


Article

# Beyond Protection: Recognizing Nature's Rights to Conserve Sharks

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**Abstract:** This paper blends conservation science with legal and policy analysis to assess the primary threats to global shark populations and explores innovative approaches to conservation building upon the philosophy of Earth law, including the Rights of Nature legal framework. Using a case study of Panamá's national Rights of Nature law, this paper highlights approaches to improve the protection and restoration of shark populations and their habitats. By examining the ecological, social, and economic aspects of conservation holistically, this study offers an interdisciplinary perspective on the urgency for shark protection and presents Rights of Nature as a valuable approach to shark conservation, with potential applications to other species globally.

**Keywords:** sharks; Rights of Nature; conservation; Chondrichthyes; holistic conservation; Nature's rights; MPAs; overfishing; ocean governance; Earth law

## 1. Introduction

As apex predators in marine ecosystems, sharks provide a critical barometer of ocean health. Despite increasing awareness of their ecological importance, many shark populations continue to decline worldwide, underscoring the urgent need for more effective management and protection measures [1–5]. While conservation efforts have been successful in many areas, there is still much work to be done to ensure their long-term survival. Simply protecting sharks from human activities is not enough. As keystone species, sharks play a crucial role in regulating food webs and maintaining ecological balance, highlighting the intricate and interconnected relationship between humans and the ocean, and the pressing need for holistic approaches and understandings [4,6–8]. This paper offers an exploratory analysis of the threats to global shark populations and considers how the advances of the Rights of Nature movement can provide imaginative solutions for holistic, rights-based, and equitable solutions to conservation [8,9]. The present research intends to enhance the existing discourse on shark conservation by investigating questions that have received limited attention in the literature. These questions not only encompass strategies for the effective conservation of sharks, but also extend to how we may progress beyond the protection of sharks to ensure restoration, preventive management, and the reimagining of a more harmonious relationship between humans, sharks, and the ocean.

## 2. Methods

Initially, the primary threats to global shark populations, which total 1200 species belonging to the subclass Elasmobranchii, class Chondrichthyes, and are hereafter referred to as 'sharks', were assessed [10,11]. These threats include climate change and habitat degradation, with overfishing, targeted fishing, and the bycatch of sharks being the most pervasive risk to their survival [2,3,10–14].

The methodology employed in the study aims to connect conservation science with the legal and policy analysis of the Rights of Nature. This includes drawing on the philosophy of Earth law, which prioritizes ethical principles of care, reciprocal responsibilities, and interconnection, and recognizes the fundamental interdependence between humans and



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the environment, of which there is no separation or superior hierarchy. One expression of this philosophy is the Rights of Nature legal framework, which underscores the need for more holistic and equitable approaches to environmental governance [8,9,15–22]. As an illustration, various viewpoints have arisen regarding the necessity for a reimagined ethical relationship with Nature, such as Leopold’s land ethic, Berry’s stance on transforming human behavior through the reshaping of values from an anthropocentric worldview to an Earth-centered one, the global vision to live in harmony with Nature by 2050, and the overall call for transformative change [16,23–27]. Similarly, ocean-centered governance promotes “scientists and decision-makers to shift from an anthropocentric lens to an ocean-centered lens” by recognizing the ocean as a legal entity in decision-making and calling for legal, policy, and institutional changes that center the ocean’s needs [9]. By centering the ecological needs of sharks in conservation management, we can begin to explore what such a rethinking would entail. This exploration might lead us to reconsider our assumptions about how we interact with the environment, and how we value sharks, as well as to reexamine the legal and policy frameworks that guide our decision-making processes. In alignment with emerging ocean scholarship and comparative Rights of Nature cases, references to the Ocean and Nature will be capitalized to emphasize their intrinsic value in place of valuing the environment as a resource [9,28,29].

Building upon the ethics, applications, and analyses of Rights of Nature well-established in the literature, this paper adopts an interdisciplinary perspective in demonstrating the urgency for shark protection at national and global scales in light of the applicability of Rights of Nature as a holistic approach and legal framework [8,15,16,20,22,30–32]. Rights of Nature is a globally emerging legal approach and movement, having now been enacted into law and policy in more than thirty-five countries, with numerous case studies, court decisions, and management structures demonstrating its positive implementation worldwide [29,33,34]. For example, Ecuador [35], Bolivia [36], and Mexico City [37] recognize the Rights of Nature either constitutionally or through national law, Colombia declared the Atrato River and Colombia Amazon [38,39] as legal entities and as subject of rights, and Belize recognized the Belize Barrier Reef as a living entity [40]. Both New Zealand [41] and the United Kingdom [42] passed legislation that recognizes that animals, like humans, “are sentient beings.” At the international level, the Kunming-Montreal Global Biodiversity Framework, adopted under the Convention on Biological Diversity, is the first environmental multilateral treaty to reference Rights of Nature, stipulating that the framework “recognizes and considers . . . diverse value systems and concepts, including, for those countries that recognize them, rights of nature and rights of Mother Earth, as being an integral part of its successful implementation” [27].

In early 2022, President Cortizo of Panamá enacted Law 287, “that recognizes the Rights of Nature and the obligations of the state related to these rights” [43]. Panamá now joins a host of countries worldwide in legally recognizing Nature’s rights at the national level [29,33,34]. The law, which entered into force in February 2023, provides an opportunity to define the measures, procedures, and applications for all administrative and legal ministries and sectors to uphold and respect the Rights of Nature in practice. As such, this analysis is additionally informed by a case study of Panamá, specifically to implement the national law to enhance the protection and restoration of Nature, which includes shark populations and their habitats. The selection of this case study is due to the country’s unique position provided by the Rights of Nature law, and demonstrated ambitious conservation actions in the Ocean seascape to date [44–47]. The applicability of this exploratory exercise is not limited only to Panamá or shark species. By examining a complex ecological, social, and economic issue of conservation through a holistic and rights-based lens, this analysis may act as a microcosm for inspiring similar examinations of different species worldwide. In fact, exploring the applications of Rights of Nature laws and policies to a specific species is largely under-researched. This paper can help fill this gap in the Rights of Nature scholarship while providing a valuable contribution and novel area of study to shark conservation.

### 3. Threats to Shark Populations

Unlike other marine megafauna or those more highly valued as economically beneficial to fisheries or tourism, sharks remain particularly under-protected. Their populations are crucial to the balance of marine ecosystems as an umbrella species, as “efforts to conserve shark populations and their habitat will result in protection of a large number of other marine species” [48]. As apex predators and keystone species, sharks sustain the health of the Ocean and coral reefs. They balance food chains by removing weaker or diseased individuals, which strengthens prey genetics and stabilizes ecosystems and natural selective processes, helping ensure species diversity [4,6]. In fact, numerous studies have found such correlations, including in commercial fisheries for crustaceans and tuna, among others, when shark populations declined, which caused cascading ecological effects [49].

However, insufficient data continue to impede the enforcement efforts and ability to conceptualize the extent of overexploitation to date. Such information across spatial scales is crucial to conservation [48–55]. Shark products often undergo several stages and are transported through various countries before consumption, thereby obscuring the accounting process and understanding of the supply chain. Data gaps are of concern, given the “boom and bust” and serial depletion patterns of shark fisheries, which namely involve “first producing huge catches and gains but rapidly collapsing to unsustainable levels in response to increasing fishing pressure”, while catching smaller and smaller species over time [50,56]. Therefore, their population recovery potential is highly threatened as “the reduction in catch usually occurs within the first years of exploitation, thereby affecting the marine food web before any scientific monitoring can be considered or implemented” [56]. The high inter-variability of shark species, habitat ranges, and behaviors make governance challenging; thus, enhancing data collection could potentially foster political will and action.

The areas listed below, while not exhaustive, demonstrate where increased data collection would be beneficial for conservation:

- a. Quantitative evaluations of catches and shark derivatives, such as liver oil or skin, which are lacking to date, increased monitoring of intense fishing zones and within the Areas Beyond National Jurisdiction (ABNJ), and a deeper understanding of the impacts of different fishing gears [1,3,57–61].
- b. Improved data on the spatial distribution of shark populations, including migration patterns, breeding areas, and nursery habitats, to better inform effective marine protected areas [3].
- c. Enhanced understanding of the ecological role of sharks: There is a need for more research, particularly on their interactions with other species and their impact on marine ecosystems, to better understand the consequences of declines in shark populations and the potential benefits of their conservation [4].
- d. Consultations with fishing communities through stakeholder analyses. Data collections on human attitudes towards sharks are found to be useful in developing effective conservation strategies that encourage public participation, helping identify incentives to motivate behavior changes and encourage stewardship for long-term sustainability [48,60].
- e. A greater understanding of the economics of shark fisheries. There is a need for more research, particularly on the costs and benefits of different management approaches, to identify incentives for sustainable fishing practices and promote the conservation of shark populations [62].

Through a holistic understanding of the interconnections between sharks and human communities, we can identify more needed areas of data and research, and further develop science-informed policy and management proposals that protect the future resilience of shark populations and the health of marine ecosystems in tandem. As unsustainable fishing and the use of sharks persist, ecological boundaries will continue to be passed, risking their populations’ rebound potential [48]. This next section will examine the

primary anthropocentric impacts on sharks, including targeted fisheries, bycatch, habitat degradation, and climate change.

### 3.1. Targeted Fisheries

Relevant data indicates that over 100 million sharks are killed each year, which is largely driven by overfishing and the demand for shark fins, and that more than one-third of all shark species are now threatened with extinction [63]. While global statistics provide insight into the overexploitation of sharks, it should be noted that gaps in the data remain a prominent issue in quantifying shark abundance, distribution, and levels of exploitation due to the lack of financial resources, poor global coordination of species statuses, and illegal capture, among other reasons [50,64,65]. For example, international mechanisms to date inadequately monitor or regulate the rampant global trade of shark fins [66].

Several studies confirm that “just [five] decades ago, sharks were abundant in the ocean; however, in recent years, their populations have been alarmingly reduced (~90%)”, meaning that there is a “catastrophic loss of Sharks” [3,56,63,67] (pp. 316 and 115). According to one disparate global estimate, approximately “63 and 273 million sharks were killed in 2010 alone”, significantly exceeding the ability of these populations to rebound [64]. The widespread nature of this problem, affecting not only national Exclusive Economic Zones (EEZs), but also the ABNJ, where population abundance is reported to have decreased by 71% since 1970, underscores the urgent need for more effective and coordinated conservation efforts [12,63]. If we continue to mismanage the impact of human activities on shark populations, we risk their vulnerable potential to recover, thereby destabilizing the delicate balance of marine ecosystems and jeopardizing the future health of the Ocean.

Sharks are slow to grow and mature and are long-lived with low fecundity, causing them to be particularly vulnerable to overfishing. Porcher et al. argue that in the long-term, excluding local sustenance, no large-scale shark fishery can be sustainable, as “certainly, no species can withstand targeted, mechanized, industrial fishing” [68,69] (p. 86). Additionally, once a shark population is substantially depleted, it is incredibly challenging to restore them to a healthy abundance. In fact, this recovery process can take decades [2]. Their decline can also cause trophic cascades, namely the ecological imbalance, and change between predator and prey relationships, leading to declines of coral reefs and seagrass beds [70,71].

The overexploitation of the *Sphyrnidae* family (hammerheads) serves as a poignant example of the detrimental effects of human activities on shark populations and their ecosystems [72]. Of the eleven species of hammerhead globally, five species are critically endangered, two are endangered, one is vulnerable, and two are unevaluated or data deficient according to the International Union for the Conservation of Nature Red List of Threatened Species [73]. Accordingly, UN data estimates that the global capture of hammerheads has increased by more than 8000% since 1990 [50].

### 3.2. Bycatch

Though highly underreported, available global data indicate that bycatch is a primary threat [74,75]. In fact, leading research estimates that “50% of the global shark production is composed of sharks caught as bycatch in the [ABNJ] pelagic longline fisheries” [74–76]. At-vessel mortality (AVM) occurs when an individual shark is dead when captured. AVM incidents can be more easily reported and accounted for in fishery management. In contrast, post-release mortality (PRM) occurs when an individual is released and subsequently dies due to the harm caused by the capture. As expected, these incidents are challenging to quantify as PRM varies widely depending on the species and fishery gear or practices [74].

There are several emerging innovations to address bycatch and ensure that the best practices for handling and release are implemented [3]. For example, the Marshall Islands, Cook Islands, Federated States of Micronesia, and the Western and Central Pacific Ocean Fisheries Commission all prohibited the use of trace wires. Additional restrictions on various types of fishing gear can help reduce bycatch incidents, including modifying the

materials of longline wires that allow sharks to sever, utilizing different baits that attract distinct species, and changing hooks to those that lead to reductions in mortality. In 1994, California, U.S., banned the use of coastal gillnets, resulting in a notable population rise of species that had previously experienced high rates of bycatch mortality [69]. To prevent a further decline in shark populations, it is crucial to ensure a better collaboration among stakeholders, including fishers, conservationists, policymakers, and scientists, to develop effective and sustainable solutions that better manage and minimize the unintended harm caused by fishing activities.

### 3.3. Habitat Degradation

Habitat degradation and loss pose a significant threat to shark populations, reducing their access to critical ecosystems, altering their behavior and migration patterns, and increasing their vulnerability to overfishing and other anthropocentric threats. Of particular concern are nearshore shark populations, which rely on mangroves and seagrass beds for foraging, reproduction, and refuge from predators. Coastal development, pollution, and habitat fragmentation are the primary documented threats to these fragile ecosystems, compromising the survival of sharks and other species [52,77,78]. Additionally, bottom-fishing trawlers have severe impacts on oceanic and deep-sea species, harming benthic ecosystems, destroying seafloor habitats, and reducing species diversity [79]. As further explored in the subsequent section, the impacts of climate change are exacerbating habitat degradation across marine ecosystems worldwide, presenting unprecedented challenges for conservation efforts. To preserve the ecological role of sharks and safeguard the health of the Ocean, it is crucial to prioritize effective, preventive, and restorative management strategies that account for the interconnectedness of these ecosystems and human activities.

### 3.4. Climate Change

Human-induced climate change threatens sharks by contributing to changes in habitats, behaviors, and population abundance, distribution, and diversity. For example, high-emissions scenarios predict high loss rates of biodiversity and species richness in tropical waters [80,81]. Sea level rise, acidification, and warmer waters can alter the suitability of habitats and subsequently vary the distribution and availability of prey [82–84]. Consequently, sharks may change their migratory patterns or nursery and foraging grounds dependent on long-term shifts to their habitats.

Species reliant on healthy estuaries, mangroves, and coral reefs are expected to be the most vulnerable and most harmed by climate impacts [14]. In fact, scientists discovered that warmer waters impacted the embryonic growth of hatched eggs, with implications for sharks that give birth to live young as well. From these studies, they hypothesize that nearing 31 °C, sharks may start to be negatively impacted, as they discovered that “embryos hatched more quickly, were lighter in mass, exhibited reductions in metabolic performance, and required twice as long to recover from exhaustive exercise than their lower temperature reared counterparts” [85] (p. 6). These findings are of great concern given “that this temperature range is well within [O]cean warming scenarios predicted for this species’ distribution over the next century” [85] (p. 1). An additional study found that the compounded effects of elevated temperature and CO<sub>2</sub> concentrations had similar results, ultimately harming sharks’ capacity to hunt and exert predatory control over food chains [86]. The interconnection between human activities and the health of shark populations is underscored by the impacts of climate change. It is crucial to explore holistic approaches that prioritize a healthy and resilient Ocean in climate negotiations, ultimately reimagining pathways to a balanced relationship with the Ocean to prevent crossing ecological and planetary boundaries.

### Case Study: Panamá

Intensive shark fisheries began in the 1980s in Panamá, first as incidental catches before industrializing and expanding in line with technological advancements, coupled with the

increasing global pressure on fisheries [56]. Sharks became a targeted and species-directed industry, and a new source of protein, substantially increasing landings for their fins, meat, and other shark-derived products, such as liver oil and skin [87–90]. Of note, research has confirmed that 96% of captured *Sphyrnidae* (hammerheads) in Panamá are either “new-born or juveniles” [91,92]. This aligns with the global pressure of fishing sharks, though worldwide, this trend began early in the 1950s and expanded thereafter [52,64,91–93].

Over forty species of sharks are present within Panamá’s waters, of which over half are “threatened or near threatened with extinction [73].” However, an estimated 75% of shark catches in Panamá are unreported, highlighting the need for enhanced monitoring [56,94]. In fact, scientists found “that between 2001 and 2011, shark catches dropped over 90 percent”, supporting claims of underreporting by other studies [95]. Additionally, there is wide uncertainty in the size of the domestic shark meat market, with some studies even calculating negative numbers, illustrating a potential high underreporting in artisanal fisheries [50].

To date, Panamá has implemented notable legal protections for sharks, including a ban on fishing *Rhincodon typus* (whale shark) (Appendix A) [94,96,97]. Nevertheless, the capture of sharks is primarily regulated through a fins-attached law [98,99]. This law mandates that industrial fishing vessels must keep the fins attached to any sharks caught throughout the landing process, thereby preventing the practice of removing fins and discarding the rest of the sharks at sea. However, artisanal fisheries are permitted to remove fins from landed sharks, provided that the onboard fins do not exceed 5% of the weight of the sharks [100]. Despite these regulations, there is a need for enhanced management measures and increased legal protections to conserve the populations of endangered or threatened shark species [56,88,101–104].

Consequently, shark fishing has developed into a highly profitable industry, producing an annual average of “3514 [tons] of meat since 1999”, which equates to approximately US\$6.4 million per year in gross profit [56]. Despite the short-term economic benefits of shark fishing, expanding shark-related tourism could provide a significantly greater net benefit, and scientists warn that local shark fisheries may “start reporting economic losses and become unsustainable in the short- or medium-term future” [7,56,66] (p. 328). Recognizing the intrinsic value of Nature and protecting Nature’s rights, as outlined in the national Rights of Nature law, presents an opportunity to prioritize sustainability and ensure the continued existence and regeneration of life systems affected by human activities, which could prove highly beneficial in the long term [43].

The national Rights of Nature law stipulates that the State and all citizens of Panamá recognize Nature’s intrinsic value and protect Nature’s rights, which among others, include its rights to exist, persist, regenerate its life cycles, and “the right to the timely and effective restoration of life systems affected by human activities directly or indirectly” [43] (Art. 10). Through this law, Nature is acknowledged as a “collective, indivisible, self-relegated entity and is made up of its elements, biodiversity, and interrelated ecosystems”, and requires the State to “prevent and restrict the effects of human activities that can contribute to species extinction including . . . unsustainable fishing and in detriment of threatened or endangered species” [43] (Art. 3). Through this national recognition of the Rights of Nature, “that extends to all living beings, elements and ecosystems of which it is composed”, this law also acknowledges the rights of marine species by extension [43] (Art. 10). In fact, a subsequent national law that promotes the Protection and Conservation of Sea Turtles and their Habitats was passed in March 2023, which, among other protections, recognizes the inherent rights of sea turtles and their habitats [105] (Art. 29). Additionally, the law requires fisheries to implement measures to avoid bycatch and create a national committee to conserve sea turtles, which will be responsible for identifying and recommending protected areas for their protection, among other key tasks [105].

#### 4. Discussion

The recognition of the rights of sea turtles is novel in the Rights of Nature movement, and possibly one of the first for a particular species of marine life. Perhaps then, protections could be extended to sharks in Panamá or other countries that have embraced Rights of Nature laws and policies. The comparative experience following Ecuador's constitutional recognition of the Rights of Nature in 2008 illustrates that adopting specific regulations and management plans can help ensure effective implementation by harmonizing the legal framework [23,35,106,107]. For example, in Ecuador, several legal actions and judicial decisions have led to positive, preventive, and restorative effects on the environment, such as halting infrastructure projects to protect mangroves and preventing mining concessions to safeguard a protected forest [108,109]. In 2022, the Constitutional Court ruled that individual wild animals are a subject of rights, stating "this Court warns that animals should not be protected only from an ecosystemic perspective or with a view to the needs of human beings, but mainly from a perspective that focuses on their individuality and intrinsic value" [110]. Each new case sets a precedent and further defines the standards and models of decision-making to apply in practice to prevent the violation of Nature's rights. Establishing supplementary policies following a broad recognition of Nature's rights helps to strengthen the Court's capacity to interpret and enforce these laws and encourages policymakers to take proactive measures to protect Nature. Within jurisdictions that recognize the Rights of Nature, the specification of the inherent rights of sharks could help administrative authorities adhere to their obligations, namely, to respect and protect all of the environment.

Findings show that fins-attached laws predominantly do not achieve effective protection on their own [68,100]. For example, in Costa Rica, a fins-attached policy created a surplus of meat, which was traded under false names and ultimately contributed to further growing a local consumer market. An avenue for further research could be to explore policies for sharks inspired by the national law for sea turtles, such as recognizing the intrinsic value and inherent rights of sharks and their habitats. This could involve recognizing their rights to live and have free passage in a healthy environment, free of direct and incidental capture or finning, and other anthropocentric impacts that cause physical damage such as climate change, pollution, and unregulated tourism, among others. Additionally, it could increase the protection of their habitats and life cycles, modify gear use, or create legal standards for ecotourism. These non-exhaustive inherent rights derive from the scientific evidence of the threats endangering sharks. This listing is also informed by two other global examples, namely the signing of the 2014 San Francisco, California "Resolution supporting the free and safe passage of whales and dolphins in San Francisco's coastal waters, San Francisco Bay, and its estuaries", recognizing their right to be free of captivity, and the 2010 'Declaration of Rights for Cetaceans: Whales and Dolphins', where a collective of scientists meeting in Finland, stipulated that, among other listed rights, "every individual cetacean has the right to life, to freedom of movement and residence within their natural environment, and to the protection of their natural environment" [111,112]. In practice, the recognition of the inherent rights of sharks could fully legalize their capture, as stipulated in the sea turtle law, or could prioritize prohibiting the most harmful large-scale fishing practices [105] (Art. 31). A third alternative could be to enact fishing bans or catch limits that are species-specific, or establish seasonal closures. However, when species and fisheries data are scarce, such policies can prove challenging to enforce or incentivize compliance [60].

As human activities continue to threaten the delicate balance of the Ocean and the survival of sharks, exploring holistic approaches such as the Rights of Nature framework could provide a pathway towards restoring a sustainable and balanced relationship with the Ocean amidst the growing threats of climate change, habitat degradation, and overfishing. The importance of protecting and restoring shark populations extends far beyond the realm of conservation biology. For example, shark populations help sustain fish populations, and the Ocean as a whole, and thus, human communities in tandem. There are ecological,

social, and economic reasons to protect sharks as their healthy populations help maintain vital fisheries that support local economies and sustenance [13,71,113]. However, some experts conclude that protecting biodiversity for its own sake can have a positive impact on ecosystem integrity, is a necessary step to rebalance the human relationship with Nature, and is the most effective way to secure a sustainable future for humanity [21,23–25,114–119]. This approach emphasizes the intrinsic value of Nature and recognizes that preserving biodiversity and ecosystems benefits all living beings, not just humans. For example, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Methodological Assessment Report on the Diverse Values and Valuation of Nature finds that Rights of Nature is an approach to center intrinsic and relational values, with “considerable transformative potential” [25] (p. 461).

It should be noted that Earth law and Rights of Nature are not solely defined by the recognition of rights, but that also, inherently, these legal frameworks are grounded in ethics and values that inform key principles of governance [9,17,23,29]. For example, the IPBES values report concludes that the causes of and solutions for our global environmental challenges are tightly linked to the ways in which we value our environments [25]. Including a range of valuations of Nature into policy, such as through Rights of Nature, is found to advance both justice and sustainability by addressing the diverse ways in which people relate to and value Nature. It is worth questioning how sharks and their habitats are currently valued, whether as mere fishery resources or as species with inherent value. Rights of Nature provides a promising approach towards restoring a sustainable and balanced relationship with the Ocean and sharks, with its grounding in ethics and values that inform key principles of governance. Following this line of thinking, if conservation were to be grounded on ethics of relationality and care, conservation could be reinterpreted to prioritize the needs and interests of sharks [23,107].

As an illustration, the national law of Panamá is governed by principles, including restoration, precaution, prevention, and *in dubio pro natura*, meaning that when in doubt in decision-making, act in favor of protecting Nature. Identifying the compounding threats that sharks face and spotlighting particular attention to their needs in decision-making across sectors could be a viable pathway to enhancing their protection [43,120]. Another important distinction between this legal framework and traditional environmental law lies in the holistic approach to addressing the restoration of Nature by law. Unlike many environmental laws which prioritize the prevention of harm, this framework also provides a mechanism for restoring ecosystems and species populations, as found in Panamá’s national law, which states that Nature has the “right to timely and effective restoration of life systems affected by human activities directly or indirectly” [43]. Such norms of interconnection, reciprocal responsibilities, stewardship, and the prioritization and representation of the needs of a species or ecosystem outside of the benefits that humans receive, could be compelling to explore in terms of conserving and restoring shark populations [8,9,120]. Incorporating a legal framework that recognizes the intrinsic value of Nature and the responsibility to protect Nature could offer a promising path towards effective, preventive, and restorative shark conservation. One practical implementation to explore in this context is the use of marine protected areas (MPAs) to conserve and restore shark populations [62,70,121,122].

The size of MPAs and the scope of activities restricted within can vary greatly across different regions of the world. For example, establishing MPAs for nursery areas is an increasingly recognized strategy to protect the “reproduction and early growth of sharks”, wherein “extractive activities are either partially restricted or fully prohibited” [122,123]. Guidelines for identifying areas of the greatest importance for protection have been established, and research shows that the protection of critical habitats can be more effective if designated with species-specific goals and strong enforcement, including no-take zones or seasonal fishing bans [124,125].



Despite the use of protected nursery areas as a conservation strategy for shark populations, concerns have been raised about their effectiveness in preserving the spatial movements of sharks over their lifetimes. Some experts assert that seasonal or specific area closures can shift “fishing pressure on animals outside the time-area closure” or can “also disproportionately affect certain life-history stages outside of the closed area” [60,126] (p. 404). Therefore, a comprehensive approach that considers the spatial ecology of sharks may be necessary to ensure the effective management of their populations. For example, one emerging trend is the designation of entire EEZs as “shark sanctuaries”, as found in eleven countries to date, such as Honduras, Colombia, Cook Islands, and Palau, which restrict all commercial fishing and exports of sharks, claiming a more effective population rebound strategy takes a whole life-systems approach [121,123,127]. If resources are available, shark sanctuaries have been found to be “relatively easy to enforce . . . because managers can quickly identify any captured shark as illegal without having to identify the species, capture location or fishing gear in question” [69] (p. 406). To date, 29% of Ocean protected areas are designated for shark conservation. Such reserves are often established due to depleting populations, Illegal, Unreported, and Unregulated fishing, and “the challenges associated with implementing sustainable shark fishing” [70]. For example, the Bahamas prohibit the “possessing, fishing for or landing sharks or shark parts” and require bycaught sharks to “be released unharmed” [126]. Even so, as the most widely distributed marine apex predator, several shark species travel thousands of miles over their lifetimes due to breeding, changes in seasonal water temperatures, and prey migrations [7]. Enhancing regional and international coordination will help improve the effectiveness of existing management plans and sustain global populations, as migratory species are unprotected when moving outside MPAs [88,128,129].

Moreover, implementing Rights of Nature norms and standards in law can also strengthen the effectiveness of MPAs, as presented in “The Earth Law Framework for MPAs” [31]. In fact, the Republic of Panamá has proposed the creation of an MPA on the Pacific coast, namely the Refugio de Vida Silvestre Saboga, which is now open to public comment, and includes language to recognize and defend the Rights of Nature in the archipelago. If officially established, it will be pertinent to monitor how this approach will influence the governance of the area [130]. Finally, the case of the Galápagos Marine Reserve in Ecuador is an illustration in the context of sharks. This MPA, one of the world’s largest, operates under the Special Law of Galápagos that was enacted in 2015, and follows the guiding principle of the Rights of Nature in management practices. The reserve strictly prohibits industrial fishing and any harm caused to shark populations within the archipelago [70,131]. The Galápagos Plan 2015–2020 recognizes the constitutional right of citizens and Nature to live well, as enshrined in Ecuador’s Constitution, and leverages the Rights of Nature as a cornerstone of management to “an equilibrium among the society, the economy, and nature” [131]. These standards were put into practice in 2017 when a Chinese fishing vessel was detained by authorities for carrying over 300 tons of sharks, including endangered and threatened species. Consequently, twenty crewmembers were prosecuted in accordance with Ecuador’s Comprehensive Criminal Code and fined \$6,137,753.42 in total. The Court recognized that Nature was the legally protected entity in the case, and must be represented by the Galápagos National Park Institution, declaring:

“sharks being natural predators, being at the top of the food chain and being protected, allows the recovery of marine ecosystems, the stability of the population levels of species at low levels of this chain as well as balances the state of the oceans . . . the Galápagos province has a larger volume of marine organisms than other places worldwide, as scientists would say high biomass, and this is the contribution to their environment, the country, and humanity”. [113,132,133]

The economic value of a live shark to the tourism industry in the Galápagos is quantified to be \$360,105. As sharks can live long lives and bring in local revenue for many years, the lifetime of one shark is estimated to generate \$5.4 million on average in the Galápagos—an extraordinary contrast to the \$158 valuation of one shark sold for meat and fins [113]. With this example, the court ruled in favor of the Rights of Nature, noting that illegal shark fishing was against the interest of Nature, and that consequently, Nature is entitled to reparations. The Court decision also demonstrated a unique quantification of the value of sharks, noting that conserving their ecological value and economic value to ecotourism is a net benefit. This decision recognized the importance of shark conservation for its essential ecological role in the ecosystem and demonstrates how strict policies can be implemented and enforced under the Rights of Nature framework to protect sharks. Doing so exemplifies a proactive approach to protection, but also the importance of restoration and the recognition of Nature's entitlement to reparations from harm. This case, now the second of its kind in the Galápagos, sets a precedent for protecting not just sharks, but the Ocean and marine ecosystems as a whole [134]. In alignment with Bender's findings, strict policies implemented and enforced under the Rights of Nature framework regarding MPAs can extend "the traditional methods of 'resource' management to provide a clear legal mandate for managing protected areas as part of a system, and as part of the whole that also includes humans" [31,135,136].

Furthermore, as evidenced by this case, scholarly research suggests that ecotourism can generate novel revenue streams, promote the establishment of alternative livelihoods, and provide fishers with incentives to transition away from the capture of sharks [66,113,137]. This is an often undervalued opportunity, and thus, is an important area of further research to enhance benefit analyses. For example, research shows that with increased protection, the value of the marine environment in the Galápagos could be preserved while also stimulating additional revenue "without necessarily increasing the tourist footprint" [113] (p. 10). Encouraging positive shifts in fishing behaviors and legitimizing management plans are tightly linked to including and supporting the welfare of fishing communities in decision-making [121]. This has been exemplified worldwide. For example, in the Philippines, Oslob Whale Sharks are protected from poaching and have provided alternative livelihoods for fishers and supported community projects, totaling \$18.4 million over five years in diving tourism ticket sales. Fishers noted increased fish abundance and catches because of this protection [138]. It is clear from emerging holistic approaches and relational management structures that it is possible to "achieve the collective optimum" for fishers and their communities, sharks, and the Ocean ecosystem [62,139] (p. 14508).

## 5. Conclusions

The decline of shark populations worldwide is a pressing issue that requires urgent action, as evidenced by the crucial role that sharks play in maintaining healthy Ocean ecosystems and the devastating consequences of their depletion. The Rights of Nature legal framework offers a promising approach to protect sharks by recognizing the interconnected relationship between humans and the environment and recognizing the inherent rights of sharks. Even so, instilling principles of care, responsibility, and reciprocity could prove beneficial to conservation without legal recognition. For example, humans should recognize that sharks are inherently valuable beyond the benefits that humans receive from their capture and appreciate their ecological role in maintaining ecosystem integrity. By implementing a holistic approach that considers the needs of shark species throughout their life cycles and ecosystems, this framework can shift the management perspective from protecting humanity from sharks to protecting sharks from human impacts and economic interests.

The case study of Panamá provides a compelling example of how this innovative approach can be applied to enhance the protection and restoration of Nature, and promote the recognition of the inherent rights of marine species. Rights of Nature increasingly receives recognition in the literature and acknowledgment in global governance as a

successful approach to conservation. This is demonstrated by the countries and localities that have implemented these laws and policies successfully, resulting in positive impacts on the environment. In such jurisdictions, to ensure the full and effective realization of Nature's rights, policymakers are uniquely positioned to administer supplemental policies to protect shark populations and their habitats.

Conservation efforts for sharks need to be multifaceted, incorporating a variety of approaches, including fisheries management and marine protected areas. As this paper introduces, the implementation of Rights of Nature norms and standards in law, such as the case of the Galápagos Marine Reserve, provides a compelling example of how such measures can be successfully employed. The use of Rights of Nature as a guiding principle has led to strict policies being implemented and enforced, resulting in the protection of sharks and their critical ecological role. The economic value of live sharks to the tourism industry also demonstrates the potential of ecotourism to provide alternative livelihoods and incentives for fishers to shift away from capturing sharks.

While there are increased protections under the Convention on International Trade in Endangered Species of Wild Fauna and Flora, providing promising steps towards conserving their populations, adaptive and restorative measures are still needed, particularly in less affluent countries where small-scale and subsistence fisheries are common, and strict protection measures are difficult to implement and enforce due to the important roles that sharks play in food security and livelihoods. In such cases, innovative and equitable management approaches that transform markets and provide alternative livelihood options will be necessary to balance the needs of fishing communities with the conservation of shark populations. By furthering research on holistic and rights-based approaches, we can pave the way for the adoption of emerging legal and governance frameworks and ethical relationships that can ensure the survival of these apex predators and the health of the Ocean. Adopting approaches grounded in the Rights of Nature perspective can help us move beyond mere protection, towards envisioning conservation as an interconnected relationship. Such an approach powerfully reminds us of our responsibility to protect, restore, and live in harmony with Nature.

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## Abbreviations

ABNJ	Areas Beyond National Jurisdiction
AVM	at-vessel mortality
EEZs	Exclusive Economic Zones
MPA	Marine Protected Area
PRM	post-release mortality
IUU	Illegal, Unreported, and Unregulated fishing

## Appendix A

National legislation with protections for sharks and regulations to shark fisheries in Panamá:

Law and Date	Mandate
Law No. 9, 2006 [99].	<ul style="list-style-type: none"> <li>• “Fishing efforts for sharks must not be increased;”</li> <li>• “New shark fishing licenses or the authorization of new boats, except in cases of over-production of sharks (Article 7) are prohibited;”</li> <li>• “Imports of shark fins that are not partially naturally attached require a certificate from the relevant competent authority of the country of origin that confirms that they are not the product of finning;”</li> <li>• The National Plan of Action (2010, 2017) must be implemented and “be revised every four years;”</li> <li>• Industrial fisheries are required to land sharks “while their fins are still naturally attached;”</li> <li>• Artisanal fisheries are permitted to remove fins from landed sharks, with a restriction “that onboard fins cannot weigh more than 5 percent of the weight of the sharks.”</li> </ul>
Executive Decree No. 17, 2008 [140]	Mandated vessel monitoring systems (VMS) be installed to obtain an international fishing license.
Executive Decree No. 486, 2010 [141]	Prohibited “the use of all types of longlines by commercial and industrial vessels in waters under the jurisdiction of Panamá. Use of longlines was limited to vessels with a gross registered tonnage of under 6 tons, which had received authorization from the Aquatic Resources Authority of Panamá.”
Executive Order 9, 2009 [142]	Prohibited fishing of <i>Rhincodon typus</i> (Whale Sharks): prohibited “fishing at any level . . . as well as captivity, commercialization, and export of any of its parts—meat, cartilage, fins.” In 2014, Panamá signed an international binding agreement with Costa Rica, Belize, Honduras, Guatemala, Nicaragua, the Dominican Republic, and El Salvador to protect Whale Sharks in all Eastern Pacific and Caribbean waters [87]. This agreement and the creation of additional tourism guidelines for Whale Shark watching was the result of a research team tagging fifty Whale Sharks to track their routes through international waters.
Executive Decree 131, April 2020 [143]	Established regulations for the prevention of Illegal, Unreported, and Unregulated (IUU) fishing. This response followed the issuance of two yellow cards from the European Union’s IUU market-based approach carding scheme. Panamá was the first country to receive two yellow cards, which signify a warning before a trade sanction for a country not effectively preventing IUU.
Law No. 204 of 2021 [144]	Regulates fishing and aquaculture activities, and includes promoting principles of Sustainability, a Precautionary Approach, Citizen Participation, Stakeholder Cooperation, Prevention, and an Ecosystem Approach. The objective of taking an Ecosystem Approach includes an “integrated vision of the management of land, water and living resources whose purpose is their conservation and sustainable use in an equitable way.”
Draft bill presented by Panamanian Parliament Member, Juan Diego Vásquez Gutiérrez [145]	A new project of law, or draft bill, “Which modifies, adds, and repeals provisions of Law 9 of 1 March 2006, with the objective of restoring and conserving shark populations in the jurisdictional waters of the Republic of Panamá”, has been presented in February, 2023. Of note, the draft proposes: “The application of a ban, on all international import, export or re-export of shark fins through Panamanian territory is necessary to protect shark populations from overfishing and depletion.” Repeals Article 5, from Law No. 9 “since it allowed artisanal vessels of up to 60 horsepower to fin sharks as long as the fins corresponded to 5% or less of the weight of the shark carcass landed.”

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