PANAMA

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INTRODUCTION

Panama was formed between 15 and 3 million years ago and divided the oceans into the Pacific and Atlantic Oceans. The country belongs to the Central American region and spans an estimated 75,000 km^2. Panama's Exclusive Economic Zone (EEZ) covers an area of 209,779 km^2, with the Pacific region covering a larger area (111,087 km^2) than the Caribbean region (98,693 km^2).

Both the Caribbean and Pacific coasts are characterised by numerous ecosystems, including mangroves, corals, and seagrass, which serve as crucial habitats for sharks and rays. In addition, the country includes insular coastal areas, such as Coiba National Park and its special marine protection zone, which sustains an important number of marine species, including several threatened (as per the IUCN Red List of Threatened Species) migratory sharks such as the Scalloped Hammerhead (*Sphyrna lewini*) and Whale Shark (*Rhincodon typus*).

Panama has approximately 2,900 km of coastline, of which around 1,697 km lies on the Pacific coast and 1,295 km on the Caribbean coast. The Gulf of Panama experiences an intense and seasonal upwelling during the dry season (December to April) that boosts the primary and secondary productivity in the area. Two main archipelagos occur on the Caribbean coast of the Country: Guna Yala (eastern zone) and Bocas del Toro (western region). Although there is no seasonal upwelling, as in the Pacific side of the country, the Caribbean side is affected by river runoff and rainfall. The Pacific coast has semi-diurnal tides with an amplitude of 3–6 m. In contrast, the Caribbean coast has a semidiurnal or diurnal tide with an amplitude of less than 0.5 m.

The coastline in Panama comprises diverse habitats such as mangroves, seagrass, sandy and muddy shore, coral reefs, and rocky shores, with the different cover extensions. For example, mangrove forests cover approximately 165,000 ha, with a more significant extension on the Pacific coast (153,183 ha) than on the Caribbean coast (12,204 ha). Mangrove forests are concentrated in two wetland sites of international importance or Ramsar sites (Panama Bay and Gulf of San Miguel); in a national mangrove-estuaries protected area (Chame Bay); and in the Gulfs of Montijo and Chiriquí, where only small segment is covered. On the Caribbean coast, mangroves are present in the provinces of Bocas del Toro and Colón and the Comarca of Guna Yala, an indigenous territory located northeast. Coral reefs are found on both coasts with around 754 km^2 in the Caribbean (about 70 coral reef species), while the Pacific side only holds around 16 km^2 of coral cover with about 30 coral reef species. Most coral reefs in Pacific are located near islands in both Gulfs (Gulf of Panama and Chiriquí). However, the Gulf of Chiriquí holds the most extensive coverage of coral reefs on the Pacific side of the country. The cold water produced by upwelling during the dry season has been responsible for the low cover of the coral reef in the Gulf of Panama. However, due to rising temperatures the Gulf of Panama's upwelling may face thermal stresses and become a coral refuge in the near future (Rodriguez-Ruano et al., 2023)

Both the Gulf Panama and Gulf of Chiriquí are important for sharks and rays. These areas comprise several habitats which support essential life cycle characteristics of these species, such as foraging, breeding, and migration. For example, spatial analysis of satellite tracking data from Whale Shark shows that the Pacific side, including the Gulfs of Panama and Chiriquí, are vital areas for foraging and migration (Guzman et al., 2022). Recent observations suggest that Bahia Chame in the Gulf of Panama is an important area for breeding and migrating Scalloped Hammerhead (Rodriguez-Arriatti, 2011). Moreover, contemporary evidence suggests that the province of Darien retains a small local population of Largetooth Sawfish (*Pristis pristis*). This species is considered extinct in most of the Eastern Tropical Pacific mainly due to overfishing and habitat modification. Other areas, such as the Gulf of Montijo, located southwest of Veraguas Province in Pacific Panamá, represent important areas for sharks. For example, based on many neonates and juveniles Scalloped Hammerhead captured by small-scale fisheries in the Gulf of Montijo, this area is considered a potential nursery in the Pacific Panamá (Rodriguez-Arriatti, 2014).

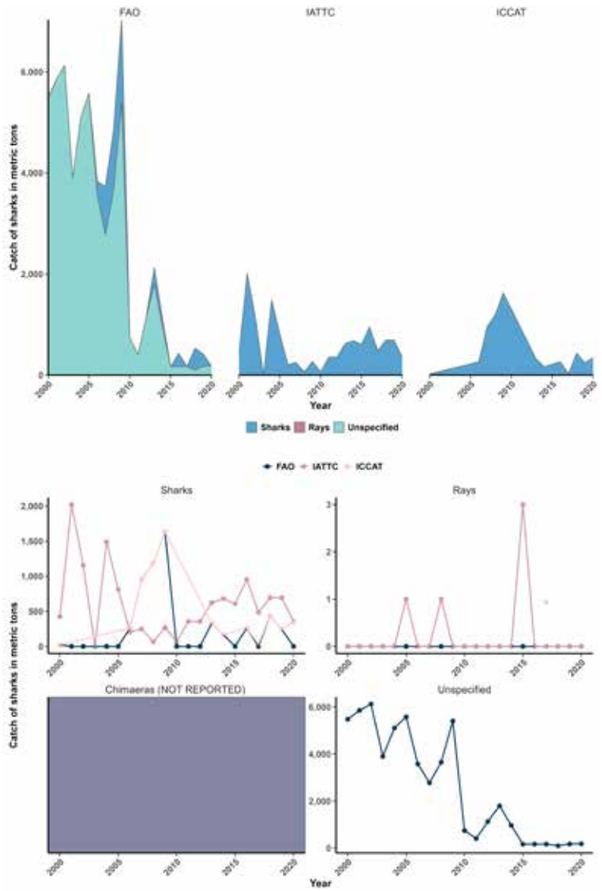
Panama's Pacific holds important coastal islands that promote biodiversity for the region and the presence of migratory shark and ray species. For example, Coiba National Park and its special marine protection zone, a reserve identified by United Nations Educational, Scientific and Cultural Organization (UNESCO) as a World Heritage Site, encompasses 38 islands, including Coiba Island, which is part of the Tropical Eastern Pacific Marine Corridor, a network of marine protected areas that includes the Galapagos (Ecuador), Cocos (Costa Rica), and Malpelo and Gorgona (Colombia). Various studies indicate that this protected area represents a migratory corridor and foraging grounds for Whale Shark (Guzman et al., 2022). Additionally, the seasonal occurrence and aggregation of this species, particularly in Islas Canales de Afuera and Wahoo Rock, support Whale Shark watching and the local tourism industry. Based on further observations, it is suggested that other species, such as the Whitetip Reef Shark (*Triaenodon obesus*), use Coiba National Park as reproductive and resting grounds (Vega et al., 2019); seamounts, such as the Cordillera de Coiba, have been recognised as an important area for Scalloped Hammerhead, Prickly Shark (*Echinorhinus cookei*), and Pelagic Thresher Shark; although more information is still necessary. In general, Pacific Panama comprises several species considered threatened on the IUCN Red List, including pelagic and coastal shark and rays such as Munk's Pygmy Devil Ray (*Mobula munkiana*), Pacific Eagle Ray (*Aetobatus laticeps*), Southern Banded Guitarfish (*Zapteryx xyster*), Whitesnout Guitarfish (*Pseudobatos leucorhynchus*), Speckled Guitarfish (*Pseudobatos glaucostigmus*), Bigeye Thresher (*Alopias superciliosus*), Silky Shark (*Carcharhinus falciformis*), and Great Hammerhead (*Sphyrna mokarran*).

Along both the Caribbean and Pacific coasts of the country, sharks and rays are frequently captured in targeted fisheries and as incidental catch by several small and large-scale fisheries, using gear such as drifting and bottom longlines, surface and bottom gillnets, and handlines. Several threatened species are frequently reported in artisanal and industrial landings. These include coastal species such as the Pacific Sharpnose Shark (*Rhizoprionodon longurio*), smoothhound sharks (*Mustelus* spp.), and Pacific Smalltail Shark (*Carcharhinus cerdale*; Harper et al., 2014; Guzman et al., 2020; Rodriguez-Arriatti et al., 2021; Vega et al., 2023). Likewise, pelagic species such as Scalloped Hammerhead, Pelagic Thresher (*Alopias pelagicus*), and Silky Shark are commonly captured in both nearshore and offshore fisheries using multiple gear types (Harper et al., 2014; Guzman et al., 2020).

Sharks and rays are primarily captured as incidental catch, although there is evidence that longline fisheries target some species of rays along the Pacific coast (Rodriguez-Arriatti, 2011). It is estimated that shark and ray capture production between 1991–2020 was around 64 metric tonnes (mt)/year, according to reports to the Food and Agriculture Organization of the United Nations (FAO). However, a study showed that 75% of shark catches still need to be added to official statistics (Harper et al., 2014), suggesting that the reported national exploitation rate might be under-representing the country's current harvest level of sharks and rays. In addition, unlike sharks, there is limited information on the interaction between the population of rays and fisheries. This might be attributed to a multitude of factors including the absence of incidental catches and discard data derived from fisheries that frequently interact with rays, such as bottom trawl fisheries, and the inadequate capacity and resources to oversee and manage most small-scale coastal fisheries in the country. This lack of data prevents us from accurately assessing the impact of fisheries on ray populations. There is currently no information on the interaction between chimaeras and fisheries.

Although important regulations relevant to shark conservation have been implemented, such as law No. 9 of March 2006 prohibiting finning and the establishment of marine protected areas that include seamounts, such as the Cordillera de Coiba (recognised as an important area for the occurrence of Scalloped Hammerhead and other species of sharks), it is necessary to continue developing appropriate management and conservation measures that aim to ensure the recovery and adequate protection for sharks and rays.

Panama's total catch of shark, ray, chimaera, and unspecified species reported to the Food and Agriculture Organization of the United Nations (FAO), Inter-American Tropical Tuna Commission (IATTC), and International Commission for the Conservation of Atlantic Tunas (ICCAT) from 2000–2020 in metric tonnes (mt) | Source: FAO (2022), IATTC (2022), and ICCAT (2022)



FISHERIES

Fleets

According to government records, in 2021, there were 2,070 artisanal boats registered (<10 mt). In the same year, a total of 291 industrial fishing vessels were registered. This includes 114 industrial trawling vessels targeting shrimp, 19 purse seine vessels targeting small pelagic finfish (e.g., herrings, sardines), 20 tuna fishing boats, and 138 "other" industrial fishing boats (e.g., longliners).

Gear

Sharks and rays are primarily captured as incidental catch in fisheries targeting other species. However, it has been suggested that the Longtail Stingray (*Hypanus longus*) is targeted by longliners of industrial fisheries in the Gulf of Panama (Rodriguez-Arriati, 2011). The reason for targeting Longtail Stingray in the Gulf of Panama is unknown, but it could be due to multiple factors, including their high abundance in the area and the international demand for ray products.

Small and large-scale fisheries in Panama exploit sharks and rays. Small-scale fisheries, which include canoes and motorised panga-like boats, employ a diversity of fishing gear. These include drifting longlines, set bottom longlines, vertical longlines, beach seines, surface gillnets, bottom gillnets, handlines, and harpoons. In industrial fisheries, it is common to use trawl nets (targeting different species of shrimps), drifting, bottom and vertical longlines (targeting a variety of species such as Common Dolphinfish, [*Coryphaena hippurus*], and groupers [Serranidae]), purse seine fishing (targeting small fish such as sardines and herrings).

PRODUCTION

Overall landings

Data on shark and ray capture production have been reported to the FAO for the period between 1991–2020. Capture production of sharks and rays represents an average of 0.95% (approximately 64 mt /year) of the total marine fisheries production of the country. However, this percentage of captures has lacked consistency throughout the years. For instance, the most significant peak of production in 2009 (7,033 mt) represents around 2.1% of the total national marine capture fisheries production. In contrast, in 1995, sharks and rays captured in

Panama only represented 0.04% of the national production. There are marked differences between periods. For instance, in the period between 2000–2009, shark and rays' captures were an average of 5,152 mt/year; in contrast, from 2010–2018, catches dropped to 762 mt/year, with the most towering peak in 2013 (2,127 mt), representing 0.4% of the national marine resource production. It is unclear why this drop in shark and ray captures between these periods occurred. However, it appears to be related to population declines, fisheries monitoring issues or new fishing regulations implemented from 2010–2017, which prohibited longline fishing vessels of >6 mt operating in national waters (Guzman et al., 2020).

Species-specific

Most official landings data are aggregated, and many shark and ray species are reported as *tiburón, cazón, raya* or *mantarraya*, which complicates the analysis of the fishing impacts at the species level. This prevents an understanding of the status of populations in the country (Guzman et al., 2020). However, some short-term surveys along the coasts of Panama provide insights into the impacts of the different fisheries on shark and ray diversity at the species levels. According to these surveys, four shark families are most exploited on both coasts, including requiem (Carcharhinidae), thresher (Alopiidae), hammerhead (Sphyrnidae), and hound (Triakidae) sharks. Twenty-five species of sharks are interacting with fisheries, the most common species reported in fisheries are sharks such as Scalloped Hammerhead, Pacific Sharpnose Shark, Pelagic Thresher, Pacific Smalltail Shark, Silky Shark, and hound sharks (*Mustelus* spp.). However, the species composition varies according to the fisheries type. For example, the three most frequent species captured in artisanal fisheries are Scalloped Hammerhead, Pacific Sharpnose Shark, and *Mustelus* spp., representing over 85% of the catches on the Pacific coast (Harper et al., 2014). On the other hand, in industrial and semi-industrial fisheries, Silky Shark, Pelagic Thresher, and Scalloped Hammerhead represented over 75% of the catches reported according to short-term surveys undertaken between 2007–2009 along the Pacific coast (Harper et al., 2014).

Compared to sharks, rays have rarely been studied. Short-term surveys conducted along the Pacific coast have demonstrated that at least three families of rays (Urotrygonidae, Dasyatidae, and Rhinopteridae) are being captured by small-scale and industrial fisheries. Between species that interact with fisheries in the country are Diamond Stingray (*Dasyatis brevis*), Longtail Stingray, Pacific Chupare (*Styracura pacifica*), Rogers' Round Ray (*Urotrygon rogersi*), Pacific Eagle Ray, Whitesnout Guitarfish, Speckled Guitarfish, and Pacific Cownose Ray (*Rhinoptera steindachneri*; Rodríguez-Arriatti, 2011; CeDePesca, 2016; Vega et al., 2023). Among these species, Longtail Stingray, Rogers' Round Ray, and Whitesnout Guitarfish are among the most frequent species captured along the Pacific side (Rodríguez-Arriatti, 2011; CeDePesca, 2016; Vega et al., 2023). Some information exists for a few shark species reportedly caught in industrial and semi-industrial fisheries. Analysing fishing statistics from a processing seafood company in Panama, between 2006–2009, an average of 31.2 mt/year of sharks were caught in the Gulf of Panama and Chiriqui, located on the country's Pacific coast (Guzman et al., 2020). From the same data, two groups of sharks were reported: *Carcharhinus* spp. (118.05±20.6 mt/ year) and *Sphyrna* spp. (35.67±17.1 mt/ year). At the species-specific level, three species of sharks were reported: Pelagic Thresher (30.85±11.9 mt/year), Pacific Nurse Shark (*Ginglymostoma unami*; 9.58±4.1 mt year), and Tiger Shark (*Galeocerdo cuvier*; 0.36±0.3 mt/year; Guzman et al., 2020). Moreover, between 1999–2019, FAO statistics reported catches of Blue Shark (*Prionace glauca*) for an average of 258.90 mt/year, with the highest captured period between 2008–2009 with 1,134 mt and 1,574 mt, respectively. For Shortfin Mako (*Isurus oxyrinchus*), between 1999–2014, the average catches per year were 11.43 mt, with a peak in 2007 of 49 mt. Similarly, catches of Blacktip Shark (*Carcharhinus limbatus*) between 2006–2014 were an average of 8.44 mt/year, with a peak in 2007 of 21 mt. So far, unlike sharks, there is no species-specific information for ray and chimaera catches in Panama.

TRADE

Processing

Sharks in the small-scale fisheries are landed as gutted trunks (dressed carcass) with fins removed and stored separately. Animals are landed processed according to the 5% fin-to-carcass weight ratio or whole with fins attached. Small sharks are processed on land as fillets and sold fresh or salted and dried. Most trunks and other derivative products, such as shark skin, and dried cartilage, are exported. Between 2009–2017, shark meat was mainly exported to the United States (US), Colombia, and Uruguay (Ross et al., 2019), while fins were exported to Taiwan and Hong Kong (Ross et al., 2019). Rays are usually discarded due to the low demand for ray products for domestic consumption and trade in Panama. However, when rays are retained, they are part of export product, either as meat, gills, or leather (Ross et al., 2019).

Domestic

Shark meat is consumed locally fresh, salted, and dried. Meat from small sharks is consumed in ceviche but is often sold under *corvina* or *corvinata* (Teplitzky, 2005). In local markets, it is possible to find fresh, salted-dried skate and ray fillets. Although the size of the domestic market of sharks and rays is unclear, some reports estimated that shark meat consumption was high in the province of Panamá, with an estimate of 160.3 mt consumed per year (Ramirez & Medina, 1998). Since shark fins are not a part of the local cuisine, they are usually sold to owners of Asian restaurants or exported, and sometimes discarded, but not sold in the local markets. Shark heads are discarded, but occasionally shark jaws, particularly large individuals, are sold on customer demand for display as showpieces. Locals do not use shark fins or jaws, or dried gill plates from manta and devil rays , and instead export these products.

Export

Panama was considered an important exporter of shark-related products. Between 2000–2011, Panama was included in the top 20 most important shark meat and fin exporter countries (Mundy-Taylor & Crook, 2013; Dent & Clarke, 2015). However, this situation has changed considerably, and currently, smaller volumes of shark and ray products are being exported than before. According to an export analysis from 2009–2017, around 19,419.9 mt of shark and ray products, representing a revenue of USD 40,007,497 were exported (Ross et al., 2019). The main shark products were trunk or dressed carcasses (i.e., gutted, headed, and finned, 13,014 mt, worth USD 21,054,412), fillet (3,469 mt, USD 7,590,915), and fins (655 mt, USD 6,589,732; Ross et al., 2019). In the same period, 904,279 kg and 632,325 kg of manta fillet with a revenue of USD 2,264,233 and USD 1,218,639, respectively were exported (Ross et al., 2019). For ray gill plates, only 2 kg was exported. Importantly, manta rays are not a regular part of the fisheries; thus, it is believed that this category of manta exported potentially actually corresponds to the generic category of rays (Ross et al., 2019). This is supported by the idea that fishers frequently refer to rays as manta. Furthermore, at a species-level, between 2009–2017, Panama exported trunks of Blue Shark (375 mt), Silky Shark (117.5 mt), and mako shark (probably Shortfin Mako; 7.2 mt). These shark products generated a value of USD 324,346, USD 117,481, and USD 7,220, respectively.

Between 2009–2017, the US was the most important destination for shark exports, with a volume of 5,180 mt of shark meat, representing USD 11,416,705 in revenue. The second and third most important destination for shark meat from Panama were Colombia and Uruguay, with about 2,471 mt and 2,366 mt for each country, representing earnings for USD 4,376,877 and USD 2,613,086, respectively (Ross et al., 2019). During the same period, over one million kg of shark meat were exported to countries such as Mexico, Taiwan, Trinidad and Tobago, Brazil, and Portugal. Regarding shark fin exports, Asian countries such as Taiwan and Hong Kong Special Administrative Region (SAR) were the most important destinations for this product, with 413 mt (USD 577,608) and 218 mt (USD 3,474,608), respectively.

Panama exports most shark and ray products through five points: Colon City, Panamá City, Tocumen airport, Chiriquí, and Azuero. Colon City, Panamá City, and Tocumen airport are the most important for exporting shark products. For example, between 2009–2017, via ports in the Colon and Panamá cities, volumes of 9,472 mt (USD 14,379,701) and 2,630 mt (USD 4,076,590) of shark meat, respectively, were exported (Ross et al., 2019). Additionally, 222 mt (USD 368,099) and 1,299 mt (USD 3,073,053) of rays were exported via ports located in the cities of Colon and Panamá, respectively (Ross et al., 2019). In Tocumen airport, during the same period, 4,876 mt of shark meat with a value of USD 10,740,036 and 509 kg of ray meat with a value of USD 1,737 were exported. Shark fins were exported in larger quantities from Colon city (334 mt; USD 1,734,457), Panamá City (293 mt; USD 1,307,511), and Tocumen airport (25 mt; USD 3,351,628) to mainly Asian countries such as Hong Kong SAR and Taiwan (Ross et al., 2019). In Chiriquí, a total of 155 mt kg of shark meat and fins was exported for the same period with a value of USD 602,169. According to the customs information, Chiriquí was the only point used to export shark-related products by road between 2009–2017. Through Azuero, 22 mt of ray meat valued at USD 50,859 were exported.

CULTURAL SIGNIFICANCE

In the pre-Columbian culture, shark teeth had some traditional, practical value. For example, they were used as pendants for necklaces and bracelets (de Borhegyi, 1961). Moreover, shark teeth and stingray spines may have served as weapons for natives (de Borhegyi, 1961). The large number of stingray spines found in graves may indicate a potential function in rituals in the culture of some indigenous people (Castillero, 2004). Several artifacts have been found with an artistic motif, such as stingrays effigy vessels (Haile, 2020), which might indicate the importance of the sharks and rays in native culture. There is some evidence of

Small-scale fishing vessels in Panama City | Francisco Rioseco | Unsplash

the use of sawfish rostral teeth, rostra, and vertebrates as cultural depictions by the Gran Coclé culture (c. 150 BCE–700 CE) , and in the Emberá-Wounaan community in Darien Province (Kyne et al., 2014). Moreover, in the Guna ethnic community, sawfish are considered a protector of humanity, whether physically by using their rostra against sea creatures, or spiritually against bad spirits (McDavitt, 2014). Sawfish rostral teeth from Panama and other countries such as Brazil and Ecuador are also used as spurs for cockfighting in Peru and Costa Rica (McDavitt, 2014).

RESEARCH

The Panama Aquatic Resources Authority (ARAP) leads shark and ray-related monitoring in different fishing ports and landing sites on the Caribbean and Pacific coasts. Researchers from local public and private universities, such as the National University of Panama (UP) and its branches, and the International Maritime University of Panama (UMIP), are conducting research projects on shark and rays, such as genetics, reproduction, life history traits, interaction with fisheries, and habitat utilisation. There are institutions that conduct research on sharks and rays in Panama, including the Smithsonian Tropical Research Institute (STRI), where researchers explore shark and ray's behaviour, ecology, migration, and palaeontology; and the Institute of Scientific Research and High Technology Services of Panama (INDICASAT), which has conducted genetics research, such as the development of molecular tools for the traceability of sharks and rays from the Panamanian fishery and population genetics of some species of sharks in the Tropical eastern Pacific. Some non-profit organisations, such as MarAlliance, MarViva, and Shark Defenders, have conducted in-country surveys to improve understanding on the interaction between sharks and rays and fisheries, and to explore the biology and ecology of shark and ray species in different coastal areas.

MANAGEMENT

Governance framework

The conservation management of sharks and rays falls mainly on ARAP, which is responsible for managing fisheries and ensuring compliance and enforcement of national fisheries and aquaculture laws and policies. ARAP is accountable for monitoring the production of different fishing ports and landing sites on Panama's Caribbean and Pacific coasts. The Ministry of Environment of Panama (MiAmbiente) oversees different categories of protected areas, including Marine Protected Areas (MPAs). MiAmbiente is the authority in charge of implementing and enforcing of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in country. Since 2015, the Coast and Seas Division (DICOMAR) from the Ministry of Environment is responsible for managing coastal and marine resources via an ecosystem-based approach. Furthermore, the National Aeronautic and Naval Service of Panama (SENAN) and the environmental police of Panama collaborate, with other authorities, such as ARAP and MiAmbiente, to enforce fisheries, trade, and MPA regulations on both coasts. The Panama Maritime Authority (AMP) oversees registering fishing vessels and the country's maritime, logistic, and port services. Moreover, in a shared effort with the ARAP, AMP participates in the fight against illegal, unreported, and unregulated (IUU) fishing.

Policy

Panama has passed the following laws that benefit sharks and rays:

Panama law No.9

- Implemented on 16 of March 2006.
- Objective: Ban on shark finning.
- Key points: This law prohibits finning but allows small-scale fisheries the 5% fin-to-carcass weight ratio as opposed to landing sharks with fins attached. However, caught sharks needs to be landed with the fins naturally attached in industrial fisheries.

Panama Executive Decree No. 9

- Implemented in 2009.
- Objective: Conservation of Whale Shark.
- Key points: This law bans the fishing, capture, and trade of Whale Shark.

Panama Resolution 69 of May 19, 2014, Gaceta oficial No 27537

- Implemented in 2014 by MiAmbiente.
- Objective: Management of Whale Shark tourism.
- Key points: Resolution regulates Whale Shark watching in the Gulf of Chiriqui, specifically in Coiba National Park including the Isla Canales de Afuera marine reserve, key sites of importance for seasonally foraging Whale Shark.

Panama Executive Decree No. 486

- Implemented in 2010.
- Objective: Regulate longline fishing in waters under jurisdiction of Panama.
- Key points: The law prohibits all types of longlines with a gross registered weight greater than 6 mt.

Regional Regulation OSP-05-11, agreed between Central American countries in November 2011

- Implemented in 2012.
- Objective: Ban on shark finning and requiring sharks to be landed with fins naturally attached .
- Regulation OSP-05-11, was adopted via Central American Integration System's (In Spanish: Sistema de Integración Centroamericana; SICA) Fisheries and Aquaculture Sector Organization of the Central American Isthmus (OSPESCA). It binds Belize, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, and Panama to landings sharks with fins naturally attached. This is implemented with Panama law No.9.

In addition to this national and regional policies that benefits sharks and rays, Panama is a signatory to the Convention on Migratory Species (CMS) since 1989 and CITES since 1978.

Enforcement and monitoring

Enforcement of fisheries regulations remains a significant challenge to conserving sharks and rays. However, there are government efforts to improve their status. For example, an inter-institutional commission was created to prevent and eliminate IUU fishing. This commission is integrated by authorities relevant to fisheries (e.g., the ARAP; AMP; MiAmbiente; and the navy [Aeronaval]) and aims to develop strategies to reinforce fisheries management through monitoring fishing vessels using technology, development of new management processes and protocols, strengthening monitoring at fish landing sites, and incorporate specialised human resources to fisheries monitoring and surveillance.

Non-governmental organisations (NGOs), such as MarAlliance and Shark Defenders, are conducting research and education programs to increase awareness and public knowledge of fishery regulations and shark and ray conservation, and support fisheries management initiatives. MarViva has focused efforts on campaigns that seek to raise awareness and public support for threatened species.

The Fisheries Transparency Initiative (FiTI) has been participating in collaborative efforts with various stakeholders in Panama since 2022, with the aim of advancing transparency in marine fisheries and encouraging the adoption of FiTI standards by the government. Evaluations conducted by FiTI focused on the assessment of transparency in marine fisheries on Panamanian government websites. The lack of publication of crucial information associated to transparent and inclusive fisheries management highlights the country's relatively limited performance in this regard. The implementation of FiTI would have positive impacts on Panama's fisheries sector. Nevertheless, despite the relevance of its marine fisheries sector, the government of Panama has yet to demonstrate a commitment to join the FiTI (FiTI, 2023).

Community involvement

Indigenous territorial authorities are involved in the management of some marine protected areas, namely the Cayos Miskitos and Franja Inmediata Reserve. Such authorities are involved in developing the rules of control, regulation, and management of this area. However, management norms are often not recognised by state authorities and therefore not properly enforced. This has resulted in conflicts between authorities and users (González, 2018). Relationships between communities and authorities can be strained by the fact that some communities continuously report illegal industrial fishing in their territories, to find that they may have been granted permission from INPESCA to carry out such activities. Improving communication between state authorities, Indigenous territorial authorities, and users is therefore key for promoting more effective management in such areas.

Gaps

There is a lack of data and information on fisheries which can preclude the conservation of sharks and rays in the country. For example, official statistics of shark and ray targeted and incidental catches, landings, and exports are not species-specific, which makes it challenging to identify population trends for the important commercial species. In addition, discard data are only provided for some fisheries, limiting our understanding of the fishing impact on sharks and rays. Furthermore, the domestic market information (e.g., market chain and utilisation) on sharks and rays must be better understood. There is a need to strengthen the technical capacity and the monitoring and control of shark and ray fisheries and trade. Improving and enhancing the research on the biology and ecology of the sharks and rays associated with any fisheries in the country is essential; however, research is limited to collecting data related to the interaction

Bull Shark *Carcharhinus leucas* | Ewout Knoester | iNaturalist.org (CC BY-NC)

of sharks and rays with fisheries. Indigenous fishing activities that involve sharks and rays and their utilisation are unclear, and communication among agencies and external stakeholders is limited. This is a vital exchange of information, mainly because the success of potential conservation strategies might depend on this supply of information between both parties. Finally, public awareness of shark and ray threats should be promoted to engage public participation in shark and ray conservation activities.

RECOMMENDATIONS

To understand the impacts of fishing exploitation on higher-risk shark and ray species, it is crucial to increase and improve the data collection and analysis of the sharks and rays' fisheries and trade in Panama. This process includes not only collecting data at a species-specific level but also strengthening monitoring of landing sites, organising full-time observer programmes in both small- and large-scale fisheries, and establishing a research programme that involves fishers from distinct artisanal fishing communities in the collection of data. Moreover, developing an innovative way to monitor ports and fishing vessels, such as employing videos and onboard cameras, is recommended, which can facilitate the monitoring and surveillance programme. Similarly, it is recommended to create monitoring schemes that include collecting data on fisheries that usually are unknown such as data on recreational fishing or data related to indigenous communities. Data collection should include the collection of each species' biological traits (e.g., sizes). Fisheries in Panama would benefit from creating monitoring programs that ensure the obtention of data and information on bycatch and discard in fisheries. Finally, it is essential to strengthen the monitoring of the exports of shark-related products and ensure compliance with CITES listings and the development of Non-Detriment Findings (NDF) for sharks and rays.

Policy

- Review and update Panama's legal and regulatory framework concerning the conservation and management of sharks and rays. For example, law No. 9 of March 2006, which prohibits finning, is the primary legal conservation tool for sharks. However, this measure allows fishers to have a certain number of fins (5% of the total weight of shark carcasses) landing by vessel. This contravenes the OSPESCA legislation adopted in 2012 that requires Central American countries to land all sharks with fins naturally attached to the body. This regulation makes the morphological identification of specimens at specific levels difficult, jeopardizing the conservation strategies for shark and ray fisheries. A simple way to minimize these issues is to require that sharks be landed with fins naturally attached to their respective carcass, which would facilitate the identification of shark species;
- Promote constant cooperation between institutions related to managing fisheries, such as the ARAP, MiAmbiente, the National Aeronaval Service of Panama (SENAN), and the environmental policies of Panama. Reinforcing this synergy can assist in guaranteeing more efficient enforcement of the existing national and international regulations for the trade and protection of sharks and rays and help to reduce IUU fishing; and
- Increase the technical capacity and extend the fishery monitoring systems to areas that, although are important to landings, processed and traded shark and ray species are frequently not monitored.

Science/knowledge/research

- Conduct research to understand the biological aspects of these groups' reproduction, growth, and feeding patterns. Similarly, an essential contribution to conservation would be genetics populations studies that focus on investigating the connectivity of the commercially important species in the region;
- Develop programmes that improve understanding of the seasonal and temporal distribution, migration, and habitat use of sharks and rays in the country. Such studies will help to identify critical areas for sharks and rays, such as nurseries and foraging grounds, areas of potential focus for the conservation and efficient management of shark and ray populations;
- Develop research projects that aim to directly reduce the mortality of sharks and rays, such as assessing the efficiency of bycatch technologies or assessing methods to enhance the survival rates of release sharks and rays, supporting an important conservation management measure for the country; and
- Promote and encourage cooperative and regionally autochthonous research programs to allow to highlight transboundary conservation of migratory species of sharks and rays.

Management/governance/conservation

- Update the national plan of action for the conservation and management of sharks and rays (NPOA-Sharks) published in 2016 to integrate updated actions and collected data. Updates should focus on actions achieved since the plan's publication, effectiveness of conservation measures, population status, threats, and potential conservation and management of threatened shark and ray species as well as the integration of new threats and concerns. It is necessary to create mechanisms that ensure the achievement of all the strategic objectives of the plans since, in the previous plan, most of them still needed to be achieved;
- Encourage effective communication and collaboration between management agencies and stakeholders (e.g., civil society organisations, fishing companies, fishing communities, fisher organisations, fishing industry, and scientists). The creation of a truly multisectoral national shark working group that integrates stakeholders' interests and knowledge into the conservation and management strategies of the country is a key first step. This approach can improve transparency, engagement, and participation in decision-making regarding sharks and would hopefully lead to better compliance with regulations and management measures;
- Increase in science-based education and outreach program would be beneficial in promoting participation from the public in conservation activities and increase the understanding of the role that they can play in the conservation of sharks and rays.

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