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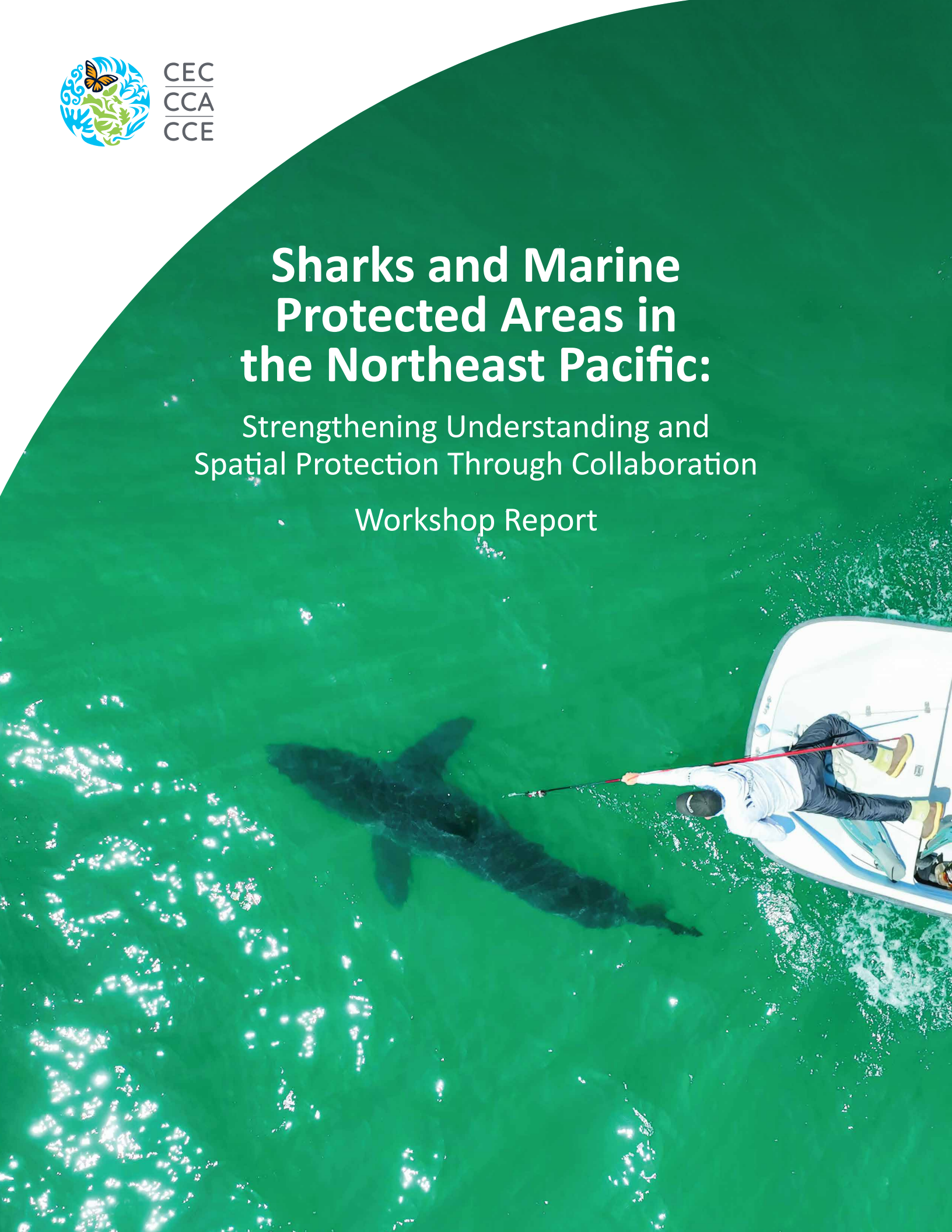
# Sharks and Marine Protected Areas in the Northeast Pacific:

## Strengthening Understanding and Spatial Protection Through Collaboration

Workshop Report



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Cover photo: Ryan Logan, Manager of the Northeast Pacific Acoustic Telemetry Node – N-PAcT, tagging a juvenile white shark (Carcharodon carcharias) in southern California. Photo credit: California State University Long Beach (CSULB) Shark Lab.

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COMMISSION FOR ENVIRONMENTAL COOPERATION

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# List of Abbreviations and Acronyms

| | |
|---|---|
| CEC | Commission for Environmental Cooperation |
| CICES | *Centro de Investigación Científica y de Educación Superior de Ensenada* [Center for Scientific Research and Higher Education of Ensenada] |
| Conanp | *Comisión Nacional de Áreas Naturales Protegidas* [National Commission of Protected Natural Areas of Mexico] |
| CPPS | Permanent Commission for the South Pacific |
| eDNA | Environmental DNA |
| EEZ | Exclusive Economic Zone |
| ICCA | Indigenous and Community Conserved Area |
| IPCA | Indigenous Protected and Conserved Area |
| ISRA | Important Shark and Ray Areas |
| IUCN | International Union for the Conservation of Nature |
| IUCN SSC | IUCN Species Survival Commission |
| IUCN SSG | IUCN SSG Shark Specialist Group |
| MPA | Marine Protected Area |
| N-PAcT | Northeast Pacific Acoustic Telemetry Node |
| NMS | National Marine Sanctuaries |
| NOAA | National Oceanic and Atmospheric Administration |
| OECM | Other Effective Area Based Conservation Measure |

# Abstract

Sharks, rays, skates, and chimaeras are among the most vulnerable marine species globally, with many populations experiencing significant decline due to overfishing, habitat degradation, and a lack of effective management. Marine Protected Areas (MPAs)—including Indigenous Protected and Conserved Areas (IPCAs/ICCAs) and Other Effective Area-Based Conservation Measures (OECMs)—offer a promising tool for spatial conservation of these species, particularly when design is informed by shark biology, movement patterns, and life history characteristics, and when socioeconomic factors are considered.

To strengthen understanding and collaboration related to this topic in the Northeast Pacific, the Commission for Environmental Cooperation (CEC) hosted two workshops (a virtual and an in-person workshop) that convened shark scientists and MPA practitioners from Canada, Mexico, and the United States. The workshops fostered dialogue on research underway, information and data needs, and challenges associated with the spatial conservation of sharks. Opportunities related to trinational and seascape-scale collaboration were explored.

This report synthesizes the perspectives and insights of workshop participants, drawing attention to the importance of multidisciplinary and cross-jurisdictional collaboration. It analyzes the various roles MPAs currently play in shark conservation, including awareness-raising, community and stakeholder engagement and participation, and habitat protection. The analysis underscores the need for improved integration of biological, ecological, social, and cultural data related to sharks to inform MPA planning, implementation, and effectiveness assessments. It also highlights existing data gaps and the potential of emerging technologies—such as acoustic telemetry and environmental DNA—to bridge these gaps and enhance adaptive spatial management. Ultimately, the report reflects a growing desire and regional momentum towards more integrated, knowledge-based, and inclusive approaches to shark conservation in the Northeast Pacific.

# Executive Summary

Sharks and their relatives (skates, rays, and chimaeras) are among the most threatened marine species globally, with over a third at risk of extinction. The Northeast Pacific, spanning from Alaska to Mexico, hosts a high diversity of these species, many of which are highly migratory and cross multiple jurisdictions.

Marine Protected Areas (MPAs) and other spatial management tools have the potential to play a key role in biodiversity conservation, including for sharks, provided they are informed by species-

or taxa-specific data. When developed systematically, involving multiple sectors, (including coastal communities) and through coordinated international efforts, they have the potential to protect local to wide-ranging species and impart lasting ecological and socioeconomic benefits.

The Commission for Environmental Cooperation (CEC) facilitated a virtual workshop (10 December 2024) and an in-person workshop (4–5 February 2025), bringing together MPA practitioners and shark scientists from Canada, Mexico, and the United States. Together, participants at these workshops explored how MPAs can better support shark conservation in the Northeast Pacific. Specific objectives were knowledge-sharing, identifying key data and management gaps, and catalyzing trinational collaboration.

Key findings highlight that MPAs can benefit sharks when designed and managed with species- and taxa-specific characteristics and needs in mind, and when integrated with other conservation tools such as fishing regulations. Participants emphasized the importance of bridging Indigenous knowledge and perspectives with western science and processes; addressing baseline data deficiencies (especially for deep-sea and non-charismatic species), both within and across countries; and exploring the use of technologies like acoustic telemetry and eDNA to understand shark movement and habitat use. Greater communication and awareness raising were also highlighted as priority needs.

Challenges with respect to the spatial protection of sharks remain in aspects such as governance, funding, and stakeholder and community engagement. Early efforts to balance conservation outcomes (such as increased shark abundance) with socioeconomic ones will increase the likelihood of successful MPAs and MPA networks for sharks.

Multiple opportunities for collaboration were identified by workshop participants, including the establishment of a Northeast Pacific *Collaborative Sharks—MPAs Working Group*. Such a group might aim to enhance knowledge sharing, coordinate research, standardize monitoring methods, promote management best practices, and support shark education and outreach initiatives across the three countries.

By 2030, the vision emerging from the workshops is to see key shark habitats identified and protected through MPAs and MPA networks, supported by robust trinational collaboration, interdisciplinary knowledge, and strong public awareness. MPAs—when guided by science, knowledge, inclusivity, and cooperation—can serve as powerful instruments to safeguard and restore shark populations and the broader marine ecosystems they support.

# Acknowledgments

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A special thank you is extended to the presenters at the virtual (v) and in-person (p) workshops who generously gave their time, expertise, and enthusiasm (listed alphabetically by last name): Nick Dulvy (v), Taylor Chapple (v), Max Delaney (p), Ryan Freedman (v), Sara Hutto (p), Rima Jabado (v), Robert Lennox (v), Ryan Logan (v, p), Harri Pettitt-Wade (v), Carlos Julio Polo Silva (v), Ernesto Israel Popoca Arellano (v), Tito Navia Solorzano (v), Oscar Sosa-Nishizaki (v), Ryan Stanley (v), and Dave Wiley (v).

Thank you are also extended to the participants to the in-person workshop that took place on 4-5 February 2025 in Vancouver, British Columbia, Canada (see Appendix I).

This workshop report was prepared by Romney McPhie from Ococo Consulting & Creative. Major contributions to the report were made by members of the CEC Enhancing Co-benefits of Marine Protected Areas Steering Committee, members of the Sharks-MPAs Technical Advisory Group (Appendix II), and CEC project staff.

The CEC acknowledges that the in-person workshop was held in Vancouver, British Columbia, Canada, on the unceded, traditional, and contemporary territories of the xʷməθkʷəy̓əm (Musqueam), Sḵwx̱wú7mesh (Squamish), and səlilwətaɬ (Tsleil-Waututh) Nations.

# 1 Background Context

Marine protected areas (MPAs), Indigenous-led protected and conserved areas (IPCAs), Indigenous and community conserved areas (ICCAs), and other effective area-based conservation measures (OECMs)—hereafter referred to as "MPAs" unless otherwise specified—are increasingly recognized as vital tools in addressing the global decline of chondrichthyans. This group, which includes sharks, skates, rays, and chimaeras (hereafter, "sharks"), is among the most threatened of all marine vertebrates, with over a third at elevated risk of extinction (Dulvy et al. 2014, Dulvy et al. 2024).

Ongoing global population declines in shark populations—driven primarily by overfishing, habitat degradation, and loss (Dulvy et al. 2017, Dulvy et al. 2021)—combined with their critical roles in marine ecosystems (Larson et al. 2021, Dedman et al. 2024), highlight the urgent need for more effective spatial conservation strategies (Bräutigam et al. 2015, MacKeracher et al. 2018, Hyde et al. 2022). For MPAs to play a key role alongside aspatial management in advancing stewardship, conservation, and recovery efforts of sharks, considerable scientific knowledge is needed about shark biology, movement, and habitat use (Hyde et al. 2022). This knowledge should be used to set clear goals and measurable conservation objectives and targets for the species of interest (Rigby et al. 2019). Socioeconomic and cultural considerations must also be integrated alongside both scientific and Indigenous knowledge and applied through adaptive management and enforcement (MacKeracher et al. 2018, Rigby et al. 2019). Long-term management and funding commitments, including for MPA monitoring and evaluation, are necessary to ensure these animals are protected now and into the future (Rigby et al. 2019).

Because many shark species are highly migratory and cross jurisdictional and international boundaries, their effective conservation demands international cooperation (Larson et al. 2021, Sun et al. 2024, UNEP-WCMC 2024). Understanding migratory networks—especially for threatened species—and developing strong networks of MPA practitioners and researchers is crucial. These networks should align goals, share data and information, and prioritize collaborative implementation.

The Northeast Pacific (from Alaska to Mexico) hosts high shark species' richness, endemism, and evolutionary distinctiveness (Derrick et al. 2020). There is also high risk to sharks, with ongoing threats, high data deficiency, and a need for greater management (Larson et al. 2021). Many sharks in the Northeast Pacific are of wide-ranging, highly migratory species that span across multiple jurisdictions, increasing their risk of threat and extinction (Heupel et al. 2015, Dulvy et al. 2017, Sherman et al. 2022, Sherman et al. 2023).

Numerous MPAs[1] and MPA networks have been established or are in development across the Northeast Pacific (Hall-Arber et al. 2021, Nature United 2023). Many of these are designed and managed to protect biological and cultural diversity. However, the benefits of these MPAs for migratory sharks are often unclear. When MPAs overlap with key movements, critical habitats, life stages, or aggregations of shark species, they may provide conservation benefits. MPAs that are most effective for shark conservation are those that are tailored to species- (or taxa-) specific needs, incorporating biological and behavioral characteristics (e.g., residency, site fidelity, philopatry, critical habitat) into planning, design, and management, and that combine spatial protection with fisheries management measures to reduce mortality (Rigby et al. 2019). A strong understanding of the local socioeconomic context and conditions of an area, and a focus on achieving ecological, cultural, and community outcomes, can greatly enhance the effectiveness of MPAs (MacKeracher et al. 2018).

Strengthening shark conservation in the Northeast Pacific requires integrated, multi-faceted approaches that combine area-based protections and conservation measures with fishing regulations and consider human dimensions throughout. These approaches depend on collaborations and partnerships working across countries, disciplines, and cultures (Larson et al. 2021).

# 2 Workshops

As part of its Enhancing Co-Benefits of Marine Protected Areas (MPAs) project, the Commission for Environmental Cooperation (CEC) organized two workshops—one virtual and one in-person—focused on sharks and MPAs in the Northeast Pacific. This initiative aimed to strengthen trinational collaboration and build partnerships to support more effective spatial management and conservation of sharks in the region. The virtual workshop was held on 10 December 2024, and the in-person workshop was held in Vancouver, British Columbia, Canada, on 4–5 February 2025.

The workshops brought together MPA practitioners and shark researchers from Canada, Mexico, and the United States to exchange information and knowledge on shark species, and to foster seascape-level collaboration on research, monitoring, and spatial management measures. “MPAs” in the context of this workshop series refers broadly to all spatial management tools used to meet conservation and sustainability objectives, including MPAs, OECMs, IPCAs/ICCAs, marine spatial planning initiatives, and MPA networks.

[1] Terminology and legal designations for “MPAs” differ by country. In Mexico, marine areas are designated as Protected Areas, but the term “MPA” is not commonly used. In Canada, the term includes various federal designations, such as Marine Protected Areas under the Oceans Act, National Marine Conservation Areas (NMCAs), and Marine Wildlife Areas. In the United States, MPAs encompass National Marine Sanctuaries under the National Marine Sanctuaries Act, Marine National Monuments, and a range of state-level designations.

## 2.1 Workshop Goals

The virtual workshop was designed to initiate communication and knowledge-sharing among shark scientists and MPA managers, stewards, and other practitioners, across Canada, Mexico, and the United States. Speakers from all three countries were invited to share insights on shark species occurring in Northeast Pacific waters, ongoing research and monitoring, research needs, spatial management practices for sharks, and lessons learned from existing MPAs implementing shark conservation measures. Presenters involved in international initiatives also contributed to stimulate thinking around synergies and opportunities for applying broad-scale collaboration at the regional level.

The in-person workshop convened a smaller group of shark experts and MPA practitioners from the Pacific Coast of Canada, Mexico, and the United States to strengthen relationships, share perspectives, and explore future directions for enhancing international cooperation on shark conservation within and among existing and planned MPAs in the Northeast Pacific.

## 2.2 Workshop Objectives

Both workshops were guided by the following objectives:

- To connect shark researchers and MPA practitioners (managers, stewards) in order to build understanding and foster relationships;
- To identify challenges and opportunities for conserving transboundary shark species through MPAs in the Northeast Pacific, with a focus on research, monitoring, data management and sharing, and communication between scientists and practitioners;
- To identify preliminary recommendations and potential actions to support shark conservation; and,
- To define possible next steps, including the creation of a *Collaborative Sharks–MPAs Working Group* to advance discussions and follow through on workshop outcomes.

## 2.3 Workshop Presentations

The following presentations were given as part of the virtual and in-person workshops (listed in order of appearance under each workshop):

**Table 1. Virtual and In-person Workshop Presenters and Their Presentation Titles and Affiliations**

| Presenter | Presentation Title | Affiliation |
|---|---|---|
| Virtual Workshop, December 10th, 2024 | | |
| Nick Dulvy | Status, trends, and priorities for Northeast and Eastern Central Pacific Ocean sharks, rays, and chimaeras | Marine Biology and Conservation Lab, Earth to Ocean Research Group, Simon Fraser University |
| Taylor Chapple | Shark movement in the Northeast Pacific (NEP) | Big Fish Lab, Coastal Oregon Marine Experiment Station, Oregon State University |
| Oscar Sosa Nishizaki | MPAs and sharks in Mexico: White sharks as a flagship species | Centre for Scientific Research and Higher Education of Ensenada (CICESE) |
| Ryan Freedman | Sharks in the West Coast National Marine Sanctuaries (NMS) | Channel Islands National Marine Sanctuary, National Marine Sanctuaries (NMS), National Oceanic and Atmospheric Administration (NOAA) |
| Ryan Stanley, Harri Pettitt-Wade, Rob Lennox | Acoustic telemetry as a Marine Protected Area Network (MPA) monitoring approach | Marine Conservation Research Group, Habitat Ecology Section, Coastal Ecosystem Services, Fisheries and Oceans Canada<br><br>Ocean Tracking Network (OTN), Dalhousie University |
| Dave Wiley | Shark conservation and MPAs: The good, the bad, and the frustrating: Perspectives from NOAAs Stellwagen Bank National Marine Sanctuary | Stellwagen Bank National Marine Sanctuary, NMS, NOAA |
| Ernesto Israel Popoca Arellano | Great white shark conservation in the Guadalupe Reserve | National Commission of Protected Natural Areas of Mexico (Conanp), Guadalupe Island Biosphere Reserve |
| Ryan Logan | Northeast Pacific Acoustic Telemetry Node (N-PAcT): Building partnerships to better understand marine species on the move<br>**Also presented at the in-person workshop* | N-PAcT, Channel Islands National Marine Sanctuary, NMS, NOAA |
| Carlos Julio Polo Silva, Tito Navia Solórzano | Shark protection and management initiatives from the CPPS: Blue Five Project | Permanent Commission for the South Pacific (CPPS), Blue Five Project |
| Rima Jabado | Important Shark and Ray Areas – ISRA | IUCN Species Survival Commission (SSC), IUCN SSC Shark Specialist Group (SSG) |

| In-Person Workshop, February 4th and 5th, 2025 | | |
|---|---|---|
| Sara Hutto | Building an international collaborative to protect whales | Greater Farallones and Cordell Bank National Marine Sanctuaries, NMS, NOAA |
| Max Delaney | Management of white shark aggregation sites: Licensing/permitting issues, challenges and opportunities | NMS, NOAA |

# 3 Main Findings

Workshop participants were asked to consider how MPAs—and networks of MPAs—could play a greater role in conserving shark species in the Northeast Pacific, considering that many species migrate across national and international boundaries. Key guiding questions posed to presenters and attendees included:

- How can MPAs (and MPA networks) more effectively conserve sharks as they move across jurisdictional borders?
- What research and monitoring efforts are currently underway to understand sharks in a spatial management context, particularly at an international level? What scientific and knowledge gaps remain, and how can we collaborate to strategically address them?
- What management successes and challenges have emerged in the context of sharks and MPAs? How can we learn from these experiences or overcome obstacles?

The following sections summarize the main points of discussion and key findings from workshop participants, with supporting literature listed in Section 6.

## 3.1 The Roles of MPAs

The diverse roles of MPAs in shark conservation were an extensive topic of discussion during both the virtual and in-person workshops. This section summarizes key issues, considerations, and thoughts raised by participants. Best practices, challenges, and opportunities related to the spatial conservation and management of sharks are also highlighted. References mentioned during the workshop and/or supporting the workshop findings are listed in Section 6.

MPAs are established for a variety of reasons and can serve multiple roles in the protection and conservation of marine ecosystems. Most MPAs are created to conserve ecosystem function by protecting species, habitats, and overall biodiversity in a particular region. Some MPAs are designed specifically to protect and conserve taxa of concern, but may also provide secondary benefits, including for sharks. While referred to here under the broad term “MPAs,” OECMs are geographically defined areas other than protected areas that are managed in ways that achieve

positive and sustained long-term outcomes for the in-situ conservation of biodiversity. Key examples of OECMs in the marine environment include fisheries time-area closures that are designed to protect ecosystems from bottom-contact fishing. These may be particularly useful for benthic and demersal shark species. Marine IPCAs/ICCAs are areas where Indigenous governments have the primary role in protecting and conserving ecosystems through Indigenous laws, governance, and knowledge systems. These elevate the rights and responsibilities of Indigenous Nations and communities and are an important and growing tool to protect nature and cultural values.

Ultimately, the initial values and characteristics of an area in need of protection should be identified during MPA development, and the fundamental role(s) of an MPA should be clearly defined through goals and objectives during development and designation. Adaptive management should allow for the inclusion of new conservation objectives and measures as more knowledge and information becomes available. MPAs inadvertently benefiting, as well as those designed to benefit, sharks are no exception.

With regards to sharks, globally, spatial management approaches have had varying (or unknown) effectiveness in achieving population outcomes. Some have shown limited benefits for highly mobile and migratory species; for these species, spatial protection should be complemented with alternative measures such as the implementation of more sustainable fishing practices (for example, total allowable catch, size or bag limits, restricted take or protection of high-risk species, etc.). Smaller, coastal and estuarine species with strong site attachment (during one or more life stages) are arguably more likely to gain protection from MPAs than wide-ranging, highly migratory species. Regardless of the migratory nature of the species, greater knowledge of a species' biology and behavior at all life stages—and incorporation of this knowledge into MPA (or MPA network) planning, design, and management—will help ensure that populations outcomes are achieved.

In the Northeast Pacific, MPAs can play a very effective role in conservation through raising awareness and developing partnerships with communities and users of MPAs. MPAs, for example, can raise awareness of the economic, ecological, and cultural values associated with protecting sharks, serving as an important link between science, management, and communities. This awareness-raising—through, for example, robust feedback loops between science and management, targeted education and community engagement programs, and participatory science—can lead to greater success in terms of both population and socioeconomic outcomes. The more aware communities and users are of the benefits, and the more involved they are in the MPA process, the more likely they are to comply with MPA regulations over the short to long term.

Networks of MPAs can be beneficial, beyond single MPAs, by building efficiencies and facilitating consistency in monitoring, data collection, conservation objectives and measures, and communication across protected areas. Where there is consistency across sites, and these are

used by highly migratory species, knowledge and data can be brought together to answer questions pertaining to the biology, ecology, and movement of these species. Within and across protected areas in the Northeast Pacific, for example, the use of technology and data (such as acoustic and satellite telemetry) can increase understanding and improve decision-making related to sharks. Consistent conservation measures across sites will encourage success (where measures at one site might not be sufficient, especially for highly migratory species) and will also allow for species' movement and adaptation in response to changing conditions, increasing their chances of survival—especially in the face of climate change.

### 3.1.1 Best Practices and Lessons Learned from the Pacific Northeast

- A multi-faceted or multi-pronged approach is the most effective strategy for the conservation and management of shark species, with MPAs serving as one tool among many. MPAs are not a "panacea" and should be used in conjunction with other tools—such as aspatial measures (e.g., species-specific landing size limits, gear restrictions) to mitigate fishing-related threats.

- Where necessary and possible, MPAs should incorporate species- (or taxon-) specific management measures for shark conservation.

- MPAs with broader biodiversity conservation objectives may still provide conservation benefits to sharks if they overlap with key movements, critical habitats, aggregations, or life stages of shark species.

- For highly migratory species, dynamic (or flexible) MPAs, that adapt—either in terms of management measures or boundaries—to shifting migratory patterns driven by climate change are preferable, though more complex to design, establish, and implement.

- Greater interdisciplinary, interjurisdictional, and international communication, collaboration, and partnership can support both spatial and aspatial management by allowing scientists, managers, and stewards to share knowledge and practices and build on each other's lessons learned.

- MPAs can serve as "ecological steppingstones" or "connectivity corridors" for sharks across borders and boundaries, offering protection for critical habitats across migratory corridors ("blue ecological corridors").

- MPAs can also act as "steppingstones" in a management context by supporting the development of interconnected, consistent management measures.

- Shark management efforts that recognize, from the earliest stages, socioeconomic and cultural dimensions lead to more effective and sustainable conservation.

- IPCAs/ICCAs that leverage Indigenous knowledge and governance systems have a critical role to play in the protection and conservation of sharks.

### 3.1.2 Challenges and Opportunities Related to Sharks and MPAs in the Pacific Northeast

- For MPAs to play a key role alongside aspatial management measures in advancing the stewardship, conservation, and recovery of sharks, significant scientific knowledge is required—particularly regarding shark biology, movement, and habitat use. However, for most species of sharks in the Pacific Northeast, this information remains limited.

- The collection of baseline data is especially difficult for highly mobile and migratory species, deep-water species, and less charismatic species such as skates.

- A general lack of awareness about sharks, combined with limited data, often results in low support for shark conservation from decision-makers—especially compared to more charismatic megafauna such as whales. This disparity in support is more pronounced in some regions and countries than others.

- Sharks have a bad reputation due to sensationalized media portrayals and a fear of the unknown. Misconceptions continue to impede conservation efforts. Thus, cultivating broader socio-cultural acceptance is essential for successful spatial protections.

- Early and ongoing community involvement is critical to the success of MPAs (or MPA networks) but can be difficult to achieve in shark-focused initiatives due to tensions among stakeholder groups (e.g., fishers, ecotourism operators, and beachgoers).

- Effective shark conservation through MPAs involves diverse regulations, requiring institutional frameworks that support multijurisdictional cooperation. Governance structures must be well-integrated across agencies and institutions to enable communication (e.g., feedback loops among researchers, managers, communities, fishers, ecotourism operators and other stakeholders), as well as coordination and collaboration.

- Greater cross-sector communication is needed. Shark scientists and MPA practitioners should work more closely with fisheries managers, stock assessors, and communities to understand the impacts—both positive and negative—of current protection measures (aspatial and spatial) and to inform future ones.

- Monitoring and enforcement are essential for MPAs to meet shark conservation objectives but remain especially challenging in large, remote areas or in regions with limited resources.

- Limited funding is available for action across the ocean conservation "seascape". Long-term, sustainable financing is required to support all phases of MPA development and management—from baseline research on sharks to enforcement.

- How to consider climate change in the research, monitoring, and adaptive management of MPAs is an evolving discussion. For sharks, shifts in species distributions, migratory patterns, and habitat use will pose challenges to the effectiveness of traditional, static MPAs, increasing the need for transboundary collaboration and the sharing of information and management practices.

## 3.2 Management

Before reflecting on how MPAs in the Northeast Pacific might play a larger role in shark conservation, participants discussed existing MPAs and MPAs networks in Canada, Mexico, and the United States, and what protections they currently offer sharks—whether explicit or indirect. Key points from these discussions included:

- Existing MPAs and MPA networks across all three countries vary widely in the level of protection they provide to sharks. Some offer full (or seasonal, area-based, etc.) protection from fishing, while others focus primarily on habitat protection.

- MPAs aimed at protecting threatened or endangered species should provide full protection from fisheries: meaning both targeted and incidental mortality should be reduced to zero.

- In Canada and the United States[2], protected areas are designated by different jurisdictions and include federally, provincially, or state-managed sites, as well as IPCAs. Multiple jurisdictions often result in fragmented management and data "silos," which can hinder efforts to improve our understanding of species and the benefits of MPAs.

- In many cases, it is not well understood which shark species are using MPAs, or whether they are benefitting from these areas. Robust quantitative and qualitative data are needed to demonstrate the value of MPAs for sharks in the Northeast Pacific and to highlight their current or potential contribution to shark conservation.

- Participatory or community science—such as community-based monitoring or data collection through ecotourism—can help address monitoring gaps, provided there are

[2] In Mexico, all officially designated Protected Areas are established at the federal level and managed primarily under federal jurisdiction through Conanp.

systems in place to ensure data quality and control. Apps can support data collection, species identification, and data reporting.

- MPA managers and relevant agencies play a key role in regulating activities related to sharks through licensing and permitting processes. These include regulations for shark ecotourism, other wildlife watching, scientific research, recreational boating, and managing user conflicts (e.g., between researchers and tour operators).

- MPA permitting challenges for shark-related research and ecotourism include difficulties assessing potential impacts and benefits, evaluating new technologies and methods against current regulations, and accounting for cumulative effects on target shark species.

- Researchers often face burdensome permit application and reporting requirements in some regions, which may discourage research that could inform MPA management.

- Better communication and streamlining permit processes (e.g., across agencies) and/or co-developing research priorities and proposals could help alleviate these issues.

- Including explicit conservation messaging about sharks in MPA communications and education materials can help broaden stakeholder engagement, as well as support permitting processes and decision-making.

- Education and training programs developed through MPA initiatives can help encourage the shift from activities that are potentially harmful to sharks (e.g., fishing) to alternative livelihoods (e.g., ecotourism), where viable.

- A long-term goal for enhancing shark conservation in the Northeast Pacific should be to implement consistent conservation measures for sharks across MPAs in the region, potentially aligning with broader whale-focused initiatives. The critical first step involves building a better understanding of shark migratory corridors and regional-scale connectivity through information and data sharing.

- Consistent and standardized methods and monitoring would facilitate data integration and coordinated management measures at the regional scale.

- Adaptive management is essential, allowing for changes in site objectives, conservation measures, and boundaries, as new data on sharks become available and as sites and species respond to climate change.

## 3.3 Knowledge and Information

At the start of the virtual workshop, participants were reminded of the importance of: "protecting the shark species that need protection," namely endemics, threatened species, and those with large geographic ranges that cross multiple Exclusive Economic Zones (EEZs), making them more vulnerable to extinction due to jurisdictional challenges.

During the in-person workshop, participants were asked whether enough recent information exists to identify which shark species should be protected through spatial management measures, and which might benefit the most from such tools.

Along the Pacific coast of all three countries, research on sharks is underway, but it is often concentrated on charismatic or economically important species (e.g., white sharks, whale sharks). In the United States, for example, movement monitoring using acoustic receivers, satellite tracking, and conventional tagging is being conducted for several species, including broadnose sevengill sharks, salmon sharks, and white sharks, mainly along the southern and central California coast, with some monitoring in Oregon, Washington, and Alaska—though geographic and species' coverage remains limited. In Mexico, shark research and studies on their socioeconomic value, including through ecotourism, are underway in and outside of MPAs, often in collaboration with coastal communities. In Canada, shark research is sparse, particularly for species with low or no economic value, and data are not readily available.

There are examples of successful cross-border collaborations, such as joint studies between Mexican and American scientists on white shark movement and habitat use. An emerging acoustic telemetry-focused network—the Northeast Pacific Acoustic Telemetry Node (N-PAcT) (see Box 1)—aims to increase data sharing and collaboration amongst telemetry researchers from Alaska to Baja California, to increase understanding of mobile marine species and inform marine spatial planning and other adaptive management strategies.

**Box 1. Northeast Pacific Acoustic Telemetry Node (N-PAcT)**

The N-PAcT network is an emerging collaborative connecting researchers and institutions from Alaska to Baja California. It focuses on tracking the movement of marine species—such as sharks, fish, and sea turtles—using acoustic telemetry. By sharing detection data from deployed receivers across the network, N-PAcT enables scientists to study species movement across regional and national boundaries, providing insights into migration patterns, habitat use, and ecological connectivity. The network also facilitates long-term data storage and quality control, supporting research, conservation, and resource management. Future aims of N-PAcT include expanding real-time monitoring capacity to collect both animal movement and environmental data, enhancing marine spatial planning and adaptive management strategies.

For more information, please visit: https://npact.aoos.org/

Despite this ongoing work, discussions revealed a widespread lack of data at the species' level, especially regarding movement, migration, and habitat use, as well as at the population level. Even for more well-known species, population status is often unknown. While threats to sharks such as overfishing and habitat loss are generally recognized, the specific impacts of these threats are unclear for many species. This information gap hinders the development of effective spatial (and other) conservation objectives and measures and also limits the ability to assess the effectiveness of existing MPAs, including benefits from protection measures intended for other taxa such as whales.

Participants identified several key knowledge and information needs for improving shark spatial conservation:

- Comprehensive data on shark distribution, movement, and migratory patterns across all life stages, including information on the type, scale, and timing of movements; home range fidelity; connectivity; and critical habitat requirements. This can be obtained through acoustic and satellite telemetry, as well as conventional tagging.

- Assessments of whether and how existing MPAs are benefiting sharks, to justify spatial protection efforts (current and future). This may involve modeling shark habitat use and time spent within MPAs using tracking data, provided underlying data are available for target species and life stages.

- Habitat mapping and the collection of environmental and prey data to support habitat suitability models and improve understanding of shark movement drivers.

- Increased data on batoids (rays, skates, and sawfish) which remain understudied in the Northeast Pacific (and globally) despite their ecological importance. Batoids occupy high trophic levels, maintain balance in their prey populations, and act as habitat engineers, contributing to the overall health and stability of marine ecosystems globally. Recent discoveries of Pacific white skate nurseries near hydrothermal vents (for example, in Tang. ɢwan – ḥačxwiqak – Tsigis MPA) suggest that MPAs may be particularly beneficial for deep-sea species.

- Greater exploration of emerging technologies such as environmental DNA (eDNA) metabarcoding to cost-effectively monitor shark species diversity (Merson et al. 2025), especially in remote or deep habitats (e.g., British Columbia fjords), and very high-resolution satellite imagery for detecting large species like basking sharks.

- The use of globally unique animal IDs and digital platforms like the Movebank Life History Museum to store and share lifetime tracking data for sharks to support science, conservation, and public engagement.

- Socioeconomic and cultural information on shifting public perceptions of sharks, their importance to coastal communities, and the perceived roles of MPAs in their conservation.

- Qualitative and quantitative data on emerging threats to sharks in the Northeast Pacific—such as climate change, pollution, harmful algal blooms, coastal development (including renewable energy development), deep-sea mining, and emerging fisheries—as well as identification of potential climate refugia.

- Improved data sharing and integration. Many useful datasets are already available across agencies, organizations, NGOs, and communities, but remain siloed. The development of transparent and secure metadata- and data-sharing protocols and processes should be prioritized within and across countries. A centralized, public-facing data portal or platform (e.g., for shark movement) could serve as a "pilot" initiative for broader collaboration.

- The respectful weaving of Traditional/Indigenous Knowledge with western science—where this is done in support of and in collaboration with Indigenous communities and knowledge-holders and recognizes Indigenous rights and data sovereignty—will strengthen the evidence base for the shark spatial management.

Participants emphasized that a lack of data should not delay spatial protections. They reflected on how to prioritize shark species (with regards to both research and spatial management), in the absence of baseline information and data for many species. Participants suggested several guiding principles related to prioritization:

- Adopt a multi-species approach to shark spatial management, where possible, targeting areas that support (or may support) diverse shark assemblages and vital functions such as feeding, reproduction, parturition, growth (e.g., in the United States—Humbolt Bay in California, Willapa Bay in Washington, and Heceta Bank off Oregon).

- Identify shark species that may already be benefiting from existing spatial protections designed for other species or habitats (e.g., basking sharks and vessel slowdowns for whales, or sharks indirectly protected through gray whale conservation efforts in Baja California, Mexico) and build off of these understandings.

- Focus research and protection efforts on species that provide clear community benefits (e.g., economic opportunities through ecotourism, as is the case with whale sharks in Mexico) to encourage public support and engagement.

- Leverage "ambassador species"—those that capture public interest—and explore opportunities to align shark research with better-funded conservation efforts (e.g., salmon species studied alongside salmon in British Columbia and Alaska).

- Carry out biodiversity studies—for example, using Baited Remote Underwater Video or eDNA—to gain information on sharks in specific areas, and to support future prioritization.

- Use participatory and opportunistic data collection where possible, as successfully demonstrated in places like Guadalupe Biosphere Reserve for the white shark. Powerful tools like eOceans (see Box 2) can support community-based monitoring (of sharks and threats) in MPAs and standardization of methods and data.

Finally, participants emphasized the importance of prioritizing species most in need of protection—those that are endemic, are or may be threatened, and/or at high risk of extinction—even if they are less visible ("out of sight, out of mind") or offer fewer direct economic benefits.

**Box 2. eOceans**

eOceans is a science-driven platform designed to streamline ocean data collection, analysis, and dissemination for a wide range of stakeholders—including researchers, conservationists, Indigenous communities, managers, and policy makers. The platform offers a patent-pending, all-in-one system that supports the entire workflow from data collection to decision-making. Users can collect data on over 200,000 marine species, environmental conditions (such as temperature, pH, and microplastics), and human activities, using a mobile App that functions offline and is accessible to both professional and citizen scientists.

The eOcean platform emphasizes ethical data sharing, allowing users to control who accesses their data and ensuring that sensitive information, such as exact locations of observations, is protected. eOceans also provides automated analysis and visualization tools, enabling users to track key metrics and generate insights without the need for extensive data science expertise. This approach facilitates collaborative, transparent, and science-based decision-making, supporting initiatives like MPA monitoring and biodiversity conservation.

For more information, please see: https://www.eoceans.app/

# 4 Collaborative Recommendations/Actions

The in-person workshop was designed to set the stage for the potential creation of a Northeast Pacific *Collaborative Sharks – MPAs Working Group*. Participants considered the following questions:

- What is the most effective framework or structure for continued MPA collaboration related to sharks across countries and communities in the Northeast Pacific and beyond? Would a working group be helpful?

- What are some priority actions that a Collaborative Sharks–MPAs Working Group, or its members and organizations, could pursue?

To help ground these discussions, participants were introduced to the *Northeast Pacific Collaborative for Conserving Whales in a Changing Climate*, which has identified four key "collaboration themes":

1. Knowledge/Information Needs
2. Communication
3. Protective Measures
4. Collaboration

These same themes were used to frame workshop discussions around the potential development of a Northeast Pacific *Collaborative Sharks–MPAs Working Group*, including on visions or needs for the future, and on priority actions or recommended next steps. The following ideas were generated during reflective sessions, country breakout groups, and plenary discussions.

## 4.1 Vision

Early in the in-person workshop, participants engaged in a visioning exercise focused on what shark conservation through MPAs and broad-scale collaboration might look like by 2030. These ideas were organized by the four collaboration themes (see Figure 1). They were also translated into preliminary recommendations and tangible actions (see Sections 4.2–4.5).

A draft, overall vision statement for a *Collaborative Sharks-MPAs Working Group* was developed based on participant input:

*By 2030, key habitats and priority areas for sharks are protected in MPAs and MPA networks and by other protection measures throughout the coasts and waters of Canada, Mexico, and the United States. Knowledge sharing and public awareness of sharks has increased along with the importance of protection measures for them, including MPAs and MPA networks. Shark conservation in the Northeast Pacific is supported by an interdisciplinary trinational working group, including scientists, MPA practitioners, and Indigenous representatives.*

This vision is a starting point and will evolve through future collaboration.

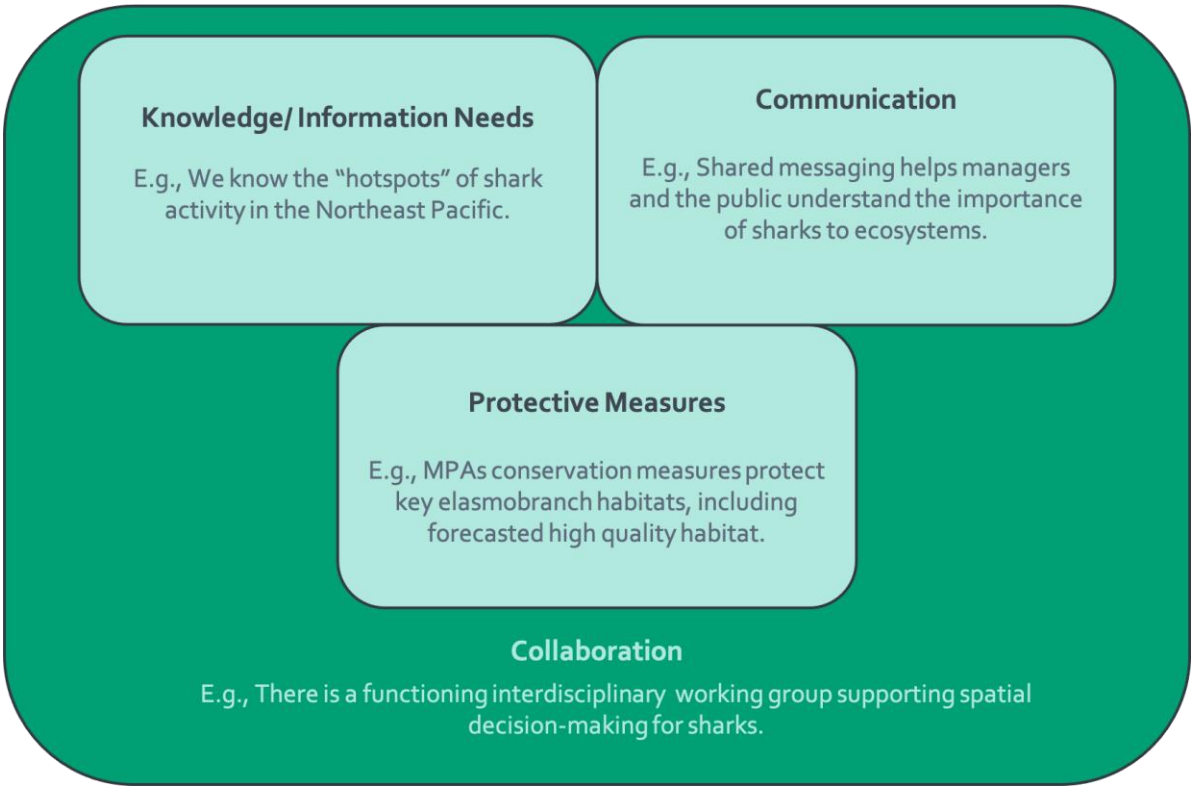


**Figure 1. The Four Collaboration Themes (under which recommended, tangible actions were grouped). Visioning results (examples of which are included under each theme heading) were also grouped under the collaboration themes, and where possible, reframed as tangible actions for collaborative implementation.**

## 4.2 Knowledge/Information

Participants emphasized that access to robust knowledge, information, and data is foundational to effective communication and management. Priority actions included:

- Continue building the N-PAcT (see Box 1), including identifying priority locations for new receiver deployment to gain information on movement and habitat use for priority shark species, and secure support for N-PAcT expansion.

- Encourage sharing and integration of telemetry data across borders.

- Develop cross-border species distribution models using both fisheries, dependent and independent (e.g., tagging, telemetry), data, beginning with priority species. See Anderson et al., 2024, for recent Canadian groundfish data, and Jabado et al., 2024, for a recent,

comprehensive synthesis of the global status of sharks, rays, and chimaeras that includes progress in data collection and fisheries management.

- Advance habitat suitability modeling for sharks, ideally incorporating climate change projections, to inform spatial conservation planning and adaptive management.
- Further explore and implement cross-border collaborations on shark genetics to understand population structure, connectivity, and climate-driven dispersal.
- Further explore and communicate how eDNA might support our understanding of sharks in coastal, offshore, and deep-sea environments.
- Improve understanding of the cultural, social, and economic values of sharks within and across countries to support trade-off evaluations and spatial protection measures.
- Develop and implement a digital survey targeting fishers and communities across all three countries to gather local to regional scale perspectives on sharks and MPAs.
- Collaborate with the California State University Long Beach (CSULB) Shark Lab to build a framework (currently under development) for assessing the benefits of MPAs for sharks based on species' characteristics (life history characteristics, movement, habitat use) and threats.
- Collect and share tissue samples (e.g., fin clips for genetics, muscle and/or liver tissue for stable isotopes) from migratory and transboundary species to enhance knowledge of populations and movement.
- Create a shared database and necropsy protocol to maximize data collection from deceased sharks, especially threatened species.
- Ensure that concerted efforts are made to weave Traditional/Indigenous Knowledge with western science, so that multiple ways of being and knowing are leveraged and applied to the conservation and protection of sharks.

## 4.3 Communication

Participants identified several needs and opportunities to improve communication across scales and sectors:

- Conduct a comprehensive valuation of sharks (ecological, socioeconomic, cultural) to support the development of a transboundary public awareness campaign.

- Co-develop a set of consistent "talking points" for both researchers and MPA practitioners, as well as key messages for a broad awareness campaign, that highlight the ecological and societal importance of sharks and the roles of MPAs in shark conservation.

- Identify and promote "shark ambassadors" to support outreach and education.

- Collaborate to fund, create, and promote novel outreach and education initiatives and materials on sharks. Potential examples discussed by participants included card games (see Justice for Jaws example, Ushaka Sa[3]), virtual reality (see Western University, basking shark example[4]), comic books (see the CSULB Beach Days comic book series[5]), shark curriculum (see Sharks4Kids[6]), brochures, digital story maps (see "In Search of Sharks: Reimagining Shark Conservation in Baja California Mexico's Artisanal Fisheries"[7]), and Apps (see the Shark Trust App[8]).

- Develop a web-based platform for shark communications, shaped by input from all three countries, to inform spatial (and other) decision-making (see Angel Shark Conservation Network[9] and the Save the North Pacific Right Whale[10] websites, as examples).

## 4.4 Protective Measures

Participants agreed that while knowledge-building and communication are essential, efforts to enhance spatial protection for sharks must also move forward. Actions included:

- Overlay known shark movement data and key habitat areas ("hot spots") with existing MPAs to assess where protections currently align with species needs.

- Continue to explore how to increase communication between researchers and MPA practitioners, informed by international case studies (e.g., Glovers Reef Marine Reserve), to support collaborations in the Northeast Pacific.

- Co-develop shark research projects with MPA managers, where possible, to ensure relevance and applicability to spatial protection and management, and to help streamline permitting and reporting requirements.

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[3] https://justice4jaws.co.za/super-ushaka/ [Accessed April 14th, 2025]
[4] https://universityaffairs.ca/news/western-prof-gets-students-to-swim-with-sharks-virtually/ [Accessed April 14th, 2025]
[5] https://www.csulb.edu/shark-lab/comic-book-series [Accessed April 14th, 2025]
[6] https://www.sharks4kids.com/sharkcurriculum [Accessed April 14th, 2025]
[7] https://storymaps.arcgis.com/stories/2201db1ddc06425b9c1f3e5d18af3f23 [Accessed April 14th, 2025]
[8] https://www.sharktrust.org/app [Accessed April 14th, 2025]
[9] https://angelsharknetwork.com/ [Accessed April 14th, 2025]
[10] https://www.northpacificrightwhale.org/ [Accessed April 14th, 2025]

- Explore the use of dynamic ocean management tools for shark conservation (e.g., Coral Sea Commonwealth Marine Reserve).

- Review and compare MPA legal and policy frameworks across countries in the Northeast Pacific and identify opportunities for bilateral or multilateral agreements that support transboundary shark conservation (e.g., for migratory corridors).

- Strengthen MPA monitoring programs (ecological and compliance-focused) to assess and maintain protective measures for sharks.

- Build cross-sector relationships and communication (e.g., with fisheries agencies/ managers), to better evaluate and align spatial and aspatial shark conservation tools over time.

## 4.5 Collaboration

Participants underscored the need for stronger collaboration within and between the three countries. Suggested actions for a potential working group and/or working group members and their associated organizations or agencies included:

- Continue sharing lessons learned via workshops, conferences, and other venues (informal and formal) that bring together shark researchers and MPA managers.

- Establish a digital resource repository (e.g., Google Drive, and/or other) with shark- and MPA- related information from across all three countries.

- Consider creating a public Sharks-MPAs Directory where individuals can self-identify, list areas of expertise, and share contact information. This could be modeled on existing platforms such as the Ocean Legacy Foundation,[11] Sea-Unicorn,[12] GEO-BON[13] members, Kelp Forest Alliance[14] and OceanExpert.[15]

- Design and distribute a survey for MPA practitioners in all three countries to assess data and information needs for designing shark-friendly MPAs or evaluating current protections.

[11] https://dir.oceanlegacy.ca/ [Accessed April 14th, 2025]
[12] https://www.sea-unicorn.com/search-the-network [Accessed April 14th, 2025]
[13] https://members.geobon.org/pages/index [Accessed April 14th, 2025]
[14] https://kelpforestalliance.com/data-community-platform [Accessed April 14th, 2025]
[15] https://oceanexpert.org/ [Accessed April 14th, 2025]

- Identify and promote cross-border training opportunities (e.g., related to tagging, sample collection) to support relationship and capacity building.

- Work to standardize metrics and indicators of MPA effectiveness for shark protection and encourage consistent monitoring methodologies across the region to facilitate regional and seascape-level assessments.

- Consider fostering "sibling MPAs" to facilitate peer learning and shared problem-solving.

- Consider forming and regularly convening smaller thematic sub-working groups focused on specific shark species (e.g., white shark) or management topics (e.g., licensing/ permitting, data sharing and management).

- Increase efforts to engage Indigenous interests, so that Indigenous perspectives and leadership are centered in all collaborative shark efforts.

- Secure funding for a coordinator to lead and support the *Collaborative Sharks-MPAs Working Group*.

- Co-develop funding proposals for national, trinational, and international grants, philanthropic sources, and industry partners.

- Explore synergies with other international shark and megafauna initiatives (e.g., the North American Marine Protected Areas Network (NAMPAN),[16] the IUCN Shark Specialist Group (SSG),[17] and Important Shark and Ray Areas (ISRAs)[18] —see Box 3) and/or other taxa such as whales and turtles (e.g., Whales in a Changing Climate,[19] the Eastern Tropical Pacific Marine Corridor (see Enright et al. 2021), MigraMar[20]).

**Box 3. Important Shark and Ray Areas (ISRAs)**

The ISRA project focuses on identifying critical habitats essential for the conservation of sharks, rays, and chimaeras. ISRAs are not MPAs—they are defined as discrete, three-dimensional portions of habitat that are vital for one or more of these species and have the potential to be managed for conservation purposes. In other words, they are intended to support the design and implementation of protected areas and networks, ensuring the

[16] https://nampan.org/ [Accessed April 14th, 2025]
[17] https://www.iucnssg.org/ [Accessed April 14th, 2025]
[18] https://sharkrayareas.org/ [Accessed April 14th, 2025]
[19] https://farallones.org/whale-climate-workshop-2023/ [Accessed April 14th, 2025]
[20] https://www.migramar.org/en/index.php [Accessed April 14th, 2025]

inclusion of essential shark habitats and biodiversity features into future spatial conservation initiatives.

The ISRA identification process is evidence-driven and biocentric, relying solely on scientific criteria without political influence. Criteria consider the diversity of species, their complex behaviors and ecology, and biological needs. To date, the ISRA initiative has conducted regional expert workshops across various global priority marine regions, resulting in the identification of numerous ISRAs. A regional workshop in the Northeast Pacific is anticipated in the future.

For more information, please see: https://sharkrayareas.org/

# 5 Conclusion

Adaptive, knowledge-based conservation measures are essential to the protection of sharks in the Northeast Pacific and beyond. MPAs are an important management tool—alongside fisheries management measures—to prevent population decline and support recovery. When applied strategically and evaluated rigorously, MPAs can help achieve both shark population and broader socioeconomic outcomes.

A key step in strengthening the design and evaluation of MPAs in the Northeast Pacific for shark conservation is the development of a robust network—or working group—of MPA practitioners, stewards, and shark scientists committed to addressing shared needs. Such a group could act as a research community of practice, encouraging data-sharing and the co-development of research projects. It could also help establish clear pathways or processes for better communication between shark scientists and MPA practitioners and facilitate cross-sector communication with fisheries agencies, other target sectors, and coastal communities.

Importantly, this group could serve as a collective voice for shark conservation-raising awareness of shark species and threats in the Northeast Pacific, as well as the vital ecological, economic, social, and cultural roles that MPAs can play in their protection.

Working together through increased information sharing, collaboration, and partnership will help build relationships and trust, and support the development of consistent and effective spatial conservation strategies across borders—to the benefit of both sharks and people.

# 6 Supporting Literature

Anderson, S.C., J.C. Dunic, E.A. Keppel, A.M. Edwards. 2024. *A data synopsis for British Columbia groundfish: 2023 data update*. Canadian Technical Report of Fisheries and Aquatic Sciences 3641: viii + 262 p. https://doi.org/10.60825/aevx-nb49

Bräutigam, A., M. Callow, I.R. Campbell, M.D. Camhi, A.S. Cornish, N.K. Dulvy, S.V. Fordham, S.L. Fowler, A.R. Hood, C. McClennen, E.L. Reuter, G. Sant, C.A. Simpfendorfer, D.J. Welch. 2015. *Global Priorities for Conserving Sharks and Rays: A 2015–2025 Strategy*. The Global Sharks and Rays Initiative (GSRI).

Davidson, L.N.K. 2012. *Shark sanctuaries: substance or spin?* Science. 338(6114) pp. 1538-1539. https://doi.org/10.1126/science.338.6114.1538

Dedman, S., J.H. Moxley, Y.P. Papastamatiou, M. Braccini, J.E. Caselle, D.D. Chapman, J.C. Cinner, E.M. Dillon, N.K. Dulvy, R.E. Dunn, M. Espinoza, A.R. Harborne, E.S. Harvey, M.R. Heupel, C. Huveneers, N.A.J. Graham, J.T. Ketchum, N.V. Klinard, A.A. Kock, C.G. Lowe, M.A. MacNeil, E.M.P. Madin, D.J. McCauley, M.G. Meekan, A.C. Meier, C.A. Simfendorfer, M.T. Tinker, M. Winton, A.J. Wirsing, M.R. Heithaus. 2024. *Ecological roles and importance of sharks in the Anthropocene Ocean*. Science 385(6708). https://doi.org/10.1126/science.adl2362

Derrick, D.H, J. Cheok, N.K. Dulvy. 2020. *Spatially congruent sites of importance for global shark and ray biodiversity*. PLoS One 15(7). https://doi.org/10.1371/journal.pone.0235559

Dulvy, N.K. 2013. *Super-sized MPAs and the marginalization of species conservation*. Aquatic Conservation—Marine and Freshwater Ecosystems 23: 357 – 362.

Dulvy, N.K., S.L. Fowler, J.A. Musick, R.D. Cavanagh, P.M. Jyne, L.R. Harrison, J.K. Carlson, L.N. Davidson, S.V. Fordham, M.P. Francis, C.M. Pollock, C.A. Simpfendorfer, G.H. Burgess, K.E. Carpenter, L.J. Compagno, D.A. Ebert, C. Gibson, M.R. Heupel, S.R. Livingstone, J.C. Sanciangco, J.D. Stevens, S. Valenti, W.T. White. 2014. *Extinction risk and conservation of the world's sharks and rays*. eLife 3. https://doi.org/10.7554/eLife.00590

Dulvy, N.K., C.A. Simpfendorfer, L.N.K. Davidson, S.V. Fordham, A. Brautigam, G. Sant, D.J. Welch. 2017. *Challenges and priorities in shark and ray conservation*. Current Biology 27(11). https://doi.org/10.1016/j.cub.2017.04.038

Dulvy, N.K, P. Pacoureau, C.L. Rigby, R.A. Pollom, R.W. Jabado, D.A. Ebert, B. Finucci, C.M. Pollock, J. Cheok, D.H. Derrick, K.B. Herman, C.S Sherman, W.J. VanderWright, J.M. Lawson, R.H.L. Walls, J.K. Carlson, P. Charvet, K.K. Bineesh, D. Fernando, G.M. Ralph, J.H. Matsushiba, C. Hilton-Taylor, S.V. Fordham, C.A. Simpfendorfer. 2021. *Overfishing drives over*

*one third of all sharks and rays toward a global extinction crisis*. Current Biology 31(21). https://doi.org/10.1016/j.cub.2021.08.062

Dulvy, N.K., N. Pacoureau, J.H. Matsushiba, H.F. Yan, W.J. VanderWright, C.L. Rigby, B. Finucci, C.S. Sherman, R.W. Jabado, J.K. Carlson, R.A. Pollom, P. Charvet, C.M. Pollock, C. Hlton-Taylor, C.A. Simpfendorfer. 2024. *Ecological erosion and expanding extinction risk of sharks and rays*. Science 386(6726). https://doi.org/10.1126/science.adn1477

Dunn, D.C., A-L Harrison, *et al.* 2019. *The importance of migratory connectivity for global ocean policy*. Proc. R. Soc. B 286: 20191472. http://dx.doi.org/10.1098/rspb.2019.1472

Enright, S.R., R. Meneses-Orellana, I. Keith. 2021. *The Eastern Tropical Pacific Marine Corridor* (CMAR)*: The Emergence of a Voluntary Regional Cooperation Mechanism for the Conservation and Sustainable Use of Marine Biodiversity Within a Fragmented Regional Ocean Governance Landscape*. Front. Mar. Sci. 8:674825. https://doi.org/10.3389/fmars.2021.674825

Espinoza, M., C. Mike, M. Heupel, A. Tobin, C. Simpfendorfer. 2014. *Quantifying shark distribution patterns and species-habitat associations: Implications of marine park zoning*. PLoS ONE 9. https://doi.org.10.1371/journal.pone.0106885

Espinoza, M., M.R. Heupel, A.J. Tobin, C.A. Simpfendorfer. 2015. *Residency patterns and movements of grey reef sharks (Carcharhinus amblyhynchos) in semi-isolated coral reef habitats*. Mar. Biol. 162. 343-358.

Gendall, L., J.C. Nelson, R. Martone, L. Slapcoff, A. Uduman, P. Grant, R. McPhie. 2022. *Megafauna from space: using very high resolution (VHR) satellite imagery to detect whales and sharks*. Canadian Manuscript Report of Fisheries and Aquatic Sciences 3248: x + 50 p.

Indigenous Circle of Experts. 2018. *We Risk Together: Achieving Pathway to Canada Target 1 through the creation of Indigenous Protected and Conserved Areas in the spirit and practice of reconciliation*. 107 pp.

Flowers, K., E.A. Babcock, Y.P. Papastamatious, M.E. Bond. 2022. *Varying reef shark abundance trends inside a marine reserve: evidence of a Caribbean reef shark decline*. Marine Ecology Progress Series 683. https://doi.org/10.3354/meps13954

Grew, M., T.F. Gaston, A.S. Griffin, S.J. Duce, V. Raoult. 2024. *Ray bioturbation rates suggest they shape estuary processes*. Remote Sensing in Ecology and Conservation 11(1). https://doi.org/10.1002/rse2.411

Hall-Arber, M., S. Murray, L. Aylesworth, M. Carr, J. Field, K. Grorud-Colvert, R. Martone, K. Nickols, E. Saarman, S. Wertz. 2021. *Scientific Guidance for California's MPA Decadal Reviews:*

*A Report by the Ocean Protection Council Science Advisory Team Working Group and California Ocean Science Trust*. June 2021.

Heupel, M., C. Simpfendorfer, M. Espinoza, A. Smoothey, A. Tobin, V. Peddemors. 2015. *Conservation challenges of shark with continental scale migrations*. Front. Mar. Sci. 2(1-7). https://doi.org/10.3389/fmars.2015.00012

Hyde, C.A., G.Notarbartolo di Sciara, L. Sorrentino, C. Boyd, B. Finucci, S.L. Fowler, P.M. Kyne, G. Leurs, C.A. Simpfendorfer, M.J. Tetley, F. Womersley, R.W. Jabado. 2022. *Putting sharks in the map: A global standard for improving shark area-based conservation*. Front. Mar. Sci. 9:968853. https://doi.org/10.3389/fmars.2022.968853

IUCN-WCPA Task Force on OECMs. 2019. *Recognizing and reporting other effective area-based conservation measures*. Gland, Switzerland: ICUN.

Jabado, R.W., A.Z.A Morata, R.H. Bennett, B. Finucci, J.R. Ellis, S.L. Fowler, M.I. Grant, A.P. Bardosa Martins, S.L. Sinclair, eds. 2024. *The global status of sharks, rays, and chimaeras*. Gland, Switzerland: IUCN. https://doi.org/10.59216/ssg.gsrsrc.2024

Kanive, P.E., J.J. Rotella, T.K. Chapple, S.D. Anderson, M. Hoyos-Padilla, A.P. Klimley, F. Galvan-Magana, S. Andrzejaczek, B.A. Block, S.J. Jorgensen. 2023. *Connectivity between white shark populations off Central California, USA and Guadalupe Island, Mexico*. Front. Mar. Sci 13(10). https://doi.org/10.3389/fmars.2023.1210969

Larson, S., D. Lowry, N.K. Dulvy, J. Wharton, F. Galván-Magaña, A.B. Sianipar, C.G. Lowe, E.K.M. 2021. *Current and future considerations for shark conservation in the Northeast and Eastern Central Pacific Ocean*. Advances in Marine Biology 90, 1-49. https://doi.org/10.1016/bs.amb.2021.08.003

Leenhardt, P., N.H.N. Low, N. Pascal, F. Micheli, J. Claudet. 2015. *The role of Marine Protected Areas in providing ecosystem services. In: Aquatic Functional Biodiversity – An Ecological and Evolutionary Perspective*. Eds. A. Belgrano, G. Woodard, U. Jacob. pp. 211-239

Lewison, R., A.J. Hobday, S. Maxwell, E. Hazen, J.R. Hartog, D.C. Dunn, D. Briscoe, S. Fossette, C.E. O'Keefe, M. Barnes, M. Abecassis, S. Bograd, N.D. Bethoney, H. Bailey, D. Wiley, S. Andrews, L. Hazen, L.B. Crowder. 2015. *Dynamic ocean management: Identifying the critical ingredients of dynamic approaches to ocean resource management*. BioScience 65(5). https://doi.org/10.1093/biosci/biv018

MacKeracher, T., A. Diedrich, C.A. Simpfendorfer. 2018. *Sharks, rays and marine protected areas: A critical evaluation of current perspectives*. Fish and Fisheries 20(2). https://doi.org/10.1111/faf.12337

McClure, M.M., M.A. Haltuch, E. Willis-Norton, D.D. Huff, E.L. Hazen, L.G. Crozier, M.G. Jacox, M.W. Nelson, K.S. Andrews, L.A.K. Barnett, A.M. Berger, S. Beyer, J. Bizzarro, D. Boughton, J.M. Cope, M. Carr, H. Dewar, E. Dick, E. Dorval, J. Dunham, V. Gertseva, C.M. Greene, R.G. Gustafson, O.S. Hamel, C.J. Harvey, M.J. Henderson, C.E. Jordan, I.C. Kaplan, S.T. Lindley, N.J. Mantua, S.E. Matson, M.H. Monk, P. Moyle, C. Nicol, J. Pohl, R.R. Rykaczewski, J.F. Samhouri, S. Sogard, N. Tolimieri, J. Wallace, C. Wetzel, S.J. Bograd. 2023. *Vulnerability to climate change of managed stocks in the California Current large marine ecosystem*. Front. Mar. Sci. https://doi.org/10.3389/fmars.2023.1103767

Merson, Z.S., E.E. Jahn, M.A. Barnes, E.S. Spurgeon, P.T. Rex, J.T. Elstner, Y.N. Samara Chacon, J.M. Anderson, W.D. Jones, C.G. Lowe. 2025. *eDNA metabarcoding detection of nearshore juvenile white sharks (Carcharodon carcharias) and prey fish communities*. Journal of Experimental Marine Biology and Ecology. 583 (2025) 152084. https://doi.org/10.1016/j.jembe.2025.152084

Nature United. 2023. *Best Practices and Procedures for Operationalizing Marine Protected Area Network Monitoring: Synthesis of Global Insights and Recommendations for British Columbia's Northern Shelf Bioregion*. Report prepared by ReConnect Consulting and ESSA Technologies. 53 pp.

Osgood, G.J., E.R. White, J.K. Baum. 2021. *Effects of climate-change-driven gradual and acute temperature changes on shark and ray species*. Journal of Animal Ecology. 90(11). https://doi.org/10.1111/1365-2656.13560

Palacios D., F. Felix, Y. Montecinos, E. Najera, S. Kelez, J. Samaniego, P. Velásquez, L. Zapata, M. Lancaster, A.S. Friedlaender, C.A. Castro, E. Quintana, C. Bermúdez-Rivas, J.J. Cazas, C. Villamil Echeverri, L. Rojas Bracho, M. Sepúlveda, L. Medrano-Gonzales, L. Santillan, R. Aguila Arakaki, L. Pineda, R. Reisinger, C.M. Johnson. 2023. *Blue Corridor of the Eastern Pacific: Opportunities and Actions for the protection of Migratory Whales.* A Technical Report. Worldwide Fund for Nature (WWF).

Rigby, C.L., C.A. Simpfendorfer, A. Cornish. 2019. *A Practical Guide to Effective Design and Management of MPAs for Sharks and Rays*. WWF, Gland, Switzerland.

Sherman, C.S., M.R. Heupel, S.K. Moore, A. Chin, C.A. Simpfendorfer. 2020. *When sharks are away, rays will play: effects of top predator removal in coral reef ecosystems*. Marine Ecology Progress Series 641. https://doi.org/10.3354/meps13307

Sherman, C.S., G. Sant, C.A. Simpfendorfer, E.D. Digel, P. Zubick, G. Johnson, M. Usher, N.K. Dulvy. 2022. *M-Risk: A framework for assessing global fisheries management efficacy of sharks, rays, and chimaeras*. Fish and Fisheries 2022; 00:1-17. https://doi.org/10.1111/faf.12695

Sherman, C.S., E.D. Digel, P. Zubick, J. Eged, A.B. Haque, J.H. Matsushiba, C.A. Simpfendorfer, G. Sant, N.K. Dulvy. 2023. *High overexploitation risk due to management shortfall in highly traded requiem sharks.* Conservation Letters 2023;16:e12940. https://doi.org/10.1111/conl.12940

Sun, R., K. Liu, W. Huang, X. Wang, H. Zhuang, Z. Wang, Z. Zhang, L. Zhao. 2024. *Global distribution prediction and ecological conservation of basking shark (Cetorhinus maximus) under integrated impacts*. Global Ecology and Conservation 56.

UNEP-WCMC. 2024. *State of the World's Migratory Species*. UNEP-WCMC, Cambridge, United Kingdom.

Wikelski, M., M. Quetting, J. Bates, T. Berger-Wolf, G. Bohrer, L. Borger, T. Chapple, M.C. Crofoot, S.C. Davidson, D.K.N. Dechmann, D. Ellis-Soto, E.R. Ellwood, W. Fiedler, A. Flack, B. Fruth, N. Franconi, R. Worsøe Havmøller, J. Hirt, N.E. Hussey, F. Iannarilli, M. Landwehr, M.E. Muller, T. Mueller, U. Mueller, R.Y. Oliver, J. Partecke, I. Pokrovsky, L. Pokrovskaya, D.R. Rubenstein, C. Rutz, K. Safi, A. Santangeli, O.L. van Schalkwyk, A.M.M. Seueira, S. Sherub, T. Ramesh, P. Viljoen, K.A. Wasik, T.A. Wild, S. Yanco, R. Kays. 2024. *Introducing a unique animal ID and digital life history museum for wildlife metadata*. Methods in Ecology and Evolution 2024; 15: 1777-1788. https://doi.org/10.1111/2041-210X.14407

# 7 Appendices

## 7.1 Appendix I: Sharks – MPAs Participants In-person Workshop

**Table 2. Sharks – MPAs Participants In-person Workshop**

| Name (First, Last) | Affiliation | Country |
|---|---|---|
| Jorge Christian Alva Basurto | Conanp | Mexico |
| Amanda Arnold | Simon Fraser University | Canada |
| Rosalía Ávalos Téllez | Conanp | Mexico |
| Taylor Chapple | Oregon State University, Big Fish Lab | United States |
| Areli Zuleth Cueto Valdivia | Conanp | Mexico |
| Nick Dulvy | Simon Fraser University | Canada |
| Carlos Domínguez Rodríguez | Conanp | Mexico |
| Ryan Freedman | NOAA | United States |
| Cassandra Hartery | Ocean tracking Network | Canada |
| Marisol Hernández Méndez | Conanp | Mexico |
| Lynn Lee | Parks Canada | Canada |
| Ryan Logan | N-PAcT, NOAA | United States |
| Chris Lowe | Cal State University, Long Beach | United States |
| Romney McPhie | Independent | Canada |
| Meaghen McCord | Independent | Canada |
| Dilia Meza Castro | Conanp | Mexico |
| Dan Ovando | IATTC | United States |
| Riley Pollom | Seattle Aquarium | United States |
| Ernesto Israel Popoca Arellano | Conanp | Mexico |
| Alejandro Rendón Correa | Conanp | Mexico |
| Christine Rock | ECCC | Canada |
| Oscar Javier Salazar Méndez | Conanp | Mexico |
| Christine Ward-Paige | eOceans | Canada |
| Chantal Vis | Parks Canada | Canada |

**Members are listed alphabetically by last name.*

## 7.2 Appendix I: Sharks – MPAs Technical Advisory Group Members

**Table 3. Sharks – MPAs Technical Advisory Group Members**

| Name (First, Last) | Affiliation | Country |
|---|---|---|
| Gonzalo Cid | NOAA | United States |
| Ryan Freedman | NOAA | United States |
| Jaime Gonzalez | Conanp | Mexico |
| Marisol Hernandez | Conanp | Mexico |
| Ryan Logan | N-PAcT, NOAA | United States |
| Meaghen McCord | Independent | Canada |
| Romney McPhie | Independent | Canada |
| Ernesto Israel Popoca Arellano | Conanp | Mexico |
| Chantal Vis | Parks Canada | Canada |

**Members are listed alphabetically by last name.*

## 7.3 Appendix III: Agendas

**Table 4. Virtual Workshop Agenda**

| Time (PST) | Description of Activity | Presenter / Moderator |
|---|---|---|
| 9:00–9:03 | Welcoming Remarks | Catherine Boyd Michaud |
| 9:03–9:10 | Introduction and Agenda Overview | Romney McPhie (Facilitator) |
| 9:10–9:55 | Session 1: Sharks in the Northeast Pacific Ocean Region: A Brief Introduction<br><br>*What species of sharks do we have in the Northeast Pacific?*<br><br>*Which shark species might benefit from being considered in MPA planning and management, including a network approach (Canada, United States, Mexico, and beyond)?*<br><br>*Where are they distributed and what habitats are they using?*<br><br>*What threats are they facing?*<br><br>*What field and other research initiatives are underway to understand the distribution, habitat use, spatial movements, and migratory behavior of Northeast Pacific sharks?*<br><br>Presentations (15 min. each):<br><br>Nick Dulvy, Simon Fraser University, Canada<br><br>Taylor Chapple, Oregon State University Big Fish Lab, US<br><br>Oscar Sosa-Nishizaki, Centre for Scientific Research and Higher Education of Ensenada, Mexico | Nick Dulvy, Taylor Chapple, Oscar Sosa-Nishizaki |
| 9:55–10:10 | Q&A | Romney McPhie, Presenters, All |

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|---|---|---|
| 10:10–10:20 | Break | All |
| 10:20–11:10 | Session 2: Sharks and MPAs: Case Studies<br><br>*In your experience, what is the role of MPAs in advancing shark conservation?*<br><br>*How are sharks currently being considered in MPAs (e.g., marine spatial planning, conservation objectives, management plans, management measures)?*<br><br>*How are sharks currently being researched and monitored in the context of MPAs?*<br><br>Presentations (10–12 min. each):<br><br>Ryan Freedman, NOAA Channel Islands National Marine Sanctuary, US Pacific<br><br>Ryan Stanley, DFO East Coast & Robert Lennox, Ocean Tracking Network (OTN), Canada Atlantic<br><br>Dave Wiley, Stellwagen Bank National Marine Sanctuary, US Atlantic<br><br>Ernesto Israel Popoca Arellano, Isla Guadalupe (Guadalupe Island) Biosphere Reserve, Mexico | Ryan Freedman, Ryan Stanley, Robert Lennox, Dave Wiley, Ernesto Israel Popoca Arellano |
| 11:10–11:25 | Q&A/ Panel Discussion<br><br>*Lessons Learned*<br><br>*What are some successes and challenges that MPA managers have encountered related to sharks and MPAs? Specifically, what have been the successes/challenges related to:*<br><br>*Research and monitoring*<br><br>*Management/policy* | Romney McPhie, Panelists, All |

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| | *Permitting, tourism, and shark-human interactions?* | |
| 11:25–11:35 | BREAK | All |
| 11:35–12:05 | Session 3: A Network Approach: Case Studies<br><br>*What is the intersection between Important Shark and Ray Areas (ISRAs) and MPAs?*<br><br>*How is a network (or seascape-level) approach helping in the spatial management and conservation of sharks? (e.g., through data sharing, analysis, corridor identification, communication)*<br><br>Presentations (10 min. each):<br><br>Ryan Logan, Northeast Pacific Acoustic Telemetry (N-PAcT)<br><br>Carlos Julio Polo Silva and Tito Navia, Save the Blue Five<br><br>Rima Jabado/ Emiliano Garcia-Rodriguez, Important Shark and Ray Areas (ISRAs) | Ryan Logan, Carlos Julio Polo Silva, Tito Navia, Rima Jabado |
| 12:05–12:35 | Q&A/ Final Discussion<br><br>*How can spatial management measures and collaborations across boundaries and borders help conserve sharks more effectively?*<br><br>*What are the roadblocks (e.g., research, management and policy-related) that you have encountered when it comes to establishing and implementing transboundary MPA networks? How might these be overcome?* | Romney McPhie, Panelists, All |
| 12:35–12:45 | Closing | Romney McPhie |

**Table 5. In-person workshop agenda**

| | | |
|---|---|---|
| DAY 1: February 4th | | |
| INTRODUCTIONS & ICEBREAKER<br>Objectives:<br>Meet/get to know each other<br>Orientation to the workshop (Day 1 & Day 2) | | |
| 9:00–9:30 AM<br>½ hour | Welcome/ Orientation to the Workshop<br>Welcome from the CEC<br>Overview of agenda (Day 1 and Day 2)<br>What are we hoping to achieve together? | Catherine Boyd Michaud<br>Romney McPhie |
| 9:30–10:00 AM | Icebreaker/ 1-on-1 Introductions<br>Quadrat Exercise | All<br>Romney McPhie (Facilitation) |
| VISIONING/INTRODUCTION TO COLLABORATIVE WORK<br>Objectives:<br>Set the stage for workshop discussions by reflecting on:<br>Where do we want to be by 2030?<br>MPAs & Sharks: By 2030, what role do MPAs play in the conservation and protection of sharks?<br>Collaboration: By 2030, how might a broad-scale collaboration support our vision for MPAs and sharks? | | |
| 10:00–10:15 AM | Introduction | Romney McPhie |
| 10:15–10:45 AM | Introduction to collaborative work ("food for thought")<br>Presentation (15 min., 15 min. Q&A/buffer)<br>Example of an emerging broad-scale working group where merger/ synergies might be possible<br>Pacific Whale Collaborative – process followed for establishment, goals, key outcomes/actions | Presenter:<br>Sarah Hutto (virtual) (with in-person support from Chantal Vis) |

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| 10:45–11:00 AM | Reflection period/sticky notes<br>Where do we want to be by 2030?<br>*These thoughts will be revisited during the Collaborative discussions (Day 2) | All |
| 11:00–11:10 AM | Break<br>Coffee/tea/snacks provided | All |
| KNOWLEDGE<br>Objectives:<br>Continue knowledge sharing amongst MPA managers/practitioners and shark researchers<br>Discuss species' prioritization for research and spatial management<br>Discuss how current MPA protections may or may not benefit sharks and identify opportunities to strengthen protections<br>In the virtual workshop, we heard:<br>"Protect the species that need protecting"<br>Endemics<br>Threatened species<br>Species with a large geographic range (more EEZs, greater extinction risk) | | |
| 11:10–11:20 AM | Introduction | Romney McPhie |
| 11:20 AM–12:20 PM | SHARKS (Research and Monitoring Needs) – Breakouts (by country)<br>Introductions (10 min., within breakouts)<br>Discussion:<br>Do we have enough recent information on shark species to know which species we should be protecting through spatial management measures? (i.e., which species/life stages would benefit most)<br>What research/monitoring is underway and where?<br>If we don't have enough information, what information do we need to collect? | All |

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| | What are some key research and monitoring needs/studies? (to help us build baseline datasets)<br>In addition to tagging, what are some non-invasive research methods being used to build understanding of sharks?<br>With the information/knowledge we do have:<br>Are there priority species for spatial management?<br>Are there "indicator" species that should be protected?<br>**Using large printed maps of each country to rough sketch research (underway/ gaps), ideas (etc.)* | |
| 12:20–1:20 PM | Lunch<br>Catered lunch provided | All |
| 1:25–2:40 PM | Plenary<br>Report back: Bringing maps and thoughts together across border (15 min. per country, 20 min. discussion) | All<br>Romney McPhie (Facilitation) |
| 2:40–3:00 PM | Example of emerging research/data-sharing network<br>Presentation (approx. 10 min., 10 min. Q&A/buffer)<br>Northeast Pacific Acoustic Telemetry Node (N-PAcT) (https://npact.aoos.org/) — goals/objectives of the Node, current & desired locations of receivers, opportunities/challenges (e.g., connecting with MPA managers/practitioners, data management/sharing) | Presenter:<br>Ryan Logan (in-person) |
| 3:00–3:10 PM | Break<br>Coffee/tea/snacks provided | All |
| 3:00–4:00 PM | SHARKS (Research and Monitoring Needs) (Cont.) – Breakouts (by country)<br>Focused Discussions (approx. 30 min. each):<br>Or Data Management & Sharing<br>What are some best practices/ processes related to data management & sharing?<br>What are some privacy concerns? | All |

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| | When should data be "open"?<br>What data should be open immediately?<br>Building Connection/Collaboration b/w Researchers & Managers/Decision-Makers<br>How can we build direct data "pipelines" to managers/decision-makers? Are there middle steps necessary (e.g., data analysis/interpretation), and if so, how can we ensure managers/decision-makers are receiving the information they need?<br>What might some processes or tools be to build greater connection b/w researchers and managers?<br>Are there any tools/case studies to learn from? | |
| 4:00–4:10 PM | Break (*if necessary) | All |
| 4:10–5:30 PM | Plenary<br>Report back: Bringing thoughts together across borders (15 min. per country, 20 min. discussion)<br>Based on the breakout group discussions today, are there preliminary thoughts on needs/strategies/actions that could be addressed collaboratively? | All<br>Romney McPhie (Facilitation) |
| 5:30–5:45 PM | Day 1 Wrap-Up Exercise | All<br>Romney McPhie (Facilitation) |
| DAY 2: February 5th | | |
| KNOWLEDGE (Cont.) | | |
| 8:45–9:00 AM | Arrivals | All |
| 9:00–9:15 AM | Introduction | Romney McPhie |

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| 9:15–9:25 AM | Reflection Exercise (Day 1) | All<br>Romney McPhie (Facilitation) |
| 9:25–10:55 AM | MPAs – Breakouts (by country)<br>Introductions (within breakouts, where necessary)<br>What protections are already in place, spatially? (Overview)<br>Where are the existing "MPAs" coastwide in the Northeast Pacific? What do (or might) they offer shark species in terms of habitat?<br>What (if anything) are these MPAs trying to achieve when it comes to sharks?<br>Are sharks included explicitly in conservation measures? (Examples)<br>What levels of protection are they afforded? (e.g., from fishing and other threats)<br>Are existing MPAs in the Northeast Pacific benefitting sharks?<br>How might existing MPA conservation measures (e.g., for whales or other species/habitats) benefit sharks?<br>Are MPA managers/practitioners working alongside stock assessors to ensure spatial and aspatial protections are maximizing protection?<br>Where are there management gaps, including communication gaps (e.g., across agencies, b/w researchers and managers)?<br>What information do MPA managers/practitioners need from researchers (or others, such as stock assessors) to better understand:<br>Whether their MPAs should include explicit protections for sharks?<br>What protections should be included?<br>**Using large, printed maps of each country to rough sketch MPAs, ideas (etc.)* | All |
| 10:55–11:05 AM | Break<br>Coffee/tea/snacks provided | All |

| | | |
|---|---|---|
| 11:05 AM–12:25 PM | Plenary<br>Report back: Bringing maps and thoughts together across borders (15 min. per country, 20 min. discussion)<br>Based on the breakout group discussion today, are there preliminary thoughts on needs/strategies/actions that could be addressed collaboratively? | All<br>Romney McPhie (Facilitation) |
| 12:25 AM–1:30 PM | Lunch | All |
| 1:35–2:00 PM<br>25 min | Snapshot: Socioeconomic considerations<br>Presentation (Approx. 10 min., 15 min. Q&A/buffer)<br>Permitting/ licensing & lessons learned from tourism in Greater Farallones National Marine Sanctuary<br>**A recognition that while this workshop is focusing on other topics, socio-economic issues are significant when it comes to sharks/MPAs and should be explored further (e.g., through future collaborative work)*<br>**Note that there will be a "boat dock" for issues that attendees would like to explore further* | Presenter: Max Delaney (virtual) |
| COLLABORATION<br>Returning to our "visions" for collaboration (from Day 1):<br>Objectives:<br>Discuss:<br>What might a collaborative transboundary working group achieve?<br>Are there synergies/ efficiencies with existing/ emerging networks or working groups?<br>Begin developing some potential tangible actions for a collaborative sharks-MPAs working group, and defining next steps to get "there" (to greater collaboration) | | |
| 2:00–2:10 PM | Introduction<br>Summary/presentation of some of the ideas from the "reflection/ sticky note" exercise from Day 1<br>Vision for/ purpose of a broad-scale collaboration | Romney McPhie |

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|---|---|---|
| 2:10–3:10 PM | Towards a collaborative network – Breakouts (by country)<br>Prompt questions for discussion:<br>What might some high-level goals of a "collaborative shark-MPA network or working group" be?<br>Are there any existing formal or informal international agreements related to broad-scale networks/ corridors of MPAs?<br>Are there potential synergies/efficiencies with existing/ emerging networks or working groups?<br>How can we ensure Indigenous representation & gender equity in future collaborations?<br>How can we ensure lasting relationships/partnerships (irrespective of political agendas)?<br>How might we secure funding to support continued collaboration? | All |
| 3:10–3:25 PM | Break | All |
| 3:25–4:55 PM | Plenary<br>Report back (15 min. per country)<br>Discussion (45 min.)<br>Bringing it all together! What are some key recommendations/ actions (low-hanging fruit) a working group or working groups members/ organizations might take? *In addition to the ones discussed already in the workshop<br>Knowledge/Information needs<br>Protective measures<br>Communication<br>Collaboration | All<br>Romney McPhie (Facilitation) |
| 4:55–5:10 PM | Takeaways/ Wrap-Up Exercise | All<br>Romney McPhie (Facilitation) |
| 5:10–5:20 PM | Next Steps/ Closing Remarks | Catherine Boyd Michaud |

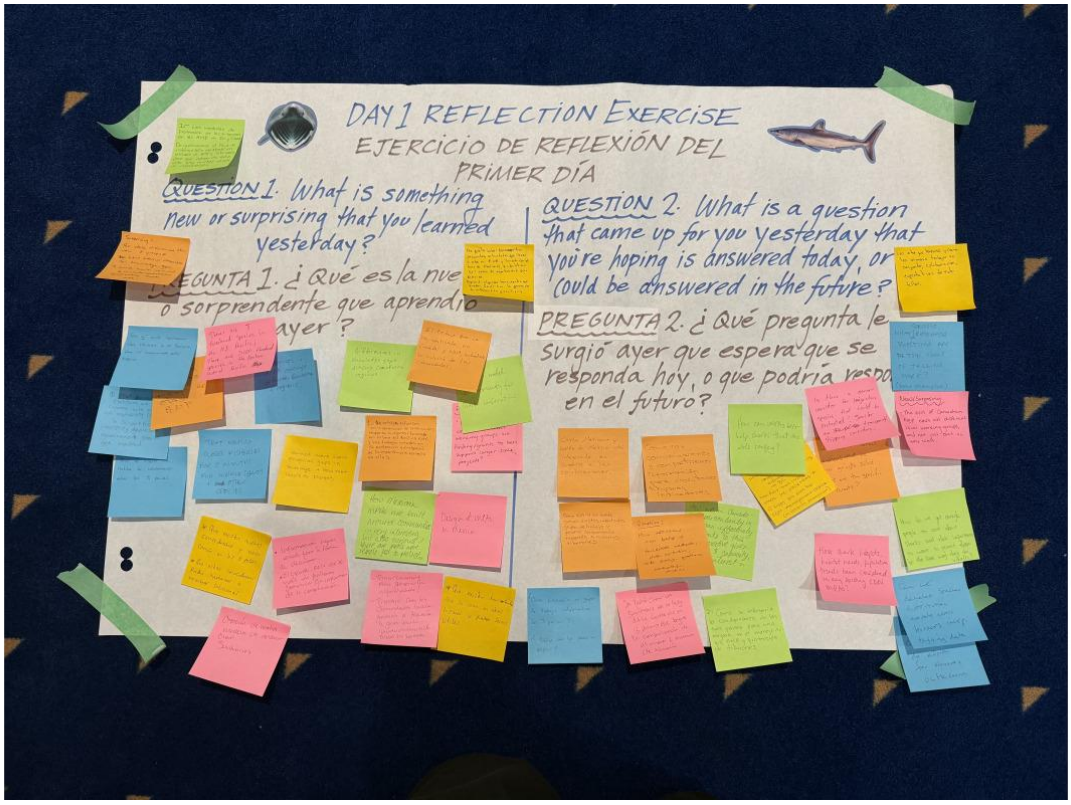
## 7.4 Appendix IV: Tools and Other Resources

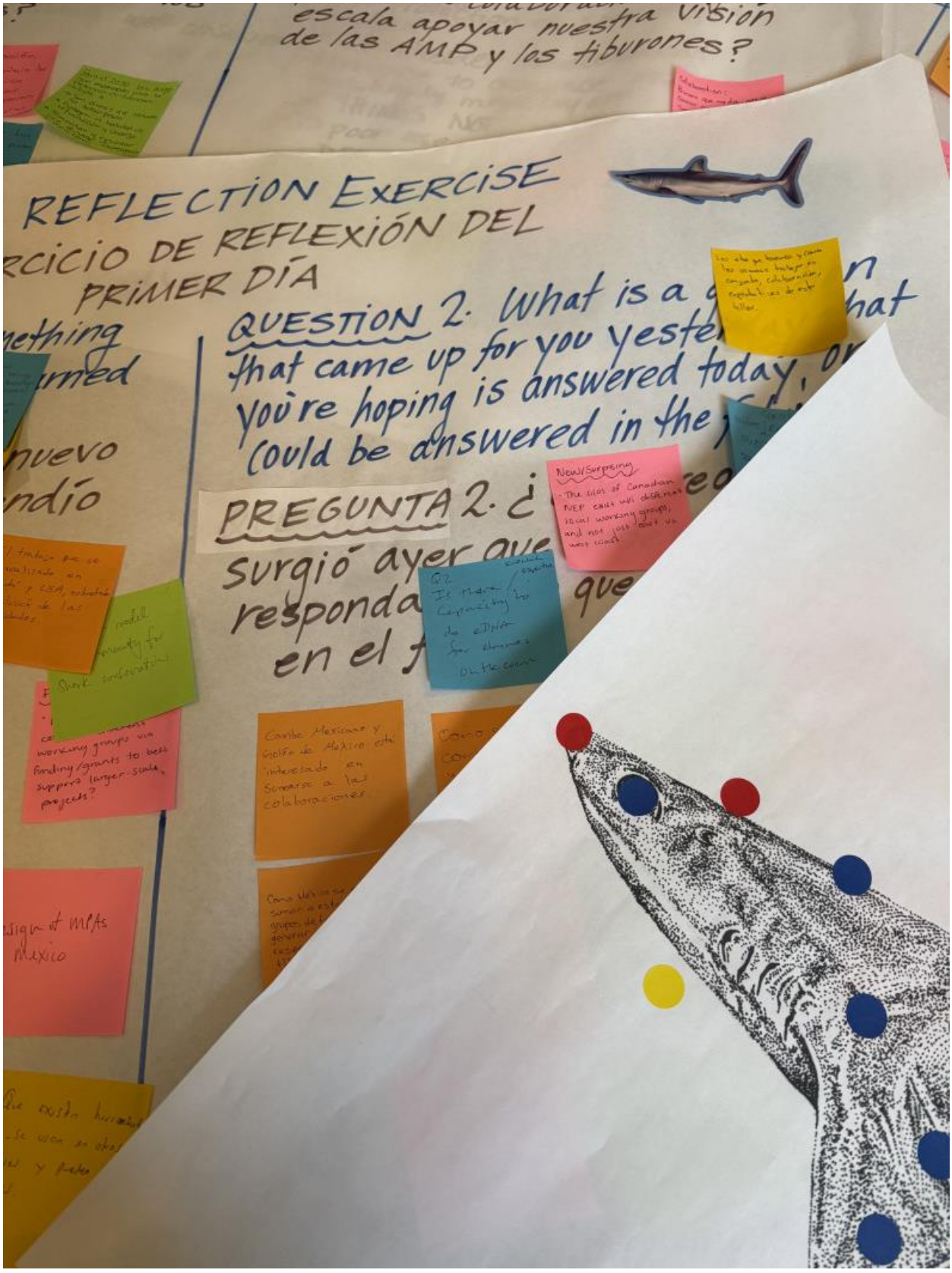
The following tools and other web-based resources were mentioned and/or discussed during the workshop series.

**Table 6. Shark- and/or MPA-related tools and resources**

| Tools and Resources | |
|---|---|
| Angel Shark Conservation Network | https://angelsharknetwork.com/ |
| Commission for Environmental Cooperation (CEC) | http://www.cec.org/ |
| CEC Enhancing Co-Benefits of Marine Protected Areas (MPAs) Project | http://www.cec.org/enhancing-co-benefits-of-marine-protected-areas/ |
| eOceans | https://www.eoceans.org/ |
| Global Fishing Watch Marine Manager | https://globalfishingwatch.org/marine-manager-portal/ |
| Global Shark, Ray, and Chimaera Species Richness GitHub | https://nickdulvy.github.io/SharkReassessment/ |
| Important Shark and Ray Area (ISRAs) | https://sharkrayareas.org/ |
| International Union for the Conservation of Nature (IUCN) Species Survival Commission (SSC) Shark Specialist Group (SSG) | https://www.iucnssg.org/ |
| IUCN Red List of Threatened Species | https://www.iucnredlist.org/ |
| Marine Protection Atlas | https://mpatlas.org/ |
| MigraMar | https://www.migramar.org/en/index |
| Movebank | https://www.movebank.org/cms/movebank-main |
| North American Marine Protected Area Network (NAMPAN) | http://nampan.org/ |
| Northeast Pacific Acoustic Telemetry (N-PAcT) Node | https://npact.aoos.org/ |
| Ocean Tracking Network (OTN) | https://oceantrackingnetwork.org/ |
| Protecting Whale in a Changing Climate (Workshops) | https://farallones.noaa.gov/eco/whales/protecting-whales.html<br>https://farallones.org/whale-climate-workshop-2023/ |
| Save the Blue Five | https://savethebluefive.net/formacion/biblioteca |
| Sharkipedia | https://www.sharkipedia.org/ |
| Shark Trust – Great Egg Case Hunt | https://www.sharktrust.org/greateggcasehunt |

## 7.5 Appendix V: Workshop Photos


DAY 1 REFLECTION EXERCISE
EJERCICIO DE REFLEXIÓN DEL PRIMER DÍA
QUESTION 1. What is something new or surprising that you learned yesterday?
QUESTION 2. What is a question that came up for you yesterday that you're hoping is answered today, or could be answered in the future?
PREGUNTA 2. ¿Qué pregunta le surgió ayer que espera que se responda hoy, o que podría


escala apoyar nuestra visión
de las AMP y los tiburones?
REFLECTION EXERCISE
ercicio de reflexión del
PRIMER DÍA
QUESTION 2. What is a
that came up for you yeste
you're hoping is answered today, o
could be answered in the
PREGUNTA 2. ¿
surgió ayer que
responda
en el
New/Surprising
working groups via
finding/grants to best
support larger-scale
projects?
Caribe Mexicano y
Golfo de México está
interesado en
Sumarse a las
colaboraciones