

A Review of Marine Protected Areas and Fisheries in Colombia: Past, Present and Alternatives

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Abstract

A review of the relationship between Marine Protected Areas (MPA) and fisheries was conducted in Colombia from different perspectives. An historic analysis was divided into two periods: MPAs established between 1960 and 1999, and those created between 2000 and 2023, reflecting significant contextual and legislative differences. Conflicts have persisted from the earliest MPAs to the present, often taking years to resolve. Current legislation regarding the creation and expansion of MPAs was examined within the framework of the 30x30 goal under the Global Biodiversity Framework. Each newly created or expanded MPA was assessed, revealing that technical fisheries-related technical aspects—particularly concerning the size and designated category of the MPAs—were overlooked. Biosphere Reserves (BRs) and Other Effective Area-Based Conservation Measures (OECMs) related to fisheries in marine-coastal areas were also identified and analyzed. Institutional stakeholders, sectoral interests, and the mechanisms that facilitate intersectoral and community consultation—as well as the challenges of applying them in offshore areas—were explored. The results highlight ongoing conflicts among sectors and a lack of consensus in key aspects between environmental and fisheries authorities regarding the establishment of MPAs or the implementation of sustainable fisheries measures. An innovative management approach is therefore needed to reconcile these differences and foster a mutually beneficial relationship between MPAs and fisheries. Alternatives are proposed to shift this historically antagonistic dynamic toward collaborative strategies that promote the conservation and sustainable use of fishery resources and ecosystems through an ecosystem-based and participatory management framework, including effective and realistic measures both within and beyond declared MPAs.

Introduction

The Colombian marine area accounts for 44.86% of the national territory (CCO, 2023), encompassing a surface area of 92,866,000 ha, of which 33,930,000 ha are in the Colombian Pacific Ocean (CPO) and 58,936,000 ha in the Colombian Caribbean Sea (CCS) (Díaz, 2002).

Two key policy instruments govern this marine territory: the National Environmental Policy for the Sustainable Development of Ocean, Coastal, and Island Areas of Colombia -PNAOCI- (Ministry of Environment, 2000) and the National Ocean and Coastal Spaces Policy- PNOEC- (CCO, 2018). According to CONPES 3990 (2020) (Colombia as a Sustainable Bio-oceanic Power 2030), these instruments have lacked the necessary scope to fully leverage the potential of marine resources, highlighting the need to improve institutional governance through stronger national and international cooperation. Additionally, the Integral Policy for the Sustainable Development of Fisheries in Colombia (PSFDC) (Ministry of Agriculture & FAO, 2015) addresses the structural challenges of the fishing sector that affect national, regional, and local economies. This policy seeks to empower and transform the sector through the involvement of both private and public stakeholders.

The United Nations Framework Convention on Climate Change (UNFCCC) established the global “30x30” goal—to conserve at least 30% of the planet by 2030 at CoP 14 (United Nations 2008; Conservation Corridor, 2023). In line with this objective, Colombia has significantly expanded its Marine Protected Areas (MPAs), many of which were first created decades ago under the framework of the National Environmental System and are part of the National System of Protected Areas (NSPA). In the case of MPAs, they fall under the National Subsystem of Marine Protected Areas. At CoP26 (United Nations, 2021), the President of Colombia announced that the country would meet the 30x30 goal by 2022, adding 16 million hectares to its existing protected marine areas.

According to the Ministry of Environment and Sustainable Development (Ministry of Environment, 2022a), the 30% protected area

target in Colombia has been pursued through two strategies: (i) the creation or expansion of protected areas (PAs), and (ii) the reporting of Other Effective Area-Based Conservation Measures (OECMs) under the Convention on Biological Diversity (CBD) to the United Nations Environment Program – World Conservation Monitoring Centre (UNEP-WCMC). This approach aims to recognize the efforts of local stakeholders in conserving strategic areas beyond officially declared PAs (as supported by Law 2169 of 2021 on Climate Action).

Moreover, efforts are also underway to establish new Biosphere Reserves (BRs) covering both continental and marine areas. While these areas are not officially designated as protected areas, their creation or expansion has been guided by conservation objectives and other sustainable management fishery frameworks particularly in coastal communities.

This review analyzes the relationship between MPAs, OECMs and BRs with fisheries in Colombia across different periods (1. 1960-1999 and 2. 2000-2023). MPAs may have benefits such as to protect biodiversity, boost the yield of fisheries and secure marine carbon stocks (Sala et al., 2021), being the most popular area-based conservation measure to manage human uses to recover overexploited resources, protect or restore habitats, biodiversity and food webs (Motta et al., 2021). On the other hand, responsible fisheries stand for a sustainable production with human benefits, without causing unacceptable changes and maintaining marine ecosystems, not leading to overfishing (Sissenwine & Mace, 2003; FAO, 2024). This review aims to understand its conflicts, realize solutions, and propose new alternatives to develop a more integrated approach that promotes both conservation and the sustainable use of fishery resources.

Relationship between MPAs and Fisheries between 1960 and 1999

The information gathered of the MPAs created in the second half of the 20th century in the CPO and the CCS was analyzed from the social, economic, environmental, institutional, cultural, and traditional perspectives in terms of their conservation and management processes,

conflicts, and relationship with fisheries. Table 1 shows the MPAs created during this period.

Table 1. Marine Protected Areas created in both Colombian Pacific and Caribbean Sea created between 1960 and 1999.

	Marine Protected Area	Creation year
Colombian Pacific Ocean	Sanquianga National Natural Park	1977
	Gorgona National Natural Park	1984
	Utria National Natural Park	1987
	Malpelo Flora and Fauna Sanctuary	1995
Colombian Caribbean Sea	Tayrona National Natural Park	1964
	Corales del Rosario and San Bernardo National Natural Park	1977
	Old Providence McBean Lagoon National Natural Park	1995

At that time, the creation of MPAs did not adequately consider coastal communities that had traditionally depended on fisheries as an ecosystem provisioning service. The focus was placed on the conservation of strategic ecosystems (e.g., mangroves, coral reefs), rather than on the relationship between those ecosystems and the communities historically settled in and around these protected areas, where fishing was practiced prior to their designation.

Although MPAs have been a valid conservation strategy to protect key areas of high biodiversity and ecological importance (Alonso et al., 2015), their establishment led to conflicts between the National Natural Parks of Colombia (NNPC)—the authority in charge of MPAs and fishing communities or fisheries authorities. Fishers reported that areas where they had traditionally fished were suddenly designated as protected, and they were no longer allowed to continue their activities. Some resisted abandoning their traditional fishing grounds, now located within MPAs.

Fishing in these areas consisted of a mix of small-scale commercial and subsistence fisheries, and the resulting socioeconomic impacts were not adequately evaluated from a fisheries sustainability standpoint. Once MPAs were established, the jurisdiction over their resources was transferred from the fisheries sector to the environmental sector. NNPC began confiscating fishing gear and sanctioning fishers within MPAs. However, the same fishery resources outside the

MPAs remained under the jurisdiction of the fisheries sector (Ministry of Agriculture and the Fisheries Authority – AUNAP).

These conflicts triggered long, complex consensus-building processes—often lasting several years—between NNPC and the fishing communities, even though all these MPAs legally prohibited fishing. These processes sought conflict resolution and improved relationships, eventually resulting in jointly agreed-upon management measures.

In the CPO, Gorgona NNP reached an agreement with fishers from the town of Bazán (Community Council Bajo Tapaje y del Mar) after years of conflict, culminating in the 2010 “*El Agujero*” Agreement (Rojas et al., 2004). Inter-institutional collaboration began with the national fisheries authority (AUNAP) to plan the “Sanquianga-Gorgona” subregion, aiming to organize buffer zones and adjacent fishing areas, but so far this is still not finished. In the northern Pacific, NNPC and fishers from El Valle eventually reached a fishing agreement for Utría NNP after similar conflicts.

In the CCS, fishing impacts within Corales del Rosario and San Bernardo NNP (Martínez Viloria et al., 2011) exposed tensions between fishers and NNPC, revealing active fisheries within the area. Martínez-Viloria et al. (2014a) documented challenges related to *Polymesoda solida* clam fishery in Isla de Salamanca MPA. Martínez-Viloria et al. (2014b) assessed the use of

hydrobiological resources within CCS MPAs, noting that increased human population, unemployment, and forced displacement due to armed conflict had intensified fishing pressure (e.g., trawling, gillnets, harpoons, and anchor damage to sensitive habitats). Beyond the issues of surveillance, enforcement, and prohibitions, the authors recommended inter-institutional measures to reduce fishing pressure and regulate subsistence fisheries within MPAs. Conflicts with fishers were also reported in other CCS MPAs such as McBean Lagoon NNP, Flamencos Fauna Sanctuary, and Acandí, Playón y Playona Sanctuary.

Relationship between MPAs and Fisheries between 2000 and 2023

The creation and expansion of new MPAs in Colombia during the 21st century underwent substantial changes. Table 2 shows created during this period in both CPO and CCS.

For example, the establishment of the Acandí, Playón y Playona Fauna Sanctuary (2013) and the Bahía Portete National Natural Park (2014) included community participation (particularly of

local fishers), in compliance with Law 21 of 1991 (regarding prior consultation) and Law 70 of 1993 (protecting the rights of Afro-descendant communities), which promote community rights, involvement, and recognition in the designation of marine-coastal MPAs.

Although these processes took longer, they were agreed upon at the territorial level, addressing social, environmental, cultural, and institutional needs. It remains unclear whether the national fisheries authority participated directly in these MPA designations, but there was clearly an existing fisheries jurisdiction over those areas prior to their establishment. Fishing activities were permitted for communities that had actively engaged in the creation of these MPAs (e.g., Playón y Playona Fauna Sanctuary), suggesting that the MPA's zoning allowed for regulated fishing as part of co-management arrangement.

Some policies (e.g., Law 1955 of 2019) proposed a strategic line aimed at preventing biodiversity loss, consolidating conservation efforts, and creating conditions for sustainable use that benefit communities.

Table 2. Marine Protected Areas created in both Colombian Pacific and Caribbean Sea created between 2000 and 2023.

	Marine Protected Area	Creation year
Colombian Pacific Ocean	La Plata Regional Integrated Management District	2008
	Uramba Bahía Málaga National Natural Park	2010
	Cabo Manglares, Bajo Mira y Frontera National Integrated Management District	2017
	Yuruparí Malpelo National Integrated Management District	2017 extended 2022
	Colinas y Lomas Pacifico Norte National Integrated Management District	2022
	Malpelo Flora and Fauna Sanctuary	extended 2022
Colombian Caribbean Sea	Acandí, Playón y Playona Fauna Sanctuary	2013
	Bahia Portete National Natural Park	2014
	Saiwaru Regional Integrated Management District	2018
	Cordillera Beata National Integrated Management District	2022

Other policies in formulation with a 2021–2030 vision, includes differentiated approaches to address conflicts arising from natural resource

use, regulate the creation of new protected areas (PAs), and recognize complementary conservation strategies (ME, 2023a).

The current legal framework governing the creation and expansion of PAs includes Decree 2372 of 2010 (D2372) (ME, 2010) and Resolution 1125 of 2015 (R1125) in Colombia (ME, 2015). The latter outlines the procedural steps for declaring or expanding a PA and establishes the context, criteria, and technical elements that must be applied. These are grouped into three main phases (Fig. 1).

The analysis of R1125 identified elements related to fisheries in terms of ecosystem services, biological importance, and sociocultural aspects. The initial phase gathers general information about the area. The preparation phase compiles

biophysical, socioeconomic, and cultural data, including inputs from the fisheries sector and participation by community stakeholders. It also presents legal, sectoral, and land tenure information. The declaration phase finally gathers the whole process and declares it. A summarized Synthesis Document (SD) supports the MPA declaration, which is submitted by the Ministry of Environment to the Colombian Academy of Exact, Physical and Natural Sciences (ACCEFYN) for review. Upon approval, the ME issues an administrative resolution to officially create or expand the MPA, which is subsequently made public.

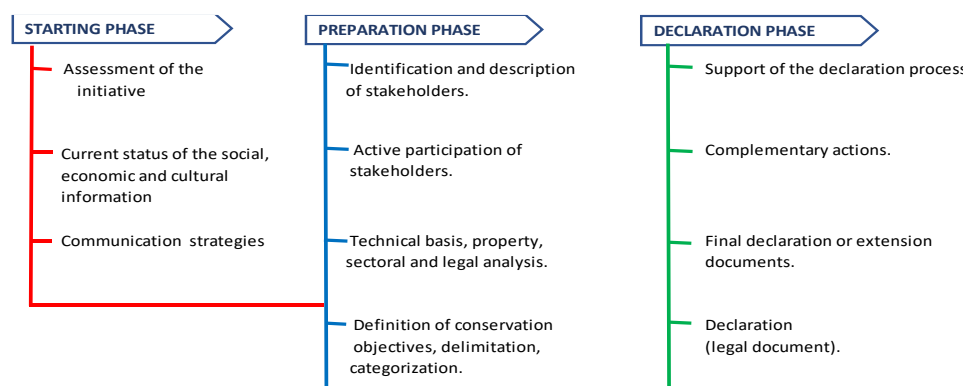


Figure 1. Phases of the Protected Area's pathway declaration according to Resolution 1125 of 2015.

The biophysical criteria related to fisheries activities include the analysis of representativeness, irreplaceability, and ecological integrity of harvested species. Socioeconomic and cultural criteria consider areas without permanent human settlements, zones where biodiversity is used responsibly (e.g., fisheries), the environmental benefits such areas provide to communities, and the presence of social and institutional stakeholders (e.g., the fisheries sector) who help ensure effective governance. These stakeholders are expected to establish agreements based on sustainability principles.

R1125 address the MPA category, which is supposed to be determined through stakeholder consensus, based on criteria such as ecosystem composition, structure, and function. The definition of objectives, delineation, and categorization of MPAs considering criteria such as ecosystem composition, structure, and function, is based on a technical integration of information and the consensus of communities and relevant sectors. Once the conservation

objectives and geographic boundaries are established, the appropriate management category is selected based on goals related to biodiversity conservation, protection, restoration, and sustainable use (e.g., fisheries), considering the ecosystem's composition, structure, and function.

Categories such as Natural Reserves, Flora and Fauna Sanctuaries, and National Natural Parks correspond to Categories Ia, Ib, and II of the International Union for Conservation of Nature (IUCN), which are focused on biodiversity protection and restoration. In contrast, the Integrated Management District (IMD) category is associated with sustainable use and aligns with IUCN Category VI (IUCN, 2023). This latter category includes MPAs such as Regional Integrated Management Districts (RIMDs), which are administered by Local Environmental Authorities, and National Integrated Management Districts (NIMDs), which are delegated to the National Natural Parks of Colombia (NNPC) by the Ministry of Environment.

The 30x30 Goal in MPAs for Colombia

The 30x30 goal was introduced as a national initiative led by the Presidency of the Republic of Colombia (2018–2022) and was publicly announced by the President at the 26th Conference of the Parties (CoP26) to the United Nations Framework Convention on Climate Change in November 2021. Given the short timeframe to meet this goal, the national government accelerated the process in order to complete it before the end of the presidential term in August 2022, even though the global agreement for biodiversity had still 8 years for its fulfillment (until 2030).

The Ministry of Environment, affiliated research institutes, and the NNPC were instructed to convene intersectoral meetings with representatives from government agencies and

civil society. These meetings were both technical and high-level in nature, involving ministers, agency directors, and other senior officials, and were coordinated by NNPC. Additional institutions, including the Ministry of Foreign Affairs, the Ministry of Defense and its affiliated entities such as the General Maritime Authority - DIMAR-, National Navy, Coast Guard, Ministry of Agriculture and fisheries authority were also involved.

For the expansion of the Malpelo Sanctuary (Fig. 2), technical meetings were held between September, 2021 and March, 2022 with fisheries and environmental institutions (fisheries authority, research institution, and an NGO) to apply the procedures outlined in R1125 using the available information.

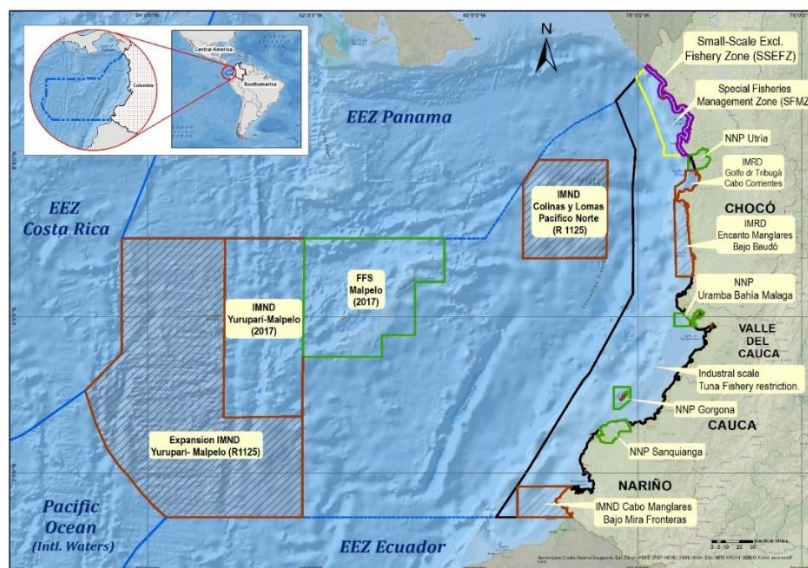


Figure 2. Technical results of the declaration or expansion route applying R1125 for the FFSM, IMNDYM and IMNDCLPN according to the information provided. M. Sanabria ©

Dispite the documented scientific evidence and technical analyzed not reflected in the SD (NNPC, 2022a) (Fig. 2), even with new information provided (Ardila et al., 2022; Fundación Malpelo and Migramar, 2022), the MPA was nevertheless expanded (Fig. 3). Similarly, the expansion of Yurupari-Malpelo NIMD was carried out to provide legal and institutional protection to a strategically important offshore area. Technical meetings to apply R1125 between September, 2021 and March, 2022 that led to a significant expansion of this MPA (Fig. 2). However, the final expansion polygon extended further east than originally proposed (Fig. 3).

For the creation of the Colinas y Lomas del Pacifico Norte NIMD, three technical meetings were held between March and June, 2022 using the methodology established in R1125. AUNAP raised concerns that such a large area was unnecessary, particularly given the seasonality and nature of the Mahi-Mahi fishery in the region, which is concentrated at the beginning of each year. Historically, this area has served as an economic alternative for the shrimp fleet during their closed season (Fig. 2), but the final designation proceeded based on the original size proposal (Fig. 3).

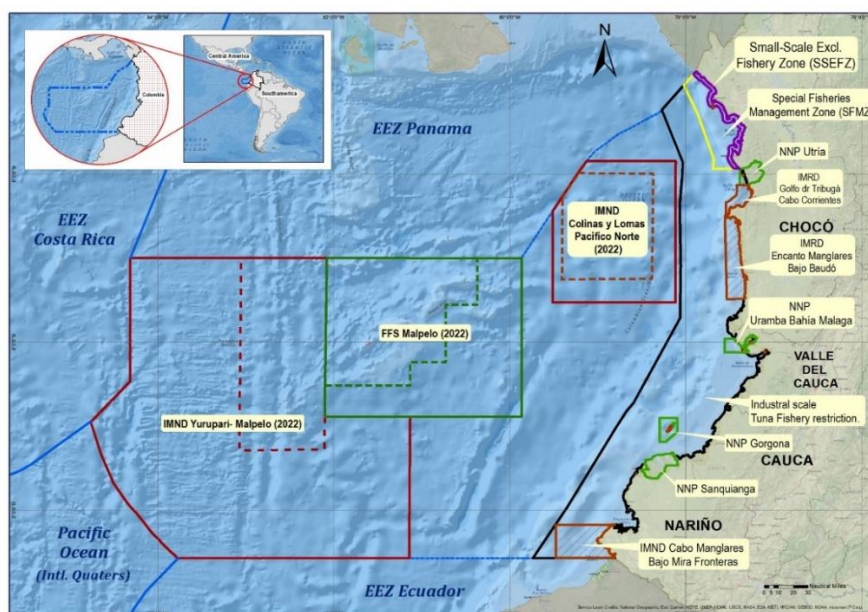


Figure 3. MPAs expanded or created in the Colombian Pacific Ocean (2022). Dotted lines are original areas (IMNDYM, FFSM) or fisheries sector's proposal for the IMNDCLPN. M. Sanabria ©

For the establishment of the Cordillera Beata Natural Reserve in the CCS (Fig. 4), three technical meetings were held between April and May, 2022, initially proposing the area as an NIMD. Two research expeditions were conducted in the area, including a hydroacoustic fisheries survey. Additional data were analyzed from

various sources, including: the International Commission for the Conservation of Atlantic Tunas (ICCAT) data, fishing records from Colombian companies that legally operated in the area over a four-year period, oceanographic studies, and environmental DNA (eDNA) analyses (Stewart, 2019).

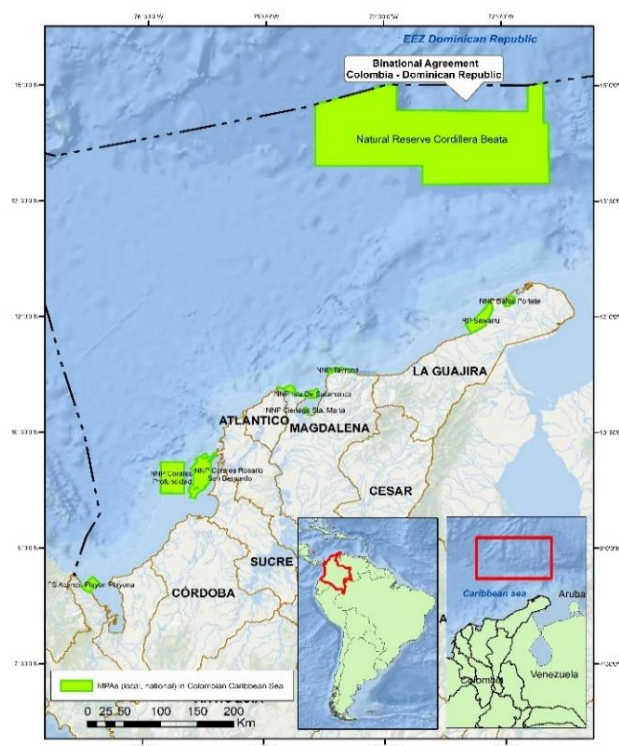


Figure 4. Cordillera Beata Natural Reserve in northern Colombian Caribbean Sea on the border with the Dominican Republic. M. Martínez ©

Evidence of illegal, unreported, and unregulated (IUU) fishing was found using ICCAT data. At the same time, a significant fishing potential was identified within the first 200 meters of depth. The findings also highlighted the uniqueness of species and ecosystems located in the deep waters of the Beata Mountain Range which are in good condition at depths greater than 1,600 meters. Other two third parts of the area is a deep-sea plain mostly over 3000 meters depth. The MPA was designated as a Natural Reserve, despite the lack of a clear technical rationale for this category—which prohibits fishing activities—given that most supporting data focused on deep-sea species referred (NNPC, 2022d).

Only one technical meeting was held with the fisheries sector within the framework of R1125 (March, 2022) to discuss the expansion of the Acandí, Playón y Playona Fauna Sanctuary, initially proposed toward the north of the existing MPA. On July, 2022, NNPC formally requested

input from fisheries authority, this time presenting an expansion on both the northern and southern boundaries of the original area (Fig. 5). In 2023, inter-institutional meetings were held, during which NNPC shared documents with the fisheries authority submitted to ACCEFYN for approval of the MPA expansion.

The fisheries sector maintained its position that the MPA should be expanded as an Integrated Management Regional District (IMRD), given that it is a coastal area—similar to two existing MPAs in the CPO—where subsistence and small-scale commercial fishing are actively practiced. Designating the area as a Sanctuary would eliminate the possibility of allowing sustainable small-scale commercial fishing. A prior consultation was conducted with coastal communities located within the Sanctuary zone, and it became evident that fishers from other communities (other side of the Gulf of Urabá) also fish in this area.

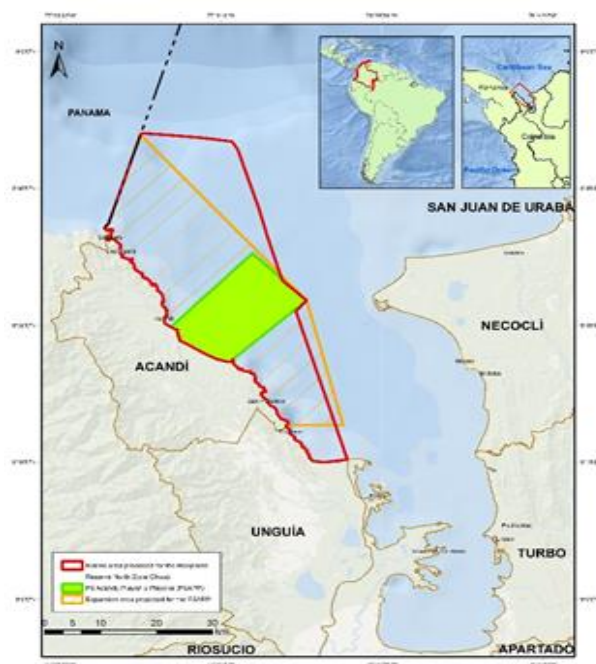


Figure 5. Original area of the Acandí, Playón y Playona Fauna Sanctuary (green area). Proposed expansion for the MPA (yellow line area) and proposed marine area of the BR Darien Norte Chocoano (red line area) (CODECHOCÓ, 2022). M. Martínez ©

Other general aspects of all MPAs created or expanded revealed intense maritime activity and identified various risks, including vessel collisions, underwater noise, the introduction of non-native species, air pollution, and the discharge of hazardous substances in these areas (NNPC, 2022a; NNPC, 2022d). It was unclear

why these environmental threats were not considered when assigning the final MPA categories. Despite no changes being made to the maritime traffic routes, sustainable fisheries were prohibited.

The maritime sector also raised logistical, technical, and financial concerns about the

creation and expansion of new MPAs during technical meetings held on February and April, 2022. According to a formal request submitted by the private fisheries sector to the Maritime Authority, the current operational capacity of the Pacific Naval Force, Coast Guard, and aerial units of the Navy allows coverage of some more than the 20% of Colombia's marine territory in the CPO (Public Formal Request for information, September 4, 2023; National Navy, 2023).

A meeting held on April, 2022, with representatives from the private and public fisheries sectors, a new MPA creation/expansion proposal— was presented highlighting the country's international commitment to achieve the 30x30 goal before the end of the 2018-2022 administration (Fig. 3).

Ministry of Environment held local outreach meetings on April, 2022, in the city of Buenaventura (Colombian Pacific) to present the proposed creation and expansion of MPAs to the community and the private fisheries sector. These proposals were not accepted. In the Colombian Caribbean Sea (CCS), no local presentation was conducted, citing the absence of current fishing activities in the Cordillera Beata Reserve.

NNPC submitted all Synthesis Documents (SDs) to ACCEFYN (NNPC, 2022a; 2022b; 2022c; 2022d), which approved the creation and expansion of the proposed MPAs. Ultimately, ME declared all MPAs on June, 2022 fulfilling the 30x30 goal for Colombia's marine territory, through the following administrative resolutions:

- Resolution 0669 – Expansion of Malpelo Fauna and Flora Sanctuary (FFSM)
- Resolution 0670 – Expansion of Yuruparí-Malpelo National Integrated Management District (IMNDYM)
- Resolution 0671 – Creation of the Colinas y Lomas del Pacífico Norte Integrated National Management District (IMNDCLPN)
- Resolution 0672 – Creation of the Cordillera Beata Natural Reserve (NRCB)

Technical support to achieve the 30x30 goal in 2022

➤ IUU Fishing

The Synthesis Documents cited fisheries— particularly IUU fishing and bycatch—as pressures justifying the creation or expansion of MPAs, arguing that these activities impact the persistence and functionality of several species (especially threatened ones). However, no concrete data on IUU fishing in the proposed areas were provided. According to a Public Formal Request for information to the Fisheries Authority (August, 23rd, 2023; AUNAP, 2023a), and based on Law 1851 of 2017, between July, 2017 and July, 2023 (6 years), AUNAP recorded 88 possible events of IUU fishing in the CPO, from which 12 possible events were in declared MPAs (2 events/year average). The national maritime authority reported 32 events of IUU fishing between 2015 and 2023 (8 years). 31 events were from foreign flagged vessels, mostly near the Ecuadorian border, and only one (1) event from a national flagged vessel (Public Formal Request for information, September 7, 2023; DIMAR, 2023).

From the 12 possible events in MPAs, another Public Formal Request for Information for a 6 years period (Public Formal Request for information, August 30, 2023; AUNAP, 2023b), 10 events involved foreign flagged vessels (offshore), and two (2) national flagged vessels (coastal areas). From national vessels, one (1) was reported in Uramba-Bahia Malaga NNP (coastal area) and other in the Small-Scale Exclusive Fisheries Zone (SSEFZ) - which is not a MPA – (coastal area), but medium and large-scale fisheries is prohibited. Most events were in Malpelo Sanctuary (6 events) and one (1) Yuruparí Malpelo NIMD offshore Colombian waters by illegal foreign flagged vessels. This evidence shows that IUU fishing is relatively low in the CPO and mainly done by illegal foreign flagged vessels.

In the case of the Cordillera Beata Reserve (NNPC, 2022d), IUU fishing was not formally listed as a pressure or justification, yet ICCAT data revealed evidence of IUU fishing activity in 26 of the 30 years analyzed in the area. During the remaining four years, legal fishing was conducted

under legal permits issued by the Colombian fisheries authority—highlighting that IUU fishing is a significant challenge for this MPA.

➤ *Fisheries Management*

The Synthesis Documents did not mention existing fisheries management and protection measures (e.g., closed seasons, bycatch release protocols, onboard observers) that significantly mitigate the impact of fishing on captured species. The endemic species identified in these areas were mostly benthic and located in healthy, undisturbed environments inaccessible to most common surface pelagic fisheries.

In the CPO, the tuna fishery data analyzed in NNPC (2022a; 2022b; 2022c), as well as the characterization of the purse seine tuna fishery (Puentes et al., 2022a), identified four major fishing grounds, two of which were in the expanded offshore areas of the Yurupari Malpelo NIMD and Malpelo Sanctuary, while none were within the Colinas y Lomas NIMD.

Although the economic valuation of the tuna fishery in the CPO showed a significant ecosystem service, the Synthesis Documents did not mention that this fishery has been under the management of the Inter-American Tropical Tuna Commission (IATTC) since 1949. The management measures adopted by IATTC are ratified annually by the Colombian fisheries authority -AUNAP- (e.g., Resolution 076 of 2022, Resolution 2824 of 2024), and include regulations on fishing effort (e.g., seasonal closures) and gear types (e.g., Fish Aggregating Devices – FADs), among others.

➤ *Bycatch*

Bycatch data from the CPO tuna fishery were used in the analysis of pelagic species (NNPC, 2022a; 2022b; 2022c), but other available data were not considered. For example, Mahi-Mahi (*Coryphaena hippurus*) shows clear seasonality and distribution patterns associated with thermal fronts in the CPO; its stock has been assessed, and the species is known to be present in the northeastern part of the Colinas y Lomas NIMD (Puentes, 1995; Selvaraj et al., 2011; Rodríguez et al., 2015; Roa-Ureta et al., 2021; Viaña et al., 2022; Martínez Arias et al., 2022), with evidence

indicating that the population is being sustainably harvested.

In addition, dolphin bycatch in the purse seine tuna fishery is regulated under the Agreement on the International Dolphin Conservation Program (AIDCP) (IATTC, 2024). This includes mandatory release protocols and mortality limits, which has not exceeded 10% of the mortality limits assigned to the Colombian tuna fleet (A. Ortiz, AUNAP; Pers. Comm, 2024). As for the tuna purse seine bycatch in the CPO has been characterized in detail by Jiménez et al. (2012) and Puentes et al. (2024).

The Synthesis Documents in the CPO reported varying shark densities (NNPC, 2022a; 2022b; 2022c), although no spatiotemporal shark aggregations were confirmed—even near the Malpelo Archipelago or certain seamounts (Ketchum et al., 2014; Chávez et al., 2020; Cambra et al., 2021). Most of these shark species are migratory, and their bycatch and trade are regulated under multiple IATTC resolutions applicable to Colombian waters (Zambrano et al., 2014; Puentes et al., 2022b; Puentes et al., 2024). Targeted shark fishing is prohibited under Colombia's National Shark Conservation Plan, adopted through Resolution 0854 of 2022 (Ministry of Environment, 2022b), and was previously prohibited by the national fisheries authority.

➤ *MPA Category*

No technical evidence supported assigning the Cordillera Beta MPA as a Natural Reserve (NR) category, which prohibits all fishing activities; conservation targets included pelagic species (e.g., billfish, sharks, turtles), which, in other contexts—such as the Integral Management Districts (National or Regional) created in the CPO—have served as valid grounds for sustainable use-oriented MPA designation. As for the Cordillera Beata Reserve, sustainable offshore small-scale fishing could have been possible using appropriate fishing technology, alternative fuels, and regulated effort limited as well by oceanographic conditions and hurricane seasons.

All public and private institutions with environmental or fisheries-related interests agreed on the importance of complying with the 30x30 goal. The fisheries sector supported the goal,

emphasizing the need to establish MPAs that permit legal and responsible fishing activities through the assignment of appropriate management categories to MPAs. The Integrated Management District (IMD), corresponding to IUCN Category VI, was identified as the most suitable designation, considering environmental, institutional, and socio-economic sustainability principles, particularly when supported by effective spatial zoning management plans.

➤ *Environmental issues*

The Significant Biodiversity Areas (SBAs) in the CPO were designated using the methodology of Alonso et al. (2010), primarily based on secondary information about pelagic fish and dolphin occurrences reported throughout the region. In the case of the Cordillera Beata Reserve (NNPC, 2022d), no SBAs were identified.

The local food web structure and function were assessed using environmental DNA (eDNA) as a non-invasive and cost-effective method for detecting fish presence from water samples (Shu et al., 2020; Nagarajan et al., 2022), which shows promising potential for biodiversity diagnostics (Pascher et al., 2022). This method reported species that had not been physically observed during research cruises, and many species were detected with wide spatial and depth distributions with trophic spectrum inferred for some species. Although this information is valuable, complementary traditional biomonitoring remains necessary (Najarayan et al., 2022), and the reliability of eDNA results depends on several factors such as enough DNA presence, density of organisms in the area, and availability of primers for target species, among others (Pascher et al., 2022). Nevertheless, eDNA analysis, together with other parameters, did not provide conclusive evidence of non-mitigable fisheries impacts to justify assigning a Natural Reserve category to this MPA.

➤ *International issues*

At the international level, support of other countries, the Eastern Tropical Pacific Marine Corridor (ETPMC), the Global Environment Facility (GEF), and several NGOs including commitments to provide financial resources for the newly declared MPA are already being implemented in the CPO. A broader analysis

highlighted the need to support fisheries management both inside and outside MPAs—especially given their large size—due to the mobility of migratory species that may be caught in legally fishing waters beyond the MPA boundaries.

In the CCS, the international cooperation agreement between the Republic of Colombia and the Dominican Republic (Law 38 of 1978) was not referenced in the Cordillera Beata Reserve Synthesis Document, despite its relevance to scientific exploration and sustainable fisheries initiatives. Although a representative from the Dominican Republic's Ministry of Environment stated there was no fishing near the Colombian maritime border, it was confirmed that most of the Dominican Republic's fishing activity takes place farther south the country with the small-scale FAD fishery (Van der Meer et al., 2014; FAO, 2018). A fisheries expert from the Dominican Republic confirmed that fishermen from Puerto Plata may reach Colombian waters, and that the activities of FAD-based fishers—particularly those involved in the Mahi-Mahi fishery recently studied by Beltrán et al. (2023)—should be further reviewed to confirm their fishing grounds near the Colombian border (J. Mateo, pers. comm., Dominican Republic Fisheries Expert, 2023).

Biosphere Reserve (BR) Initiatives in Colombia

According to UNESCO, Biosphere Reserves (BRs) are areas that encompass terrestrial, marine, and coastal ecosystems, recognized under its Man and the Biosphere Program for promoting integral solutions that reconcile biodiversity conservation with economic development (UNESCO, 2023a). In Colombia, two recently designated BR and one additional initiative involving marine territories have been identified:

- BR Tribugá Cupica Baudó - North Pacific

This BR was designated by UNESCO in June, 2023 (UNESCO, 2023b). It is located in the department of Chocó (equivalent to a province, state, or prefecture in other countries), extending from Cabo Corrientes to Punta Piña in the municipality of Juradó, and reaching 12.5 nautical miles offshore. The marine area encompasses 387,290.37 ha (Minambiente & IIAP, 2022). The designation was established in agreement with coastal communities and overlaps with several

fisheries management frameworks and a PA, including the Small-Scale Exclusive Fisheries Zone (SSEFZ), the Special Fisheries Management Zone (SFMZ), the Integrated Management Regional District (IMRD) Tribugá–Cabo Corrientes, and Utría NNP (Fig. 6).

- BR Darién Norte Chocoano – Gulf of Urabá

This BR was officially designated in July, 2024. The process was led by the regional environmental authority CODECHOCÓ, with support from an international cooperation agency and other partners. It consists of a mosaic of terrestrial, coastal, and marine ecosystems located in northwestern Colombia (Gulf of Urabá) in the CCS, including 116,254 ha of marine area (CODECHOCÓ, 2022). This marine zone significantly overlaps with the recently proposed expansion of the Acandí, Playón y Playona Fauna Sanctuary. Figure 5 illustrates the marine extent of this BR.

- BR of the Eastern Tropical Pacific Marine Corridor

At the ETPMC meeting held on October, 2022, (San José, Costa Rica), the idea of establishing a transboundary BR across some or all member countries (Costa Rica, Panama, Colombia, and Ecuador) was discussed. This initiative acknowledges the ecological importance of the region and the need for coordinated marine conservation across national boundaries. Representatives from the fishery sector were invited for the first time, recognizing the important role of fisheries in the region. All ETPMC country presidents signed an agreement reached at CoP26 (UNFCCC) offering a window of opportunity if both conservation and sustainable development purposes (fisheries) are included in the ETPMC.

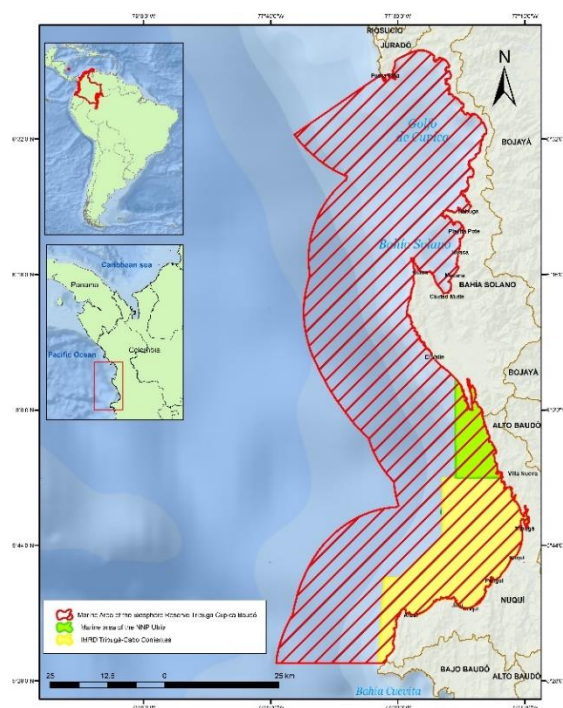


Figure 6. Marine area of the BR Tribugá – Cupica – Baudó in northern Colombian Pacific Ocean. M. Martínez ©

Initiative of the Small-Scale Exclusive Fisheries Zone -SSEFZ- as Other Effective

Area-based Conservation Measures (OECM)

The SSEFZ represents a successful initiative led by fishermen from the northern CPO, who secured its permanent designation in 2017. In 2022, fisheries management measures for the SSEFZ

were standardized under Resolution 2636 of 2022 (AUNAP). More recently, the SSEFZ was expanded to include an area where a sustainably managed deep-sea shrimp trawl fishery operates, generating conflicts between small-scale and medium-scale trawl fishers (Resolution 2668 of 2024, AUNAP). Vieira et al. (2019) outlined the criteria required to report the SSEFZ as an OECM.

Community engagement for this process began in 2019, led by the environmental sector (NGOs and the Ministry of Environment), which invested resources through a participatory approach.

Another initiative involves the Seaflower BR (which includes an NIMD) as a candidate to be recognized as an OECM (Pineda, 2019), suggesting that entire BRs—or portions of them—may qualify for OECM designation as well. For instance, the Special Conservation Area Islas-Cayos Este, Sudeste y Roncador was recently declared an OECM within the Seaflower BR (Ministry of Environment, 2023b), illustrating overlapping conservation designations (MPAs, BRs, OECMs). This overlap appears to offer increased opportunities to secure financial resources from national and international sources.

Analysis of the MPAs, BRs and OECMs with Fisheries

This analysis reveals that the relationship between MPAs and fisheries has historically been framed as antagonistic in Colombia, with fisheries often portrayed as a negative pressure or threat to conservation, and MPAs viewed as inherently ideal and positive. This dichotomy has been evident within governmental institutions from both the environmental and fisheries sectors, particularly within the framework of the Executive Committee for Fisheries (ECF) - an institutional body that defines the Total Allowable Catch (TAC) for major fishery resources, with participation from both sectors (Puentes et al., 2022b).

From the environmental sector's perspective, the recent Synthesis Documents supporting the creation or expansion of MPAs reaffirm this adversarial framing. While many NGOs, academic institutions, and research institutes generally advocate for MPAs as a conservation strategy, some others do acknowledge that fisheries can coexist with conservation goals and requires management to be sustainable. Certain NGOs support local fishing communities at the regional level, but adopt strong conservationist positions in national-level decisions—where local voices often have limited or no influence. Other NGOs maintain prohibitionist views regarding fishing, especially in relation to charismatic or

emblematic bycatch species such as marine mammals and sharks.

In the recent MPA creation/expansion process (2021-2022), although the fisheries sector presented valid arguments applying R1125 in all meetings held, this kind of technical and scientific support was poorly considered nor acknowledged so that fisheries-related concerns were practically removed from most areas (see section 3.1.1.). This mirrors a previous initiative supported by the Ministry of Environment: Decree 281 of 2021 (Ministry of Environment, 2021), which addressed the protection of marine sharks and rays. In that case as well, the perspectives of the fisheries sector—both governmental and private—were not considered, despite presenting valid and well-supported arguments (Puentes et al., 2022b). Adopting a more comprehensive and integrated view of the fisheries perspective in the creation or expansion of MPAs would offer a more realistic understanding of MPA management, rather than merely focusing on restricting or prohibiting fishing activities.

Conversely, the fisheries sector typically advocates for minimal restrictions and often opposes the creation or expansion of MPAs that further limit or ban their activities. While there is a growing awareness within the sector about the importance of sustainable use, in some regions the “tragedy of the commons” (Hardin, 1968) continues to manifest through overfishing and resource depletion (Barreto & Borda, 2008; Puentes et al., 2014). This situation is exacerbated by limited enforcement capacity—even in nearshore fisheries—highlighting the need for participatory management agreements to achieve sustainability and responsible fishing.

Engaging in consultation with communities during MPA creation or expansion is increasingly recognized as essential. This is particularly true for coastal MPAs, where there is a close geographic and socio-cultural relationship with ethnic communities (e.g., Cabo Manglares, Bajo Mira y Frontera NIMD (NNPC, 2015)). However, this is not applicable to offshore MPAs, which are only accessible to fishers. This limited accessibility was likely a key reason why the Colombian government (2018–2022) pursued the 30x30 goal primarily through the creation of

offshore MPAs, as these areas do not directly affect coastal communities and the community previous consultation does not apply. In the case of the Cordillera Beata Reserve in the CCS, fishing communities did not participate in the MPA creation process, despite R1125 clearly mandating community engagement. Although there was no evidence of ongoing legal fishing activity in the area, the Synthesis Document acknowledged the potential for legal and sustainable fisheries (NNPC, 2022d).

Conversely, in the CPO, the Ministry of Environmet and the NNPC did carry out a socialization process regarding the creation and expansion of MPAs. Whether or not fisheries are present, socializing MPA initiatives with communities remains a critical step.

It is worth emphasizing that offshore fisheries and scientific research constitute acts of territorial sovereignty over national jurisdictional waters (Rodríguez et al., 2015; Puentes et al., 2022b). The frequent presence of legal fishers and researchers in these areas provides a valuable opportunity to combat IUU fishing, especially given the limited capacity of surveillance and enforcement authorities to maintain a consistent presence in remote offshore zones (Public Formal Request of Information, September 4, 2023; National Navy, 2023).

The MPAs created or expanded by Colombia to meet the 30x30 goal in 2022 have introduced significant financial challenges. Managing such large offshore areas entails very high costs, and the effectiveness of these MPAs remains uncertain due to the lack of proper management plans aligned with the Protected Area Management Planning Guide (Ospina Moreno et al., 2020). The cost estimates reported in the Synthesis Documents may be underestimated or not including the total cost of managing areas as large as, or even larger than, Colombian departments on land (e.g., Cordillera Beata Reserve is comparable in size to the La Guajira Peninsula, Fig. 4). Clear biological indicators (abundance-density of specimens/area-biomass, size, diversity) for such large areas are lacking—whether inside or outside the MPAs, or before and after their creation/expansion (Kriegl et al., 2021). Where indicators do exist, their reliability at such a scale

remains uncertain. Effectiveness indicators has only been demonstrated for a few species, making it difficult to develop a comprehensive perspective for such vast MPAs; consequently, multi-level protection schemes offer more benefits for MPAs and fisheries in the long term (Kriegl et al., 2021).

The development of management plans for sustainable use MPAs has been slow and difficult. Some, such as the RIMD Tribugá–Cabo Corrientes, are in the implementation phase, while others have faced delays or complications due to the need for stakeholder agreements—particularly with the fisheries sector (e.g., the fisheries management plan for the Yurupari Malpelo NIMD, which resulted in the repeal of Resolution 2041 of 2022, AUNAP).

Large MPAs often fail to deliver a spillover effect (Mossler, 2023; Puentes et al., 2024). When spillover does occur, it may benefit fisheries (Medoff et al., 2022) either ecologically (through fish migration) or via fishery activity (migratory species captured outside the MPA). However, measuring this effect is complicated when MPAs share borders with other countries, as is the case of many of Colombia's new MPAs. Habitat continuity at MPA boundaries may either facilitate or limit spillover and is especially difficult to track for highly migratory pelagic species (Rodríguez-Rodríguez, 2016; Cuervo-Sánchez et al., 2018; Di Lorenzo et al., 2020; Lenihan et al., 2021; Pinillos & Riera, 2022).

Hampton et al. (2023) showed that MPAs offered little to no conservation benefit for skipjack and bigeye tuna, due to their wide larval dispersal and high mobility in adult stages—similar patterns may apply to other migratory species (e.g., Billfish, Mahi-Mahi). According to FAO (2011), MPAs cannot be considered a comprehensive fisheries management solution. They do not address overcapacity, overfishing, economic losses, or issues occurring outside their boundaries. Oversized MPAs may dilute economic benefits and mask shifts in fishing dynamics.

The relationship between fishing communities and MPAs in Colombia has evolved since the 1960s through long processes of stakeholder engagement. The Integrated Management Districts (sustainable use MPAs) model has proven

particularly successful in the Colombian Pacific (e.g. RIMD Tribugá–Cabo Corrientes, RIMD El Encanto de los Manglares del Bajo Baudó), by balancing conservation and sustainable use objectives through participatory governance. A sustainable use designation may offer better tools to manage MPAs where fishing is present. This model would have been more suitable for the Cordillera Beata Reserve, enabling the effective implementation of Law 38 of 1978 (cooperation agreement between Colombia and the Dominican Republic) while preserving the ecological value of the Cordillera Beata ecozone and addressing IUU fishing. At the same time, it would allow for the protection of benthic ecosystems and pelagic species and suitable as well for an MPA network, such as concluded for neighbor countries such as Jamaica and Nicaragua (Lopera et al., 2023)

MPAs that prohibit fishing in areas with documented fishing activity—particularly offshore—are very difficult to manage and often fail to meet their stated goals. While international financial support is welcome, it is unlikely to be permanent. Colombia's national budget for managing MPAs under NNPC must increase substantially to meet the needs of both long-standing and newly designated large MPAs.

Biosphere Reserves (BRs) and Other Effective Area-Based Conservation Measures (OECMs) offer promising alternatives that combine conservation, protection, and sustainable use, and can also attract domestic and international funding. However, most financial resources are directed toward conservation, with little investment in sustainable fisheries management—even when fisheries are a key management objective. This imbalance may stem from the environmental focus of implementing institutions or from the lack of jurisdiction over fisheries (e.g., CORALINA in the San Andrés Archipelago and the Seaflower BR).

A balanced investment approach is recommended—one that supports legal, responsible, and sustainable fisheries, combats IUU fishing, and simultaneously advances conservation goals. Areas such as SSEFZs are valuable for sustainable use and the general law for fisheries and aquaculture (Law 13 of 1990) includes reserve areas focused on fisheries.

Recognizing them as OECMs is a worthwhile goal, but only if strategic stakeholders are involved throughout the entire process. In particular, the fisheries sector—including both institutional and private stakeholders—should participate from the outset, not just during final consultations. This is essential to ensure legitimacy and long-term success.

In conclusion, BRs and OECMs with integrated fisheries management can provide viable alternatives that support comprehensive conservation and sustainable use, offering social, economic, and environmental benefits.

Towards an effective governance of MPAs including Fisheries in Colombia

A different approach is necessary—one in which MPAs and fisheries are viewed as complementary rather than antagonistic. From the perspective of Protected Areas (PA), Ospina Moreno et al. (2020) emphasized that effective protected areas management integrates conservation with sustainable development, generating benefits for human well-being and protecting strategic ecosystems. From the fisheries perspective, it is essential to promote legal and sustainable fisheries that align with conservation and protection measures when needed.

Legal fisheries must no longer be viewed as a major threat, pressure, or obstacle to achieving conservation goals. Instead, they should be seen as an opportunity for sustainable management and conservation—both within and outside MPAs—for targeted and bycatch species that may also be conservation priorities. Weigel et al. (2014) identified this MPA–fisheries antagonism and proposed combining fisheries management with conservation planning, recognizing the rights and responsibilities of fishers, and ensuring the participation of all stakeholders. Effective zoning (designating fishing and non-fishing areas), enforceable agreements, and collaborative networks are also necessary. Ramírez (2016) identified governance limitations, including a lack of integration between environmental and economic policies, sectoral polarization, and a top-down, non-participatory approach that excludes local communities, limited community capacity, and lack of fishing regulations, among others. Nonetheless, building alliances and

ensuring the participation of all stakeholders in MPA planning were consistently emphasized.

It is important to acknowledge that legal fishers had access—under existing regulations—before the MPAs were created or expanded. The subsequent introduction of new rules or prohibitions under MPA regimes may create perceptions of unfair treatment and spark conflict (Kriegl et al., 2021). These issues can be mitigated if the presence and rights of these fishers are formally recognized.

IUU fishing is not as significant for the information gathered, but regardless of this, it needs to be addressed by implementing different alternatives. A list of legal operating vessels (both national and foreign flagged ones) should be shared among institutions to identify real IUU fishing; it should be continuously updated and shared among relevant stakeholders. Information of fishing stocks should be shared among sectors, so that sustainable fisheries is enforced, specially in sustainable use MPAs. Environmental and fisheries authorities need work together in structuring, implementing and follow up fisheries activities in this kind of MPAs, and get clear enforcement protocols.

An effective approach to regulating fisheries—both inside and outside MPAs—relies on reaching consensus with fishers, rather than imposing top-down controls or prohibitions that are difficult to enforce. Regulations should be tailored to reflect the specific social, economic, and cultural—traditional contexts of each area. Environmental sustainability must remain a central, cross-cutting principle in all such considerations.

A comprehensive and holistic perspective that integrates environmental protection with resource use offers the most viable path to addressing the MPA–fisheries relationship in the context of sustainable development (Carter, 2007; Humphreys & Clark, 2020; Kriegl et al., 2021). Participatory management and governance frameworks are among the most effective strategies, having shown strong results in fisheries governance (Gutiérrez et al., 2011; López de Lara Espinoza et al., 2018), and proving to be highly successful alternatives at the national level (Rosselli et al., 2014; Saavedra & Diazgranados, 2022).

There are still major challenges in enforcing sanctions based on remote (non-*in situ*) evidence—such as satellite monitoring—which, to date, is not sufficient to legally substantiate illicit fishing activity, particularly in cases involving foreign-flag vessels operating illegally within Colombian jurisdictional waters.

Fishers will continue to exercise their legal activities in authorized areas. If they are not engaged as relevant stakeholders, conservation efforts in offshore MPAs will be severely limited in protecting migratory species—thus diminishing the effectiveness of MPAs when addressed in isolation. It is unrealistic to expect 100% *in situ* surveillance across areas covering millions of hectares.

There is a clear institutional weakness in the governmental fisheries sector, which currently participates only within its limited capacity. Strengthening the National Fisheries Authority (AUNAP) is both urgent and essential for improving management capacity and fulfilling its mandate. Regardless of current constraints, AUNAP remains a key authority that must be included in collaborative efforts with the environmental sector to achieve shared goals.

Prioritized recommendations for joint management between the environmental and fisheries sectors include i) Enhancing enforcement capabilities to combat IUU fishing both on-site and in port, as well as through the use of satellite platforms; ii) Strengthening the Colombian Fisheries Observer Program (POPC) to provide adequate coverage in key fisheries, including the use of onboard monitoring technologies (e.g., tracking cameras) and training personnel to analyze resulting data; iii) Improving onboard bycatch management by reducing bycatch rates and implementing protocols for the safe (alive) release of non-commercial or highly vulnerable species; iv) Advancing participatory fisheries management processes involving multiple authorities and communities that contribute directly or indirectly to MPA governance; v) Applying the ecosystem approach to fisheries management (FAO, 2011) both within and beyond MPA boundaries, tailored to each MPA category. A joint work among involved stakeholders (both private and governmental) to establish procedures and

protocols to achieve these recommendations may be needed. A starting point, among others, could be the enforcement of the National Committee for Bycatch Management (Resolution 1970 of 2018 - AUNAP), opening it to all stakeholders required in the environmental, fisheries and private sectors, as suggested for sharks and marine rays (Puentes et al., 2022b).

MPA-Fisheries conflicts and other approaches have been reported in other Latin American countries. Cinti et al. (2025) studied small-scale fisheries (SSF) operating in ecologically sensitive areas such as MPAs in Latin America and the Caribbean, where the balance between conservation and resource use is challenging; eleven case studies showed MPAs with SSF with a good organized governance bring positive effects, together with a supportive MPA authorities.

On the other hand, in Brazil was reported that the National Park administration have threatened fishers with removal from their residences and bans on fishing activities, which are the basis for their livelihoods and culture, although they keep fishing and living in the protected area, and making fishermen to move out without fair compensation (Diegues, 2008). In Costa Rica, analyses addressed in reducing fishing activities getting higher wages by switching fisheries to other activities such as tourism (e.g., Arias et al., 2015; Madrigal-Ballester et al., 2017), in which fishers may access to higher-valued non-fishing labor activities, or getting better fisher's compliance in MPAs.

In Panama, a legal framework was enforced to guarantee respect for the rights of marine-coastal communities, to ensure and safeguard spaces for their participation (Fonseca Borrás & Solís Rivera, 2025). In the Ecuadorian Galapagos Marine Reserve, an ecosystem approach to fisheries (EAF) was developed to strengthen fisheries governance, redistribution of fishing effort toward large pelagic species, and restore overexploited stocks. This included regulatory reforms, science-based fishing regulations, market incentives, and adaptive co-management mechanisms to improve compliance and stakeholder engagement (Castrejon & Defeo, 2025).

In Argentina, a project was carried out to create a new MPA and enforce the EAF (FAO, 2024). This successful case included a wide range of active stakeholders including the environmental and fisheries government agencies, the private sector, academia, research institutes and civil society organizations, among others; highlighted findings showed high internal and external coherence through an intersectoral approach, strong technical bases for the creation of the MPA, fisheries management plans considering an EAF, strengthened national action plans (e.g., sharks, marine mammals) to reduce bycatch through good fishing practices, among others.

Although conflicts in the relationship MPA-Fisheries was evidenced in Latin American countries, recent cases showed how both conservation and sustainable use are balanced together to have better results in both MPAs and fisheries management.

As for the MPA-Fisheries relationship in Colombia, this can be significantly improved by abandoning polarized positions and fostering intersectoral coordination among governmental and private stakeholders. The outcomes may not fully satisfy all parties, but they are likely to represent the most viable path forward to achieve both conservation and sustainable fisheries objectives.

Colombia has made substantial efforts to meet the global biodiversity conservation targets outlined in the Kunming-Montreal Global Biodiversity Framework (GBF), particularly Target 3, which aims to protect at least 30% of the planet's terrestrial and marine areas by 2030. In June 2022, Colombia officially reached more than 30% of its marine area under a protection figure, adding new or expanded MPAs with distinct management categories under the National System of Protected Areas (SINAP).

However, the 30x30 goal, though ambitious, is not solely about the numerical coverage of protected areas. It also emphasizes the importance of effectively and equitably governed, ecologically representative, well-connected, and sustainably managed systems of protected areas and other effective area-based conservation measures (OECMs) (CBD, 2022). Despite technical efforts aligned with national guidelines—such as

R1125— and the valuable information contributed by various sectors, including fisheries, key management recommendations were not adequately considered in the final MPA designations in Colombia. MPAs are important for conservation purposes, but fisheries is also important, no matter its scale, if fisheries follows the regulations to make it sustainable, and specially if it contributes to food security and sovereignty.

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Ethical approval

The authors declare that this study complies with research and publication ethics.

Informed consent

Not available.

Conflicts of interest

There is no conflict of interests for publishing this study.

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J. D. Murillo: Investigation, Writing original draft, Review, Editing.

R. Pardo: Investigation, Writing original draft, Review, Editing.

References

Alonso, D., Segura-Quintero, C., Torres, C., Rozo-Garzón, D. M., Espriella, J. L., Bolaños, J. A., & López, A. C. (2010). Áreas significativas para la biodiversidad. En INVEMAR (Ed.), *Biodiversidad del margen continental del Caribe colombiano* (Serie de Publicaciones Especiales Invemar No. 20, pp. 393–419).

Alonso, D., Barbosa, H., Duque, M., Gil, I., Morales, M., Navarrete, S., Nieto, M., Ramírez, A., Sanclemente, G., & Vásquez, J. (2015). *Conceptualización del Subsistema de Áreas Marinas Protegidas en Colombia*. Documento de Trabajo (Versión 1.0). Proyecto COL75241. Serie de Publicaciones Invemar No. 80. Invemar, MADS, GEF y PNUD.

Ardila, N., Arroyave, I., Bessudo, S., Cuellar, A., Dueñas, L., Friedlander, A., Goodell, W., Mayorga, J., Sala, E., Timmers, M., et al. (2022). *Expedición National Geographic Pristine Seas Colombia 2022: Dorsal de Yuruparí, dorsal de Malpelo, y Colinas y Lomas del Pacífico*. Reporte Científico y Recomendaciones, 44p.

Arias, A., Cinner, J. E., Jones, R.E., Pressey, R. L. (2015). Levels and drivers of fishers' compliance with marine protected areas. *Ecology and Society* 20(4):19. <http://dx.doi.org/10.5751/ES-07999-200419>

Autoridad Nacional de Acuicultura y Pesca – AUNAP-. (2017). Resolution 2724 of 2017. Por la cual se ratifica el establecimiento de la Zona Exclusiva de Pesca Artesanal (ZEPA), se establece una Zona Especial de Manejo Pesquero en el Departamento del Chocó. [accessed 2023 Jun 28]. https://www.redjurista.com/Documents/resolucion_2724_de_2017_autoridad_nacional_de_acuicultura_y_pesca.aspx#/

Autoridad Nacional de Acuicultura y Pesca – AUNAP-. (2018). Resolution 1970 of 2018, National Committee for Bycatch Management. < https://www.redjurista.com/Documents/resolucion_1970_de_2018_autoridad_nacional_de_acuicultura_y_pesca.aspx#/

ltura_y_pesca.aspx#/\> . (Accessed 22 April 2021).

Autoridad Nacional de Acuicultura y Pesca – AUNAP-. (2022). Resolution 076 of 2022. Por medio de la cual se adoptan medidas de conservación sobre poblaciones de Túnidos y especies afines en el Océano Pacífico Oriental - OPO, por parte de embarcaciones atuneras de cerco de bandera nacional y embarcaciones atuneras de cerco de bandera extranjera vinculadas a permisos de pesca otorgados a empresas colombianas para el periodo 2022 al 2024, y se establecen otras disposiciones. [accessed 2023 Jun 21]. <https://www.aunap.gov.co/download/resolucion-numero-0-1-9-5-de-09-de-febrero-de-2021/>

Autoridad Nacional de Acuicultura y Pesca – AUNAP-. (2022). Resolution 2636, 2022. Por la cual se unifican e incorporan medidas de ordenación pesquera en la Zona Exclusiva de Pesca Artesanal-ZEPA y en la Zona Especial de Manejo Pesquero-ZEMP en los Municipios de Juradó y Bahía Solano en el norte del Departamento del Chocó. [accessed 2023 Jul 17]. <https://www.aunap.gov.co/download/resolucion-numero-2636-de-04-de-noviembre-de-2022/>

Autoridad Nacional de Acuicultura y Pesca – AUNAP-. (2022). Resolution 2824, 2024. Por medio de la cual se adoptan medidas de conservación sobre poblaciones de Túnidos y especies afines en el Océano Pacífico Oriental (OPO), por parte de embarcaciones atuneras de cerco y de palangre de bandera nacional y embarcaciones atuneras de cerco y de palangre de bandera extranjera vinculadas a permisos de pesca otorgados a empresas colombianas, para el periodo 2025 y 2026, y se establecen otras disposiciones. [accessed 2024, sep 22]. <https://vlex.com.co/vid/resolucion-numero-2824-2024-1063654185>

Autoridad Nacional de Acuicultura y Pesca – AUNAP-. (2022). Resolution 2668, 2024. Por la cual se modifican los artículos 1, 2, 9 y 14 de la resolución 2636 del 4 de noviembre de 2022, y se establecen otras disposiciones.

Autoridad Nacional de Acuicultura y Pesca – AUNAP-. (2023a). Answer to Public Formal Request of Information (“Derecho de Petición” in

Spanish). Request No. E2023NC003086 of August 23rd, 2023.

Autoridad Nacional de Acuicultura y Pesca – AUNAP-. (2023b). Answer to Public Formal Request of Information (“Derecho de Petición” in Spanish). Request No. E2023NC003353 of August 30th, 2023.

Barreto, C. G., & Borda, C. A. (2008). Evaluación de Recursos Pesqueros Colombianos (P. Victoria, Ed.). ICA, Subgerencia de Pesca y Acuicultura, Dirección Técnica de Regulación.

Beltrán, C. S., Mateo, J., Blanc, P. P., & Del Rio Poza, A. (2023). The mahi-mahi value chain in the Dominican Republic: Summary Report. Fish4ACP. Unlocking the potential of sustainable fisheries and aquaculture in Africa, the Caribbean and the Pacific. FAO. Cambra M, Lara-Lizardi F, Peñaherrera-Palma C, Hearn A, Ketchum JT, Zarate P, et al. 2021. A first assessment of the distribution and abundance of large pelagic species at Cocos Ridge seamounts (Eastern Tropical Pacific) using drifting pelagic baited remote cameras. PLoS ONE 16(11): e0244343. <https://doi.org/10.1371/journal.pone.0244343>

Cambra, M., Lara-Lizardi, F., Peñaherrera-Palma, C., Hearn, A., Ketchum, J. T., Zárate, P., et al. (2021). A first assessment of the distribution and abundance of large pelagic species at Cocos Ridge seamounts (Eastern Tropical Pacific) using drifting pelagic baited remote cameras. PLoS ONE, 16(11), e0244343.

Carter, J. (2007). Spatial planning, water and the water framework directive: Insights from theory and practice. The Geographical Journal, 173, 330–342. <https://doi.org/10.1111/j.1475-4959.2007.00257.x>

Castrejón, M. & Defeo, O. (2025). Towards an ecosystem approach to fisheries in the Galapagos Marine Reserve: A science-driven and adaptive co-management framework. Marine Policy 181, 106857. <https://doi.org/10.1016/j.marpol.2025.106857>.

Chávez, E. J., Arauz, R., Hearn, A., Nalesso, E., & Steiner, T. (2020). Asociación de tiburones con el Monte Submarino Las Gemelas y primera evidencia de conectividad con la Isla del Coco, Pacífico de Costa Rica. Revista de Biología Tropical, 68(1), 320–329.

Cinti, A., Ramirez, L., Castrejón, M., Aburto, J. A., Loto, L., Fulton, S., Rueda, M., Schiavetti, A., Fernández-Rivera Melo, F. J., Bravo, M., Alarcon, D. T., Araújo, V. P., Parma, A. M. (2025). Small-scale fisheries in ecologically sensitive areas in Latin America and the Caribbean: Do marine protected areas benefit fisheries governance? *Ambio* 54(1):20-42. doi: 10.1007/s13280-024-02062-z.

CODECHOCO, CARDER, CORPONARIÑO, CRC, CVC, IIAP, INVEMAR, PNNC, WWF. (2014). Prioridades de conservación costeras y oceánicas del SIRAP Pacífico. Zapata, L. A., Moreno, X., Suárez, C., Segura, C., & Vásquez, J. Proyecto GEF-SAMP-WWF-SIRAP Pacífico. Proyecto COL-00075241, PIMS #3997. Informe Técnico, WWF y Comité Técnico Institucional del Subsistema Regional de Áreas Protegidas del Pacífico (SIRAP Pacífico). 146p + Anexos. Comisión

CODECHOCO. 2022. Reserva de Biosfera Darién Norte Chocoano”, Colombia. Informe Ejecutivo. Manteniendo la integridad ecosistémica y salvaguardando la pervivencia de las comunidades étnicas, para una relación armónica sostenible y perdurable de una de las regiones biogeográficas más importantes y diversos del mundo. GIZ, Ministerio Federal de Medio Ambiente, Protección de la Naturaleza y Seguridad Nuclear y Protección de los Consumidores – Alemania -, GIC- GITEC-IGIP Consulting Group. 25p.

Comisión Colombiana del Océano – CCO-. 2018. National Policy for the Ocean and Coastal Spaces -PNOEC-. 96p. Retrieved on June 5, 2024. <https://cco.gov.co/pnoec/>

Comisión Colombiana del Océano – CCO-. (2023). Mapa Esquemático de Colombia. Retrieved on June 5, 2024. <https://cco.gov.co/component/content/article.html?id=102:mapa->

Conservation Corridor. (2023). Conservation Corridor. Retrieved March 10, 2023 <https://conservationcorridor.org/what-is-30x30/>

Congreso de Colombia. (1978). Ley 38 de 1978: Por medio de la cual se aprueba el “Acuerdo sobre delimitación de áreas marinas y submarinas y cooperación marítima, entre la República de

Colombia y la República Dominicana”. Retrieved July 17, 2023. <https://www.suin-juricol.gov.co/viewDocument.asp?ruta=Leyes/1593874>

Congreso de Colombia. (1993). Ley 70 de 1993: Por la cual se desarrolla el artículo transitorio 55 de la Constitución Política. Retrieved August 5, 2023.

<https://www.minagricultura.gov.co/Normatividad/Leyes/Ley%2070%20de%201993.pdf>

Congreso de Colombia. (2019). Ley 21 de 1991: Por medio del cual se aprueba el Convenio No. 169 sobre pueblos indígenas y tribales en países independientes, adoptado por la 76ª reunión de la Conferencia General de la OIT, Ginebra 1989. Retrieved August 5, 2023. <https://faolex.fao.org/docs/pdf/col137355.pdf>

Congreso de Colombia. (2019). Ley 1955 de 2019: Por el cual se expide el Plan Nacional de Desarrollo 2018–2022 “Pacto por Colombia, Pacto por la Equidad”. Retrieved August 5, 2023. <https://colaboracion.dnp.gov.co/CDT/Prensa/Ley1955-PlanNacionaldeDesarrollo-pacto-por-colombia-pacto-por-la-equidad.pdf>

CONPES 3990. (2020). Colombia Potencia Bioceánica Sostenible. Available at: <https://www.dimar.mil.co/sites/default/files/informes/PDFA-conpes-3990.pdf>

Convention on Biological Diversity (CBD). (2022). Kunming-Montreal Global Biodiversity Framework. Secretariat of the Convention on Biological Diversity. Available at: <https://www.cbd.int/doc/c/9e6f/29c0/7c2822eb3a56869d6c4e7a45/cop-15-04-en.pdf>

Cuervo-Sánchez, R., Maldonado, J. H., & Rueda, M. (2018). Spillover from marine protected areas on the Pacific coast in Colombia: A bioeconomic modelling approach for shrimp fisheries. *Marine Policy*, 88, 182–188. <https://doi.org/10.1016/j.marpol.2017.10.036>

Departamento Nacional de Planeación. (2020). Documento CONPES 3990. Consejo Nacional de Política Económica y Social. República de Colombia. 91p. Retrieved August 5, 2023. <https://colaboracion.dnp.gov.co/CDT/Conpes/Económicos/3990.pdf>

Díaz, J. M. (2002). Golfos y bahías de Colombia. Banco de Occidente. Retrieved May 27, 2023, from <https://www.imeditores.com/banocc/golfos/indic e.htm>

Diegues, A.C. (2008). Marine Protected Areas and Artisanal Fisheries in Brazil. Menon, A. (Ed.). International Collective in Support of Fishworkers – ICSF-. 56p. Available at: <https://www.icsf.net/wp-content/uploads/2008/09/930.ICSF122.pdf>

Di Lorenzo, M., Guidetti, P., Di Franco, A., Caló, A., & Claudet, J. (2020). Assessing spillover from Marine Protected Areas and its drivers: A meta-analytical approach. *Fish and Fisheries*, 21(5), 906–915. <https://doi.org/10.1111/faf.12469>

DIMAR (National Maritime Authority). 2023. Answer to Public Formal Request of Information (“Derecho de Petición” in Spanish). Request No. 29202305234 MD-DIMAR-GLEMAR of September 7, 2023.

DIMAR (National Maritime Authority). 2023. Answer to Public Formal Request of Information (“Derecho de Petición” in Spanish). Request No. 29202305234 MD-DIMAR-GLEMAR of September 7, 2023.

FAO. (2011). Fisheries management. 4. Marine protected areas and fisheries. FAO Technical Guidelines for Responsible Fisheries No. 4, Suppl. 4. Rome: Food and Agriculture Organization of the United Nations. 198p.

FAO. (2018). Fishery performance indicator studies for the commercial and recreational pelagic fleets of the Dominican Republic and Grenada (by Gentner, B., Arocha, F., Anderson, C., Flett, K., Obregon, P., & van Anrooy, R.). FAO Fisheries and Aquaculture Circular No. 1162. Rome, Italy. 79p.

FAO. (2024). Terminal evaluation of the project “Governance Strengthening for the Management and Protection of Coastal & Marine Biodiversity in key ecological areas and the implementation of the Ecosystem Approach to Fisheries” – Project code: GCP/ARG/025/GFF, GEF ID: 5112. Project Evaluation Series, No. 24/2024. Rome. <https://doi.org/10.4060/cd1385en>

FAO. (2024). The State of World Fisheries and Aquaculture 2024: Blue transformation in action. Rome: FAO. <https://doi.org/10.4060/cc6261en>

Fonseca Borrás, M. & Solís Rivera. (2025). Analysis of the Governance Models of Marine Protected Areas (MPAs) and Other Effective Area-Based Conservation Measures (OECMs) and their impacts on Small-scale Fisheries: A Case Study. CoopeSoliDar R.L., International Collective in Support of Fishworkers (ICSF) Trust. 54p. Available at: https://icsfarchives.net/22481/1/930.ICSF261_M PA_Panama-Nicaragua.pdf

Fundación Malpelo & MigraMar. (2022). Evaluación espacial del Santuario de Fauna y Flora Malpelo y el Distrito Nacional de Manejo Integrado Yuruparí. Fundación Malpelo y Otros Ecosistemas Marinos y MigraMar. Bogotá, Colombia. 27p.

Gutiérrez, N. L., Hilborn, R., & Defeo, O. (2011). Leadership, social capital and incentives promote successful fisheries. *Nature*. <https://doi.org/10.1038/nature09689>

Hampton, J., Lehodey, P., Senina, I., Nicol, S., Scutt Phillips, J., & Tiamere, K. (2023). Limited conservation efficacy of large-scale marine protected areas for Pacific skipjack and bigeye tunas. *Frontiers in Marine Science*, 9, 1060943. <https://doi.org/10.3389/fmars.2022.1060943>

Hardin, G. (1968). The tragedy of commons. *Science*, 162, 1243–1248. [Tralsated by Horacio Bonfil Sánchez. *Gaceta Ecológica*, núm. 37, Instituto Nacional de Ecología, México, 1995. <http://www.ine.gob.mx/>

Humphreys, J., & Clark, R. W. E. (2020). A critical history of marine protected areas. En J. Humphreys & R. W. E. Clark (Eds.), *Marine Protected Areas* (pp. 1–12). Amsterdam: Elsevier.

Inter-American Tropical Tuna Commission – IATTC. (2024). International Dolphin Conservation Program Agreement (AIDCP). Retrieved March 27, 2024 <https://www.iattc.org/es-ES/AIDCP>

International Union for Conservation of Nature – UICN. (2023). Normativa UICN. Normativa Áreas Protegidas. Retrieved March 7, 2023. <https://www.uicn.es/mundial/>

Jiménez, S. I., Guagua, W., Maldonado, L. F., & Puentes, V. (2012). Capítulo VI: Caracterización preliminar de la captura incidental de la flota atunera mediana y pequeña que opera en aguas jurisdiccionales colombianas. En V. Puentes & A. Moncaleano (Eds.), *Sistema de Gestión Regional para el Uso Sostenible de los Recursos Pesqueros del Corredor Marino del Pacífico Este Tropical (CMAR). Resultados de Gestión en Colombia* (pp. 133–152).

Ketchum, J. T., Hearn, A., Klimley, A. P., et al. (2014). Inter-island movements of scalloped hammerhead sharks (*Sphyrna lewini*) and seasonal connectivity in a marine protected area of the eastern tropical Pacific. *Marine Biology*, 161, 939–9. <https://doi.org/10.1007/s00227-014-2393-y>

Kriegl, M., Elías Ilosvay, X. E., von Dorrien, C., & Oesterwind, D. (2021). Marine protected areas: At the crossroads of nature conservation and fisheries management. *Frontiers in Marine Science*, 8, 676264. <https://doi.org/10.3389/fmars.2021.676264>

Lenihan, H. S., Gallagher, J. P., Peters, J. R., et al. (2021). Evidence that spillover from marine protected areas benefits the spiny lobster (*Panulirus interruptus*) fishery in southern California. *Scientific Reports*, 11, 2663. <https://doi.org/10.1038/s41598-021-82075-1>

Lopera, L., Zapata-Ramírez, P. A., Cardona, Y. (2023). Overview and potential implementation of a marine protected area network between Colombia, Nicaragua, and Jamaica. *Marine Policy* 150, 105411. <https://doi.org/10.1016/j.marpol.2022.105411>

López de Lara Espinoza, D., Murillo Sandoval, S. L., & López, V. M. (2018). Gobernanza ambiental: el Consejo Asesor (CA) del Parque Nacional Huatulco (PNH) como un instrumento de conocimiento transdisciplinario. *Acta Universitaria*, 28(4), 56–73. <https://doi.org/10.15174/au.2018.168>

Madrigal-Ballester, R., Albers, H. J., Capitán, T., Salas, A. (2017). Marine protected areas in Costa Rica: How do artisanal fishers respond? *Ambio* 46(7):787-796. doi: 10.1007/s13280-017-0921-y.

Martínez Arias, A., González Salcedo, L. O., Benavides Martínez, I. F., & Selvaraj, J. J. (2022).

Satellite and historical data, and statistical modeling to predict potential fishing zones for dolphinfish, *Coryphaena hippurus* (Perciformes: Coryphaenidae) in Colombian Pacific. *Revista de Biología Tropical*, 70, 576–588. <https://doi.org/10.15517/rev.biol.trop.2022.49114>

Martínez-Viloria HM, Martínez-Whisgman LA, Vargas-Pineda A, Narváez-Barandica JC. 2011. Efectos de la Pesca sobre los Recursos Hidrobiológicos del Parque Nacional Natural Corales del Rosario y de San Bernardo. In: Zarza-González E, Editor. *El Entorno Ambiental del Parque Nacional Natural Corales del Rosario y de San Bernardo*. Capítulo 21: 273-289.

Martínez Viloria, H. M., Arias-Pardo, E. J., Saldaña-Pérez, P., Hernández, E., Córdoba, S., Guevara, J., Torrenegra, L. (2014a). Análisis asociado a la extracción ilegal de almeja *Polymesoda solida* en la Vía Parque Isla de Salamanca - Caribe de Colombia. En V. Puentes, F. D. Escobar, C. J. Polo & J. C. Alonso (Eds.), *Estado de los principales recursos pesqueros de Colombia - 2014* (pp. 86–91). Serie Recursos Pesqueros de Colombia. AUNAP.

Martínez Viloria, H. M., Franke Ante, R., Saldaña Pérez, P., Cano Correa, M., Angarita Jiménez, L. E., García Llano, C., Martínez Whisgman, L., Castro, B. A., Posada, S., Gómez, C., et al. (2014b). Caracterización del uso y aprovechamiento de recursos hidrobiológicos en áreas protegidas de Parques Nacionales Naturales en el Caribe de Colombia. *Boletín de Investigaciones Marinas y Costeras*, 43(2), 277–306.

Martínez Viloria H.M, Jaramillo Jaramillo AL, Melo Valencia AF, Navarro Yepes AE, Bermúdez Vargas,E, Rodríguez Bolaño LM, Díaz Bocanegra LF, Editors. 2018. Plan Maestro de Protección y Restauración del Parque Nacional Natural Tayrona. 235p. [accessed 2023 Dec 27]. <https://old.parquesnacionales.gov.co/portal/wp-content/uploads/2019/03/informe-plan-maestro-pnnt-2020-i.pdf>

Martínez Viloria, H. M., Jaramillo Jaramillo, A. L., Melo Valencia, A. F., Navarro Yepes, A. E., Bermúdez Vargas, E., Rodríguez Bolaño, L. M., & Díaz Bocanegra, L. F. (Eds.). (2018). Plan maestro de protección y restauración del Parque

Nacional Natural Tayrona (235 p.). Retrieved December 27, 2023.

Mossler, M. (2023). Do large MPAs benefit tuna and fishermen via spillover? The science of sustainable seafood, explained. Retrieved September 18, 2023, from <https://sustainablefisheries-uw.org/mpa-spillover-hawaii-tuna-medoff/>

Medoff, S., Lynham, J., & Raynor, J. (2022). Spillover benefits from the world's largest fully protected MPA. *Science*, 378(6617), 313–316. <https://doi.org/10.1126/science.abn0098>

Ministry of Agriculture & FAO. (2015). Política integral para el desarrollo de la pesca sostenible en Colombia (UTF/COL/052/COL). 118 p. Retrieved March 10, 2023. https://www.minagricultura.gov.co/ministerio/direcciones/Documents/Politica_Integral_de_Pesca_MADR_FAO_julio_de_2015.pdf

Ministry of Environment. (2000). Política Nacional Ambiental para el Desarrollo Sostenible de los Espacios Oceánicos y de las Zonas Costeras e Insulares de Colombia – PNAOCI-. Direccion de Ecosistemas. 101p. <https://www.minambiente.gov.co/wp-content/uploads/2021/10/politica-nacional-ambiental-desarrollo-sostenible-espacios-oceanicos.pdf>

Ministry of Environment. (2010). Decree 2372 of 2010. Por el cual se reglamenta el Decreto Ley 2811 de 1974, la Ley 99 de 1993, la Ley 165 de 1994 y el Decreto Ley 216 de 2003, en relación con el Sistema Nacional de Áreas Protegidas, las categorías de manejo que lo conforman y se dictan otras disposiciones. <https://www.minambiente.gov.co/wp-content/uploads/2022/02/decreto-2372-2010.pdf>

Ministry of Environment. (2015). Resolution 1125 of 2015. Por la cual se adopta la ruta para la declaratoria de áreas protegidas. <https://www.minambiente.gov.co/wp-content/uploads/2021/11/resolucion-1125-de-2015.pdf>

Ministry of Environment. (2021). Decree 281 of 2021: Por el cual se adiciona el Decreto 1076 de 2015, con una nueva sección en lo relacionado con el establecimiento de medidas para la protección y conservación de tiburones, rayas marinas y

quimeras de Colombia. <https://www.minambiente.gov.co/wp-content/uploads/2021/08/decreto-281-de-2021.pdf>

Ministry of Environment. (2022a). Ocho años antes de lo acordado, Colombia superó meta del 30 % de áreas marinas protegida. Retrieved March 7, 2023 from <https://www.minambiente.gov.co/ocho-anos-antes-de-lo-acordado-colombia-supero-meta-del-30-de-areas-marinas-protegidas/>.

Ministry of Environment. (2022b). Resolution 0854 of 2022: Por medio del cual se adopta el Plan Ambiental para la Protección y Conservación de Tiburones, Rayas marinas y Quimeras y se dictan otras disposiciones. <https://www.minambiente.gov.co/consulta/resolucion-por-medio-del-cual-se-adopta-el-plan-ambiental-para-la-proteccion-y-conservacion-de-tiburones-rayas-marinas-y-quimeras-y-se-dictan-otras-disposiciones/>

Ministry of Environment & IIAP. (2022). Plan de Acción de la Reserva de Biosfera Tribugá – Cupica – Baudó - “Una apuesta a la consolidación de un modelo de desarrollo sostenible, resiliente al clima y respetuoso de los derechos bioculturales” 2023 – 2030. 112p.

Ministry of Environment. (2023a). Sistema Nacional de Áreas Protegidas – SINAP. Construyendo una Política para el SINAP 2021–2030. Retrieved December 27, 2023, from <https://sinap.minambiente.gov.co/>

Ministry of Environment. (2023b). Meta del 30% del Area Marina del País, protegida y conservada. [Retrieved december 27, 2023]. <https://www.minambiente.gov.co/wp-content/uploads/2022/05/2.-META-DEL-30-MARINA.pdf>

Motta, F. S., Moura, R. L., Neves, L. M., Souza, G. R. S., Gibran, F. Z., Francini, C.L., Shintate, G. I., Rolim, F. A., Marconi, M., Giglio, V. J., Pereira-Filho, G. H. (2021). Effects of marine protected areas under different management regimes in a hot spot of biodiversity and cumulative impacts from SW Atlantic, *Regional Studies in Marine Science* 47, 101951., <https://doi.org/10.1016/j.rsma.2021.101951>.

Nagarajan, R. P., Bedwell, M., Holmes, A. E., Sanches, T., Acuña, S., Baerwald, M., Barnes, M. A., Blankenship, S., Connon, R. E., Deiner, K., Gille, D., Goldberg, C. S., Hunter, M. E., Jerde, C. L., Luikart, G., Meyer, R. S., Watts, A., & Schreier, A. (2022). Environmental DNA methods for ecological monitoring and biodiversity assessment in estuaries. *Estuaries and Coasts*, 45, 2254–2273. <https://doi.org/10.1007/s12237-022-01080-y>

National Natural Parks of Colombia. 2015. Evento de apertura de la consulta previa para la creación del Área Protegida Cabo Manglares (<https://www.youtube.com/watch?v=K8S4sf7Ro1s>)

National Natural Parks of Colombia – NNPC. (2022a). Propuesta de ampliación del Santuario de Fauna y Flora Malpelo. Documento síntesis (mayo de 2022, 68p). Retrieved March 17, 2023. <https://www.minambiente.gov.co/consulta/resolucion-por-medio-de-la-cual-se-declara-reserva-delimita-y-alindera-como-parte-del-santuario-de-fauna-y-flora-de-malpelo-un-area-ubicada-en-la-region-central-de-la-cuenca-pacifica-colombiana/>

National Natural Parks of Colombia – NNPC. (2022b). Propuesta de ampliación del Distrito Nacional de Manejo Integrado Yuruparí – Malpelo. Documento síntesis (mayo de 2022, 62p). Retrieved March 17, 2023. <https://www.minambiente.gov.co/consulta/resolucion-por-medio-de-la-cual-se-declara-reserva-delimita-y-alindera-como-parte-del-distrito-nacional-de-manejo-integrado-yurupari-malpelo-una-parte-del-extremo-suroccidental-del-pacifico-colo/>

National Natural Parks of Colombia – NNPC. (2022c). Propuesta de declaratoria del área protegida “Colinas y Lomas Submarinas de la Cuenca Pacífico Norte”. Documento síntesis (junio de 2022, 102p). Retrieved March 17, 2023. <https://www.minambiente.gov.co/consulta/resolucion-por-medio-de-la-cual-se-declara-reserva-delimita-y-alindera-como-distrito-nacional-de-manejo-integrado-colinas-y-lomas-submarinas-de-la-cuenca-pacifico-norte-un-area-ubicada-en-el-extr/>

National Natural Parks of Colombia – NNPC. (2022d). Propuesta de declaratoria de un área protegida en la Cordillera Submarina Beata.

Documento síntesis (junio de 2022, 82p). Retrieved March 17, 2023. <https://www.minambiente.gov.co/consulta/resolucion-por-medio-de-la-cual-se-declara-reserva-delimita-y-alindera-como-reserva-natural-del-sistema-de-parques-nacionales-cordillera-beata-un-area-ubicada-en-el-extremo-nororiental-del-territ/>

National Navy. 2023. Answer to Public Formal Request of Information No. 0982/MSN-COGFM-COARC-SECAR- JEMOP-JONAV-DIONA-29.709 to Mr. Otto Polanco Rengifo by the Chief of Navy Operations.

Ospina Moreno, M. A., Chamorro Ruiz, S. M., Anaya García, C., Echeverri Ramirez, P. A., Atuesta, C., Zambrano, H., Abud, M., Herrera, C. M., Ciontescu, N., Guevara, O., Zárrate, D., Barrero, A. (2020). Guía para la Planificación del Manejo en las áreas protegidas del Sinap Colombia. 159p. Cali - Colombia. Available at: https://www.minambiente.gov.co/wp-content/uploads/2021/10/Guia_sinap_acoplado.pdf

Pascher, K., Švara, V., & Jungmeier, M. (2022). Environmental DNA-based methods in biodiversity monitoring of protected areas: Application range, limitations, and needs. *Diversity*, 14(6), 463. <https://doi.org/10.3390/d14060463>

Pineda, A. (2019). Reserva de la Biosfera SEAFLOWER. Conservando áreas marinas y costeras. En C. Matallana, A. Areiza, A. Silva, A. Galán, C. Solano, & A. M. Rueda (Eds.), *Voces de la gestión territorial: estrategias complementarias para la conservación de la biodiversidad en Colombia* (pp. 152–159). Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Fundación Natura.

Pinillos, F., & Riera, R. (2022). The influence of boundary habitat continuity on spillover from a Mediterranean marine protected area. *Thalassas*, 38, 687–696. <https://doi.org/10.1007/s41208-022-00396-7>

Puentes, V. (1995). Evaluación de la Cherna Café *Epinephelus cifuentesi* Lavenberg y Grove, 1990 (Pisces, Serranidae) en el Pacífico Colombiano y datos preliminares sobre su fauna acompañante y alternativa temporal de pesca. Ministerio de

Agricultura, Instituto Nacional de Pesca y Acuicultura – INPA. Informe Final, Convenio INPA-COLCIENCIAS. Buenaventura. [Retrieved March, 17, 2023]. https://www.researchgate.net/publication/328917425_Evaluacion_De_La_Cherna_Cafe_Epinephelus_Cifuentesii_Lavenderberg_Y_Grove_1990_Pisces_Serranidae_En_El_Pacifico_Colombiano_Y_Datos_Preliminares_Sobre_Su_Fauna_Acompañante_Y_Alternativa_Temporal_De_Pesca

Puentes V, Escobar FD, Polo CJ, Alonso JC. Editors. (2014). Estado de los Principales Recursos Pesqueros de Colombia - 2014. Serie Recursos Pesqueros de Colombia – AUNAP. Oficina de Generación del Conocimiento y la Información, Autoridad Nacional de Acuicultura y Pesca – AUNAP. 244p.

Puentes, V., Hernández, H., Ardila, N., Bustamante, C. C., Zambrano, E., Jiménez, S. I., Hernández, S., Altamar, J., Murillo, J., Barreto, C. G., Rueda, M., & Benavides, I. F. (2022a). Descriptive and spatiotemporal analysis of the tuna purse seine fishery in the Colombian Pacific Ocean. *International Journal of Biological and Natural Sciences*, 2(5), 1–21. <https://doi.org/10.22533/at.ed.813252220075>

Puentes, V., Mejía-Falla, P. A., Ramírez, J. G., Manjarrés-Martínez, L. M., Rodríguez-Barón, J. M., Zapata, L. A., Tavera, J., Gómez-Delgado, F., Barreto, C. G., Zambrano, E., Villa, A. A., & Navia, A. F. (2022b). Sharks and marine batoids management in Colombia: Policy instruments, management duty and implications for their populations and stakeholders. *Marine Policy*, 145, 105264. <https://doi.org/10.1016/j.marpol.2022.105264>

Puentes, V., Barragán-Barrera, D. C., Do Amaral, K., Escobar, F. D., Zapata, L. A., Zambrano, E., Barreto, C. G., Tavera, J., Polo, C. J., Altamar, J., Moreno, A. S., & Benavides, I. F. (2024). Descriptive and spatial tuna purse-seine fishery bycatch analysis in the Colombian Pacific Ocean focusing on elasmobranchs. *Ocean and Coastal Research*. v72:e24038 <https://doi.org/10.1590/2675-2824072.23015>

Ramírez, L. (2016). Marine protected areas in Colombia: Advances in conservation and barriers for effective governance. *Ocean & Coastal Management*, 125, 49–62.

<http://dx.doi.org/10.1016/j.ocecoaman.2016.03.005>

Roa-Ureta, R. H., Román Amancio, G., Marín Abanto, P., Guevara Izquierdo, I., Norza Sior, A. A., Elías, E., & Peralta, M. (2021). Stock assessment of the dolphinfish (*Coryphaena hippurus*) in the South-East Pacific Ocean. Inter-American Tropical Tuna Commission Scientific Advisory Committee. 13th Meeting (by videoconference), 16–20 May 2022. DOCUMENT SAC-13 INF-O. [Retrieved October 12, 2023]. https://www.iattc.org/GetAttachment/6d3cf4f6-d196-4d82-905b-7a957ab9ee7d/SAC-13-INF-O_Stock-assessment-dorado-South-EPO.pdf

Rodríguez, A., Rueda, M., & Escobar, F. (Eds.). (2015). Evaluación directa de las poblaciones de peces grandes pelágicos del Pacífico y el Caribe continental de Colombia. INVEMAR y AUNAP. Serie de Publicaciones Generales de INVEMAR No. 87. Serie Recursos Pesqueros de Colombia – AUNAP. Santa Marta, Colombia. 120p.

Rodríguez, A., Viaña, J., Correa, J., Girón, A., & Rueda, M. (2015). Distribución espacial de la abundancia, estructura de tallas y estimación de biomasa. En A. Rodríguez, M. Rueda & F. Escobar (Eds.), Evaluación directa de las poblaciones de peces grandes pelágicos del Pacífico y el Caribe continental de Colombia (pp. 43–48). INVEMAR y AUNAP. Serie de Publicaciones Generales de INVEMAR No. 87. Serie Recursos Pesqueros de Colombia – AUNAP.

Rodríguez-Rodríguez, D. (2016). MPAs as sustainable fishery tools. MedPAN. Marseille, France. Retrieved May 27, 2023. [accessed 2023 May 27]. <http://www.medpan.org/documents/10180/0/Science+for+MPA+management+5+-+Issue+5/8fcecdd9-10e6-4a69-a135-39333d784f74>

Rojas, P. A., Castillo, B. C., Gómez, C., Acevedo, C. I., Zapata, L. A., Loaiza, J. H., & Rubio, E. A. (2004). Uso y conservación del recurso peces. Parque Nacional Natural Gorgona – Área de influencia. FUNDEMAR, UAESPNN, Programa Parques del Pacífico, ECOFONDO, Embajada de Holanda. 16p.

- Rosselli, A., Díazgranados, M. C., Usma, J. S., Trujillo, F., García, C. A., Valenzuela, E., Herron, P., Espinosa, S., Botero, J., Roldán, M., Ramírez, J. G., & Puentes, V. (Eds.). (2014). Manejo participativo de recursos biológicos y pesqueros: Herramienta para la conservación y uso sostenible del patrimonio natural de Colombia. Pontificia Universidad Javeriana. Conservación Internacional Colombia, Fondo Acción – Programa Conservación para el Desarrollo, AUNAP, Programa Bioredd+ USAID, Fundación Omacha, APC Colombia & WWF. 134p.
- Saavedra, L. M., & Díazgranados, M. C. (Eds.). (s.f.). Comunidades con voz: El futuro de la pesca artesanal en Latinoamérica y el Caribe. Santa Marta. 558p.
- Sala, E., Mayorga, J., Bradley, D., Cabral, R. B., Atwood, T. B., Auber, A., Cheung, W., Costello, C., Feretti, F., Friedlander, A. M., Gaines, S. D., Garilao, C., Goodell, W., Halpern, B. S., Hinson, A., Kaschner, K., Kesner-Reyes, K., Leprieur, F., McGowan, J., Morgan, L. E., Mouillot, D., Palacios-Abrantes, J., Possingham, H. P., Rechberger, K. D., Worm, B., Lubchenco, J. (2021). Protecting the global ocean for biodiversity, food and climate. *Nature*. 2021 Apr;592(7856):E25. doi: 10.1038/s41586-021-03496-1.
- Selvaraj, J., Guzmán, A. I., & Martínez, A. (2011). Guía para la identificación de áreas de pesca para grandes pelágicos en el Pacífico Colombiano. Universidad Nacional de Colombia. ISBN: 978-958-719-834-8.
- Sissenwine, M. P., & Mace, P. M. (2003). Governance for responsible fisheries: An ecosystem approach. In M. Sinclair, & G. Valdimarsson (Eds.), *Responsible fisheries in the marine ecosystem* (pp. 363–391). New York, NY: Oxford University Press
- Sistema de Información Ambiental de Colombia – SIAC. (2023). Caribe y Pacífico. Retrieved from <http://www.siac.gov.co/pacificoCorte>
- Constitucional de Colombia. (2015). Sentencia T-606/15. Retrieved September 15, 2023.
- Shu, L., Ludwig, A., & Peng, Z. (2020). Standards for methods utilizing environmental DNA for detection of fish species. *Genes*, 11, 296. <https://doi.org/10.3390/genes11030296>
- Stewart, K.A.(2019). Understanding the effects of biotic and abiotic factors on sources of aquatic environmental DNA. *Biodiversity Conservation* 28, 983–1001. <https://doi.org/10.1007/s10531-019-01709-8>
- United Nations. (2008). COP 14 – Reports. Retrieved October 9, 2023. <https://unfccc.int/process-and-meetings/conferences/past-conferences/poznan-climate-change-conference-december-2008/cop-14/cop-14-reports>
- United Nations. (2021). COP 26 – Reports. Retrieved October 9, 2023. <https://unfccc.int/event/cop-26?item=3>
- Van der Meer, L., Ramdeen, R., Zylich, K., & Zeller, D. (2014). Reconstruction of total marine fisheries catches for the Dominican Republic (1950–2010). In K. Zylich, D. Zeller, M. Ang, & D. Pauly (Eds.), *Fisheries catch reconstructions: Islands, Part IV* (pp. 43–53). University of British Columbia.
- UNESCO. (2023a). Reservas de Biosfera. Retrieved July 17, 2023. <https://www.unescomedcenter.org/reservas-de-la-biosfera/?lang=es>
- UNESCO. (2023b). UNESCO designates 11 new biosphere reserve. Retrieved July 17, 2023. <https://www.unesco.org/en/articles/unesco-designates-11-new-biosphere-reserves-0>
- Vieira, C., Borda, C., Pardo, R., & Chica, J. I. (2019). La Zona Exclusiva de Pesca Artesanal: Una estrategia complementaria de conservación en la costa norte del Pacífico chocoano. En C. Matallana, A. Areiza, A. Silva, A. Galán, C. Solano, & A. M. Rueda (Eds.), *Voces de la gestión territorial: estrategias complementarias para la conservación de la biodiversidad en Colombia* (pp. 180–187). Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Fundación Natura.
- Weigel, J. Y., Mannle, K. O., Bennett, N. J., Carter, E., Westlund, L., Burgener, V., Hoffman, Z., Da Silva, A. S., Kane, E. A., Sanders, J., et al. (2014). Marine protected areas and fisheries: Bridging the divide. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 24(Suppl. 2), 199–215.

Zambrano, E., Segura, C. E., Loaiza, J., González, W., Martínez, N. J., Villa, A. A., Jiménez, S. I., & Puentes, V. (2014). Análisis de información de especies migratorias del océano Pacífico colombiano en el marco del Corredor Marino del Pacífico Este Tropical–CMAR. Pesquería de atunes (*Thunnus albacares*, *Katsuwonus pelamis*, *Euthynnus lineatus*, *Thunnus obesus*) en la temporada 2014. En V. Puentes, F. D. Escobar, C. J. Polo, & J. C. Alonso (Eds.), Estado de los Principales Recursos Pesqueros de Colombia – 2014 (pp. 143–156). Serie Recursos Pesqueros de Colombia – AUNAP. Oficina de Generación del Conocimiento y la Información, Autoridad Nacional de Acuicultura y Pesca – AUNAP.