in Central America. The project is being built in phases, with the second phase scheduled to be operational by 2020. The 35-hectare site is located inside the Protected Area. The impacts of the current wastewater treatment plant and its future expansion are unknown. Aerial imagery and anecdotal information suggests that the treatment plant may be connected to local mangrove die-offs. Researchers studying birds had to abandon a study site near the treatment plant in 2013 due to dying mangroves. Relatedly, the *Embarcadero de Juan Díaz* and an industrial gas complex are also located inside Protected Area. Local impacts from the latter have been recognized by the Ramsar Convention. How sites located inside the Panama Bay Protected Area are managed, which will presumably be dictated



2. Making connections



in the forthcoming management plan, will be important for the future health of shorebirds and their habitats.

The real estate company *Grupo Lefevre* has plans to develop a 309-hectare parcel that extends into the current boundaries of the Protected Area. This plan is mixed-use, including residential, mixed residential-commercial, public areas, roads, and green areas. The current legal state and intentions of Grupo Lefevre around this development are unknown. However, the recent intent and investment for such a development coupled with historical development practices in Panama City make the potential development known as La Marina as a threat to the Protected Area.

Potential development near the Tocumen Airport is the most serious threat to the Panama Bay Protected Area and shorebird habitat protection. A \$780 million airport expansion is underway. The airport is located just north of the Protected Area, with the southern end of the runways approximately one kilometer from the border. Tocumen Airport experiences a high rate of wildlife collisions, averaging almost 100 collisions annually. Multi-stakeholder

efforts are underway to reduce bird strikes and identify priorities actions, which include improved land use planning that takes bird strikes and wind turbulence into consideration, improved wildlife monitoring, and a possible nature reserve around the airport. Given that multiple stakeholders are interested in reducing bird strikes and managing land use change, the current and planned expansion of Tocumen Airport could be a potential threat or asset to the Panama Bay Protected Area.

Panatropolis is a planned development located adjacent to the Tocumen Airport. It is envisioned that 250,000 people would work and live within Panatropolis, and another 125,000 would work at the industrial park based there. The development would occur in four phases over 7-10 years. The total area of the project is 856 hectares. Planning documents show development inside the Protected Area, including the first phase of the development *Costa del Sol*. The future of this project is uncertain, including if and how it would proceed. Multiple permits, however, have been secured dating back to 2008, along with \$1.2 million invested to date. The development plans include at least a dozen channelization projects—all either directly north or inside the Protected Area. Given the investment to date and permits in place, Panatropolis and the expansion of the Tocumen Airport should be a top priority for stakeholders interested in the protection of the Panama Bay Protected Area and shorebirds.

How sites located inside the Panama Bay Protected Area are managed, which will presumably be dictated in the forthcoming management plan, will be important for the future health of shorebirds and their habitats.

Recommendation #3: Support Efforts Related to Solid Waste and Plastics

The direct and indirect impacts of plastic debris on marine ecosystems and wildlife is of increasing concern. Recent research focused on future threats to migratory shorebirds identified microplastics as a priority. In Panama Bay, nothing is known about the potential ingestion of plastic by shorebirds or indirect impacts via food web disruptions. Yet, the amount of plastic along parts of the Panama Bay coastline is staggering. Organizations and individuals are focused on solid waste management and coastal trash, but the issue requires more resources and a citywide strategic plan. Supporting efforts to reduce solid waste and plastic deposition in wetland habitats could increase the perceived value of the Panama Bay Protected Area and improve shorebird protection.

2. Making connections

Panama Bay, Disaster Mitigation, and the Value of Wetlands

Natural disasters are commonplace in Panama. The World Bank ranks it 14th among countries most exposed to multiple hazards based on land area. Floods dominate Panama's disaster landscape: the country has one of the highest rainfall intensities in the world. Since 1990, over $\frac{3}{4}$ of Panama's natural disasters have been flooding events, which are responsible for 35% of mortalities caused by natural disasters. Floods alone are responsible for 87% of economic losses from natural disasters, with an expected loss per year of \$25 million.

The Panama District is the highest flood risk area in the country. In many cases, riverbeds have been compromised by development that has not taken into account mandatory setbacks established by best practices and existing regulations. An increase in impervious surfaces, lack of compliance with drainage standards, and a lack of drainage system management



have exacerbated the situation. The result is chronic blockage of rain drainage channels by solid waste, which worsens flooding events. A high proportion of Panama's low-income population resides in areas that are most exposed to flooding. Informal settlements have flourished in Panama City as a result of a historic shortage of affordable housing. Land filling and development has decreased the hydraulic capacity of the *Juan Díaz* River, further increasing flood risk. Channelization projects, like the *Quebrada La Gallinaza*, regularly flood despite attempts to maintain the channels and remove solid waste from SINAPROC and MOP⁵. A preliminary analysis suggests increases in future flood risks in the *Juan Díaz* and Tocumen Townships, including the Tocumen Airport (e.g., 40-50% increase in 1-in-100-year flood peaks).

An increase in the frequency and intensity of flooding events result from three, often interacting, factors: urbanization, rainfall, and sea level rise. All three factors are likely to increase within Panama City over the coming decades. Roads, parking lots, roofs, and other developments with impervious surfaces increase flooding frequency and sediment loading. In Central America, predictions for changes in rainfall due to climate change are highly variable. Increases in rainfall intensity, however, are predicted with more certainty and are already occurring. One analysis suggests that every 1° Celsius increase in global mean temperature will result in a 10% increase in extreme daily rainfall events. Global sea level rise has already led to significant fluctuations in the frequency of sea level extremes. However, forecasting these changes in storm surges is challenging and depends on regional differences. Due to recent intensification of Pacific trade winds, sea level rise rates in the Western Tropical Pacific are three times the global average, compared to little or no rising in the Eastern Tropical Pacific. However, a recent analysis of tidal gauge data over the past century in Panama Bay suggest some sea level rise is occurring. While impacts are difficult to forecast, two studies have evaluated coastal impacts in Panama due to the interaction of sea level rise and increasing storm frequency predicted by climate change. A World Bank study estimates that Panama will experience a 44% increase in urban areas that are impacted by large storm surges, which is predicted to impact around 45% more people than today and cause up to a 43% reduction in coastal GDP. An OECD study assessed port cities with high exposure and vulnerability to climate extremes⁶. Panama City was predicted to have an exposure portfolio that includes 15-43,000 people and \$0.53-4.55 billion in assets.

Given that multiple stakeholders are interested in reducing bird strikes and managing land use change, the current and planned expansion of Tocumen Airport could be a potential threat or asset to the Panama Bay Protected Area.

⁵ *Sistema Nacional de Protección Civil, Ministerio de Obras Públicas de Panamá.*

⁶ Organization for Economic Co-operation and Development (OECD).

2. Making connections

Both of these forecasts only considered 1-in-100-year surge-induced flood events, as opposed to the overall risk of increased coastal flooding. Thus, they are almost certainly underestimates with respect to future flooding risk.

While research is needed on the interactions between channelization, flooding, and the Panama Bay Protected Area, mangroves' ability to buffer storm surges and reduce flooding risk is well documented. Wave attenuation by mangroves is non-linear: it is the leading seaward edge of mangroves that provides the bulk of protection from storm surges. For example, it is often the first kilometer of mangroves that is responsible for the majority of wave attenuation, and thus the most valuable in terms coastal defense. Thus, the 1-2 kilometer band of mangroves inside the Protected Area just south of the *Juan Díaz* and Tocumen Townships are likely playing an important role in providing storm surge protection. That coastal protection will be increasingly important in the coming decades.

In addition to fishery nurseries and coastal defense, mangroves provide a number of other services. For example, mangroves are known for their role as long-term sinks for metal contaminants. Mangroves' high tolerance to heavy metals reduces their transport to marine systems. Metallic enrichment is common in estuarine environments, which comes from many sources including urban and agricultural runoff, sewage treatment plants, and leaching from garbage dumps. Mangroves sequester over twenty different trace metals, and limit their bio-availability and mobility. Recent research has raised concerns about potential human health risks from degradation and disturbance that could turn a mangrove system from a sink to source of heavy metal pollution.

Panama City's wastewater and solid waste challenges are daunting. The wastewater treatment plant and its future expansion will help address organic pollution in Panama Bay. Other factors are also influencing pollution in the Bay, including wetland filling, channelization, and education. Mangroves have an important role to play in contributing to pollution management. To fully capitalize on their role, more research is needed to understand mangrove dynamics and their limitations in contributing to pollution management. Mangroves could be managed as a resource and integrated into the wastewater management plans of Panama City. Stakeholders for shorebird protection and the Panama Bay Protected Area should prioritize strategies

that include mangroves being recognized for the multiple services they provide to Panama City.

The mangroves inside the Protected Area are likely playing an important role in providing storm surge protection. That coastal protection will be increasingly important in the coming decades.

Recommendation #4: Supporting Scientific Assessments and Land Use Planning in the Greater Panama Bay Protected Area.

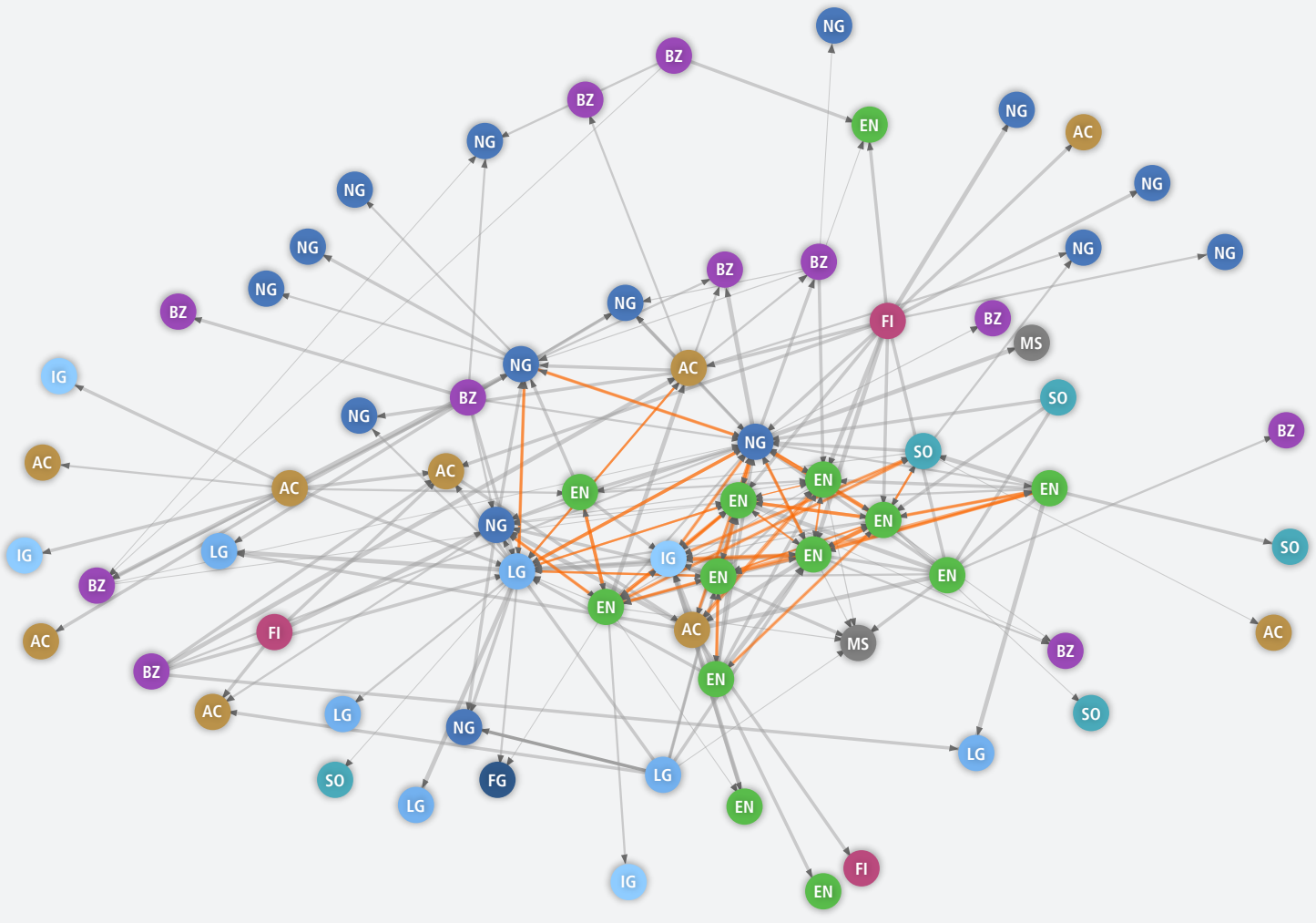
Due to the nexus of high shorebird densities and development pressures, the majority of efforts, resources, and attention has been justifiably focused on the portion of the Protected Area closest to Panama City. Little is known about the overall state of the larger Protected Area, including its biological diversity and potential impacts. This includes potential upstream impacts from the growing towns of Pacora and Chepo. While these towns are relatively small, they are along the Pan-American Highway and thus in the development corridor. The obvious development scenario for Panama City is east along the coast. Science-based information and proactive land use planning would be strategic with respect to minimizing potential impacts on the Protected Area east of Panama City in the coming decades.

The Social Landscape of Panama Bay

The landscape of organizations working in Panama Bay is dynamic, and individuals have a long history of working together. Many organizations joined forces and worked collaboratively to establish the Panama Bay Protected Area. Panama Bay has a diverse set of stakeholders, some of which are more active in the landscape than others. For example, the real estate development community is a powerful stakeholder but weakly connected to the environmental community. Others, like the artisanal fishing community, lack both power and network connections. To provide insights into the Panama Bay landscape, we conducted structured interviews and a social network analysis to explore the degree to which organizations interact with each other. Highlights of the results provide insights on the social landscape of Panama Bay⁷.

Within the core environmental network, the average organization is collaborating with 5.5 organizations on the protection of the Panama Bay. The absolute number of network connections in relation to the total possible connections was relatively low, suggesting that the network of interviewed organizations is not highly connected. Organizations perceived they are collaborating more than they are actually exchanging information or providing resources to each other (e.g., an organization states they are collaborating with an organization, but are actually exchanging little information or support). Approximately 40% of interviewed organizations reciprocally identified each other working together, exchanging information, and supporting each other. Government agencies and environmental NGOs are central in the network, with the academic and business sectors generally located on the periphery. In general, the core network of organizations interviewed has weak connections to the business sector, including the real estate development sector. Given the current threats to the Panama Bay Protected Area and shorebird health, the environmental sector would benefit greatly from forging new types of collaborations. This will require strengthening existing capacity and developing new skill sets and strategies via partnerships.

⁷ For a list of individuals interviewed for the assessment and organizations included in the social network analysis, see <http://www.panama.advancedconservation.org>



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| ● AC ACADEMIA | ● IG INTERGOVERNAMENTAL |
| ● BZ BUSINESS | ● LG LOCAL GOVERNMENTS |
| ● EN ENVIRONMENT | ● MS MULTISECTORIAL |
| ● FI FISHERIES | ● NG NATIONAL GOVERNMENTS |
| ● FG FOREIGN GOVERNMENTS | ● SO SOCIAL |

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Future Development Scenarios

In an effort to encourage dialogue and explore future development around the Panama Bay Protected Area, we compiled multiple data sources to create two realistic scenarios. First, a business as usual scenario that projects land use change under the assumption that development proceeds under the specifications and plans currently available. Second, an alternative scenario that emphasizes the following goals and design principles:

- a) Connecting the Panama Bay wetlands to the urban environment in accordance with the Open Space System mandated by the 1997 Metropolitan Land Management Plan;
- b) Maintaining wetland integrity by establishing ecologically relevant buffers that go beyond the 50 meters mandated by the law; and
- c) Providing recreational and educational facilities to promote the rational use of the urban wetlands, which will increase its value and provide new income opportunities for the adjacent Juan Díaz Township.

In the business as usual development scenario, the Protected Area remains unchanged with a few important exceptions. The Tocumen Airport expansion and Panatropolis development extend into the Protected Area by 350 hectares. High-density development also occurs all along the 50-meter buffer zone. This includes the *La Marina* Development and surrounding area⁸. Impacts to the Protected Area are likely due to the high-density development along its border, including major channelization and other hydrological changes that would result from the Panatropolis development, as well as the road infrastructure needed to provide access to new developments. Under this scenario, access to the Protected Area remains the same: limited but unrestricted road access from the nearby golf resort to the wastewater treatment plant, *Juan Díaz* Port, and industrial gas complex. Local impacts from all three sites continue.

In the alternative scenario, development is permitted but integrated with other goals. Development in *Juan Díaz* Township is managed by the establishment of a community-based conservation district. This 385-hectare area acts as an ecological buffer to the Protected Area, while still allowing for development via a cluster-based model of housing interspersed between mangroves and other natural and semi-natural habitats. Public access throughout the development would be allowed and encouraged. In order to incentivize

⁸ Based on development plans we obtained, there is a possibility that the *La Marina* Development could extend inside of the Panama Bay Protected Area.

Stakeholders for shorebird protection and the Panama Bay Protected Area should prioritize strategies that include mangroves being recognized for the multiple services they provide to Panama City.

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this alternative development, current landowners and developers could be compensated for loss revenue due to lower density development and easements with a transferable development rights program⁹. Development near the Protected Area is limited to the Tocumen Airport expansion. The Tocumen Airport manages its risk from land use change with a portfolio of tools that includes a nature reserve, which also acts as an ecological buffer for the Protected Area. A major feature of the alternative model is increasing the value of the Panama Bay wetlands by providing access. A network of paths and trails throughout the mangroves allow people to use the area for recreational experiences. A series of low-impact buildings provide resources for citizens, educators, and scientists. A Panama Bay Wetland Center provides improved public access with pedestrian and bicycle paths, as well as restricted road access. Located close to the *Corredor Sur*, the Protected Area would be easily accessible for the first time. Existing road access via the golf resort is removed, and the existing industrial gas complex is replaced with the new network of buildings. The *Juan Diaz* Port is removed. Access to the wastewater treatment plant remains intact, but the road is rerouted.

⁹ Transferable development rights is a market-based instrument that has been used in the United States to better manage urban and peri-urban growth, and has been suggested as means to manage and reduce flood risk.



Qunli Stormwater Wetland Park / Turenscape

Given the current threats to the Panama Bay Protected Area and shorebird health, the environmental sector would benefit greatly from forging new types of collaborations with the business sector. This will require strengthening existing capacity and developing new skill sets and strategies via partnerships.

Recommendation #5: Supporting a Master Planning Process Beyond the Boundaries of the Panama Bay Protected Area.

Many stakeholders have little incentive to support the protection and management of the Protected Area. Yet, the future of the Panama Bay, and by extension shorebirds, will influence aviation safety, urban flooding, pollution management, and fisheries. The Panama Bay wetlands are perceived as having little value, none of which is easily accessible. Supporting participatory planning processes that promote a future that integrates the urban environment with the wetlands would increase public engagement and awareness, forge new collaborations, and identify common interests. One cost-effective way to catalyze a master planning process through dialogue would be to support an international Open Innovation Challenge, that included a strong social media component. Open Innovation Challenges have a track record of saving money and time, while also spearheading new solutions to complex problems. In general, supporting activities around a broader master plan of Panama Bay would promote long-term planning and engage new stakeholders.

Business as Usual Scenario



*source *Diario La Prensa (Propuesta para De*



Alternate Scenario



*source *Diario La Prensa (Propuesta para De*



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Alternate Scenario



*source *Diario La Prensa* (Propuesta para De



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This report is not intended to be prescriptive. Rather, the goal of Conservation Landscape Assessment was to explore shorebird habitat protection in Panama Bay within the larger context of Panama City and its surroundings. In particular, we hope to promote new dialogues, collaborations, and connections within the greater Panama Bay community around strategies to increase the value and protection of wetlands. The situation in Panama Bay and the Protected Area is extremely dynamic, and stakeholders are in the process of transitioning into new roles and strategies. This is true across all sectors. Thus, it is perhaps a time of great opportunity to forge new collaborations in order to envision, design, and execute a vibrant and shared vision for the Panama Bay that balances economic development and environmental protection in a way that maximizes quality of life for the greatest number of Panamanian citizens possible¹⁰.

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¹⁰ For a list of important references used in the report, see <http://www.panama.advancedconservation.org>



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