



MigraMar

Science for the conservation of migratory
marine species in the Eastern Pacific

About this book

The purpose of this document is to provide information about the important work carried out by the MigraMar network for the conservation of migratory marine species in the Eastern Pacific. We are happy for it to be disseminated and encourage any persons or institutions possibly interested in collaborating with MigraMar, participating in studies, or in financing some of the projects carried out by the organization, to contact our representatives.

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Index

MigraMar

History and foundation

Programs

2

The Eastern Tropical Pacific

The heart of MigraMar

Exceptional places

Key species and their conservation status

4

Threats and protection

Threats to key species

Protection inside marine reserves

Beyond protected areas

The Eastern Tropical Pacific Marine Corridor

6

Research strategy

Aquatic biotelemetry

Tagging in numbers

8

Connected ecosystems

Hammerhead sharks

Silky sharks

Whale sharks

Green sea turtles

Leatherback turtles

10

Present and future of MigraMar

Application of MigraMar studies

In the near future

16

History and Foundation

MigraMar was founded in 2006 as a network of scientists dedicated to research and conservation of migratory marine species in the Eastern Pacific. Its goal is to implement effective plans for management and conservation that are in keeping with the nature of these creatures.

Mission

To research and provide the necessary technical advice for the conservation of the migratory marine species of the Eastern Pacific.

Vision

To provide migratory marine species of the Eastern Pacific with a threat-free environment to guarantee the health of their populations over time.

The founding members of MigraMar focused their research on the Eastern Tropical Pacific. However, owing to the migratory nature of the species researched, the network has evolved, extending its limits and signing agreements and arrangements with researchers from countries such as Mexico, Peru and the United States.

MigraMar is made up of researchers belonging to universities, government agencies and non-profit organizations in different parts of the American continent. The network's success lies in the values held by its members: respect, excellence, integrity, transparency and a commitment to education. Since 2017, MigraMar is a legally incorporated NGO in California.

Mexico

Costa Rica

Panama

Colombia

Ecuador

Programs

Among the species studied by MigraMar, there are sharks, sea turtles, whales and other migratory species. The growing threats to which many of these species are subjected make it imperative for us to understand the consequences that population declines or even extinction could have both on marine ecosystems as well as on the human activities that depend on them.

Therefore, as well as providing information referring to the migratory patterns of these species, MigraMar is a source of scientific information which will permit the assessment and prediction of the state of their populations in the future and an increase in our knowledge of the function they carry out in the marine ecosystem. To do this MigraMar divides its work into three areas of interest:



Research

Research in conservation biology, specifically in marine protected areas and their importance for the conservation of migratory species, and identification of regional migratory patterns and population assessments.



Policy advice

Technical advice for national, regional and international institutions dedicated to marine resource management, with the aim of establishing a common working framework and to facilitate mutual understanding.



Capacity building

Creation and support of technical and research skills in migratory marine species research in Latin America by means of student dissertation supervision, technical workshops and other educational activities.

The Eastern Tropical Pacific

The heart of MigraMar

The Eastern Tropical Pacific is the oceanic region that stretches from the Gulf of California to Ecuador. The influence of different warm and cold ocean currents on the Equatorial area has resulted in an unusual co-existence of tropical, warm and cold-water species.

Additionally, cold water upwelling from the ocean depths carries a large quantity of nutrients up to the surface, giving rise to high productivity zones in the region of the Galapagos archipelago in particular.

Exceptional places

These conditions are responsible for the high abundance of endemic, native and migratory species in the region. Given their exceptional universal value, high levels of biodiversity and unique and irreplaceable marine ecosystems, seven groups of islands are catalogued here as World Heritage Sites by UNESCO.

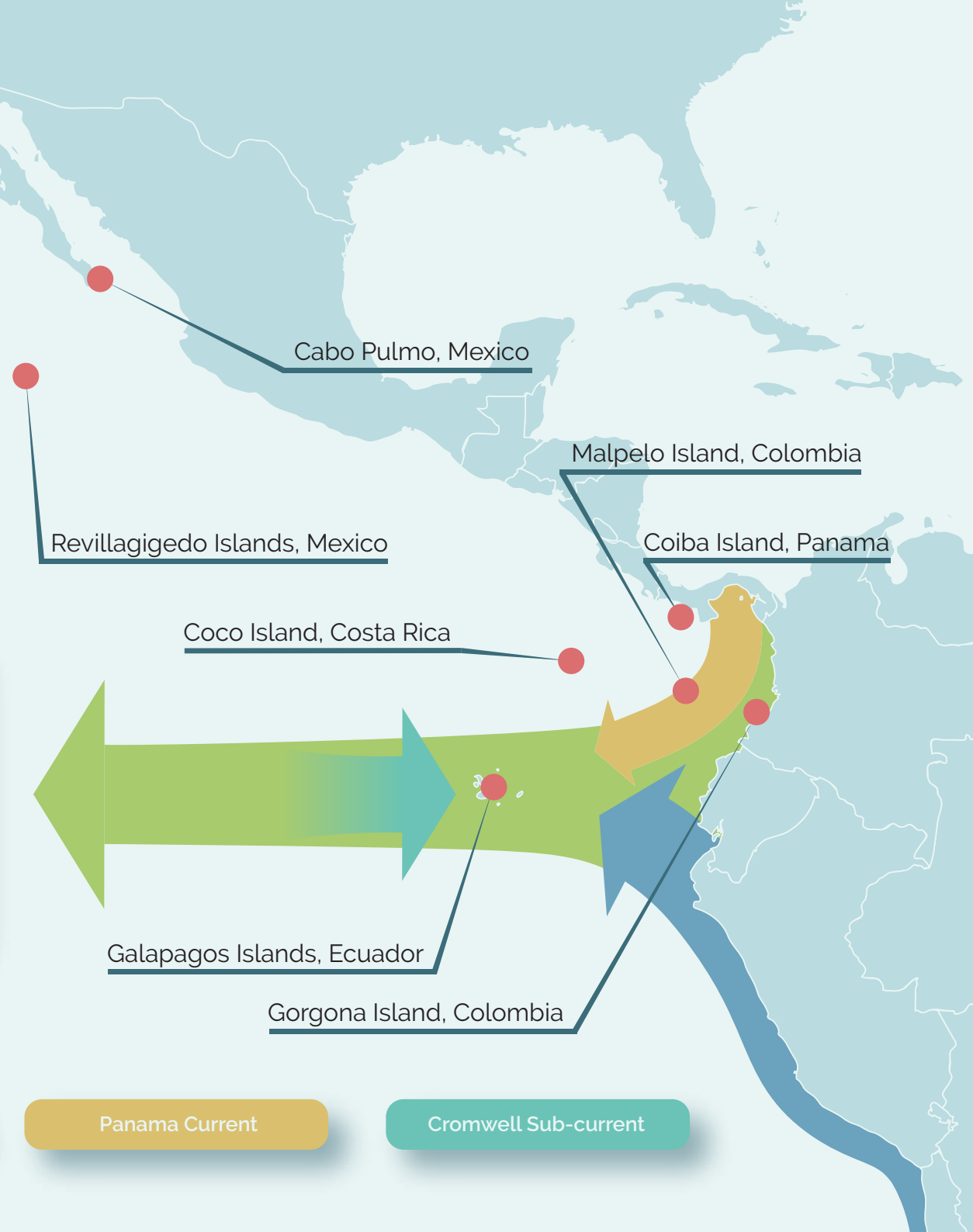
● World Heritage, UNESCO 2016.

South Equatorial Current

Humboldt Current

Panama Current

Cromwell Sub-current



Key species and their conservation status

Among the migratory species that inhabit these waters, there are a number of intense commercial interest, such as tuna, which are of great importance as food and to the economy. However, we can also find other non-commercial species. MigraMar studies focus on over 20 species, including:

All these species usually carry out migrations, either for feeding, breeding or for their different life stage needs. Unfortunately they are not free of threats, even though many of them are protected under international agreements and treaties.

Critically Endangered

Endangered

Vulnerable

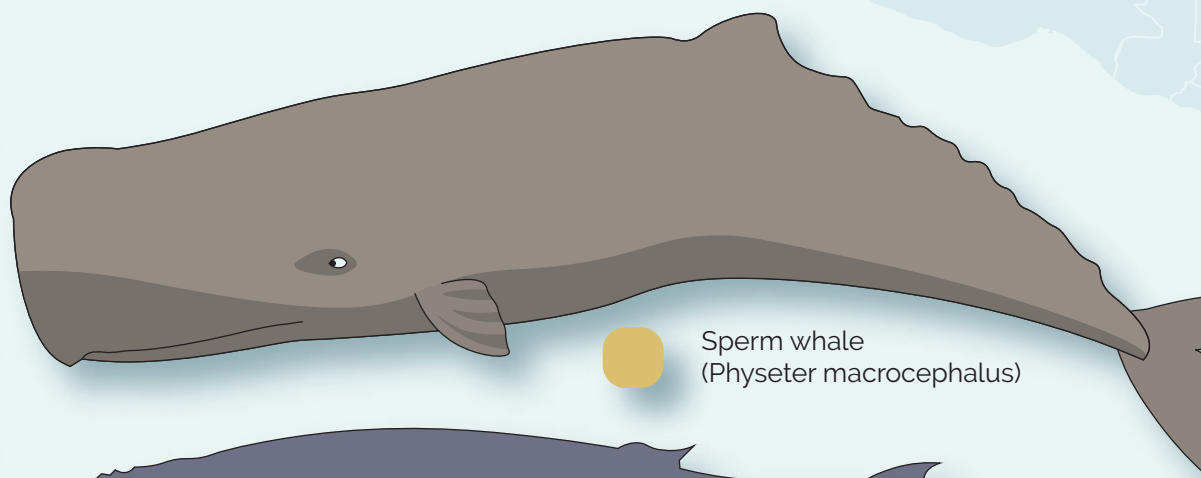
Near Threatened

Least Concern

Not Evaluated

Data Deficient

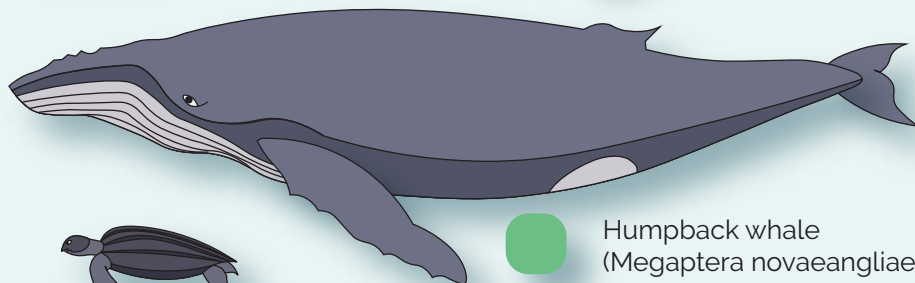
Conservation status according to the International Union for Nature Conservation (IUCN, 2016)



Sperm whale
(*Physeter macrocephalus*)



Orca
(*Orcinus orca*)



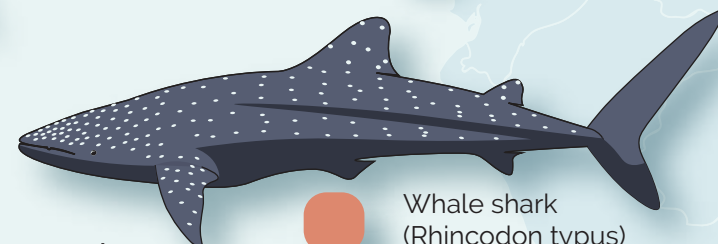
Humpback whale
(*Megaptera novaeangliae*)



Hammerhead shark
(*Sphyrna lewini*)



Leatherback turtle - Eastern Pacific population
(*Dermochelys coriacea*)



Whale shark
(*Rhincodon typus*)



Hawksbill sea turtle
(*Eretmochelys imbricata*)



Green sea turtle
(*Chelonia mydas*)



Short ocean sunfish
(*Mola ramsayi*)



Silky shark
(*Carcharhinus falciformis*)

Threats and protection

Threats to key species

Human activity, such as fishing, is the greatest direct threat to the migratory marine species in this region of the ocean. However, there are other threats that affect them indirectly and that are generally of anthropogenic origin.

Fishing

Overfishing

A low rate of reproduction and late sexual maturity make some species very vulnerable to overfishing.

By-catch

Species are caught unintentionally when they become entangled in fishing gear, such as nets and lines, used to catch commercial species.

Artisanal fishing

Sometimes, due to cultural traditions, local communities hold rights to catch endangered species.

Habitat degradation

Pollution

The dumping of plastics and waste is one of the major causes of the deterioration of marine ecosystems.

Loss of breeding areas

Urban development contributes to the disappearance of beaches and mangroves which are used as nesting and breeding sites for turtles, sharks and other fish.

Invasive species

The arrival of species from other ecosystems very often displaces the native species of an area.

Climate change

Redistribution of species

Changes in water temperature may cause changes in the geographical distribution of different species.

Influence of El Niño

This atmospheric phenomenon has its origin in the Pacific area and its effects are especially noticeable in this region.

Migration routes

Changes in oceanic currents may alter the migration patterns of different species, as well as availability of food (prey).

Illegal actions

Finning

Cutting the fins off live sharks in order to sell them on the Asian market is one of the major threats.

Poaching

Taking turtle eggs for food makes recovery of these populations more difficult.

Illegal fishing

The difficulties involved in the control of a marine reserve make it easy for some fishermen to illegally enter protected areas to catch fish.

Protection inside marine reserves

In the Eastern Pacific there are various marine reserves, which offer protection to marine life within their boundaries. The function of these reserves is vital to the conservation of endangered marine fauna and to the maintenance of the extraordinary value of World Heritage Sites.

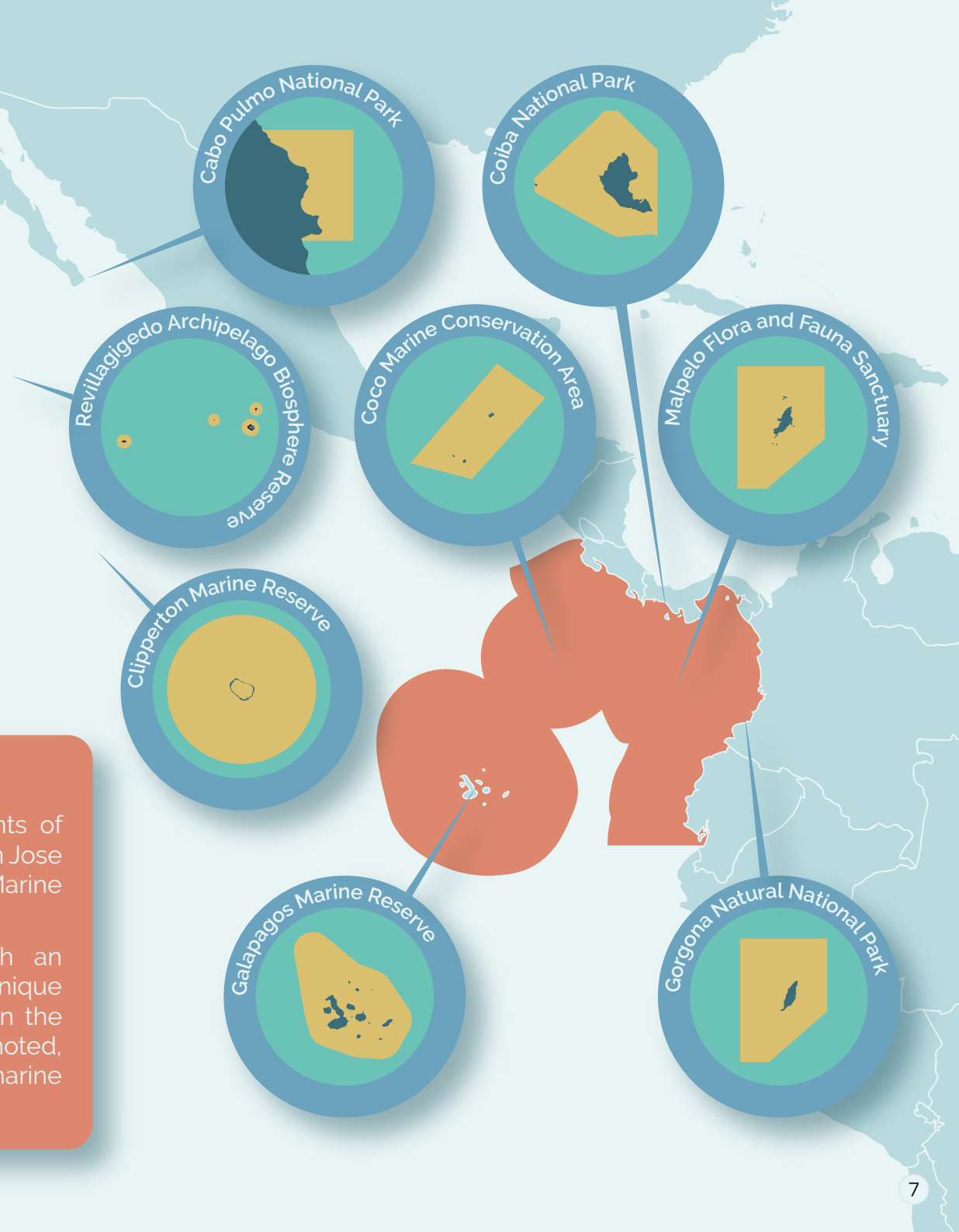
Beyond protected areas

However, marine reserves are not enough to protect migratory species. These species range over huge areas, covering large distances and often move beyond the boundaries of marine reserves. This exposes them to a range of threats.

The Eastern Tropical Pacific Marine Corridor

In order to solve this problem, in 2004 the governments of Ecuador, Colombia, Costa Rica and Panama signed the San Jose Declaration and created the Eastern Tropical Pacific Marine Corridor, or CMAR.

The purpose of the Marine Corridor is to establish an international framework for the joint conservation of the unique ecosystems and exceptional biodiversity of the region. In the Marine Corridor, sustainable economic activities are promoted, along with scientific collaboration and conservation of marine species.



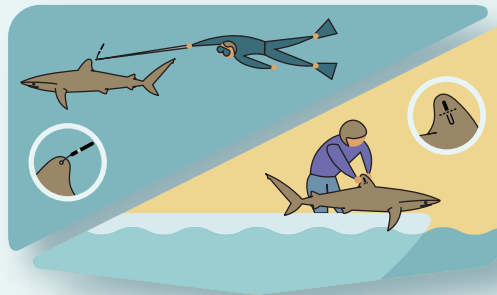
Research strategy

Aquatic biotelemetry

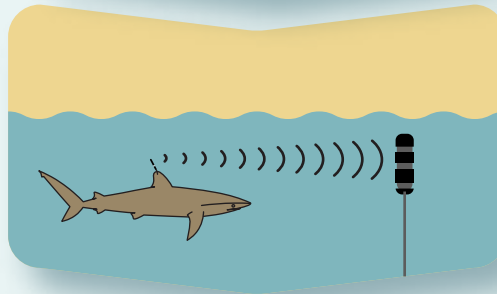
In order to study the migratory patterns of pelagic species, MigraMar uses two types of technology.

Acoustic tracking

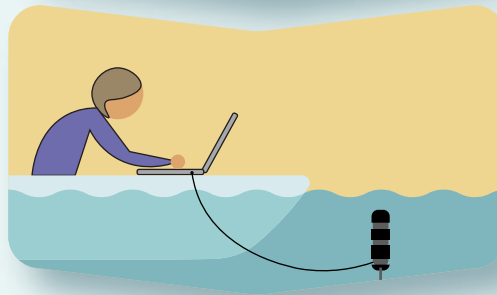
Tags fitted externally on free animals, or internally on captured animals.



Signaling and recording of signals by acoustic receivers fixed on the sea bed.

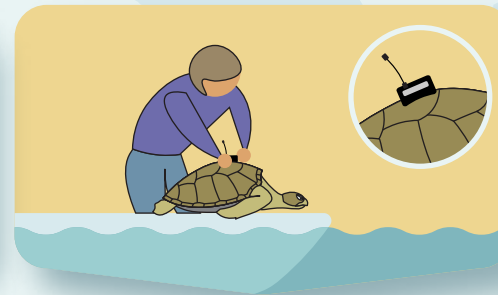


Geo-referenced data collection by the MigraMar science team.

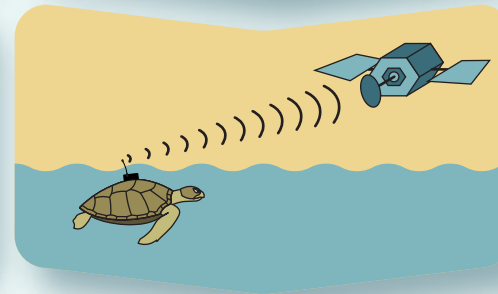


Satellite tracking

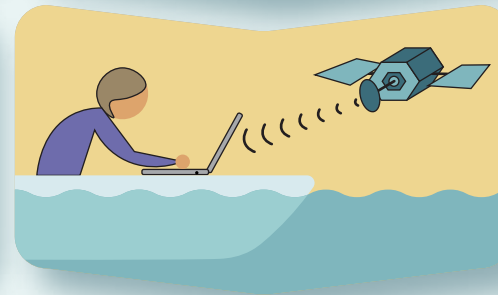
Tags fitted externally on both free and captured animals.



Signaling and recording of signals by ARGOS satellites when the animal nears the surface.



Transmission of geo-referenced data to the MigraMar science team.

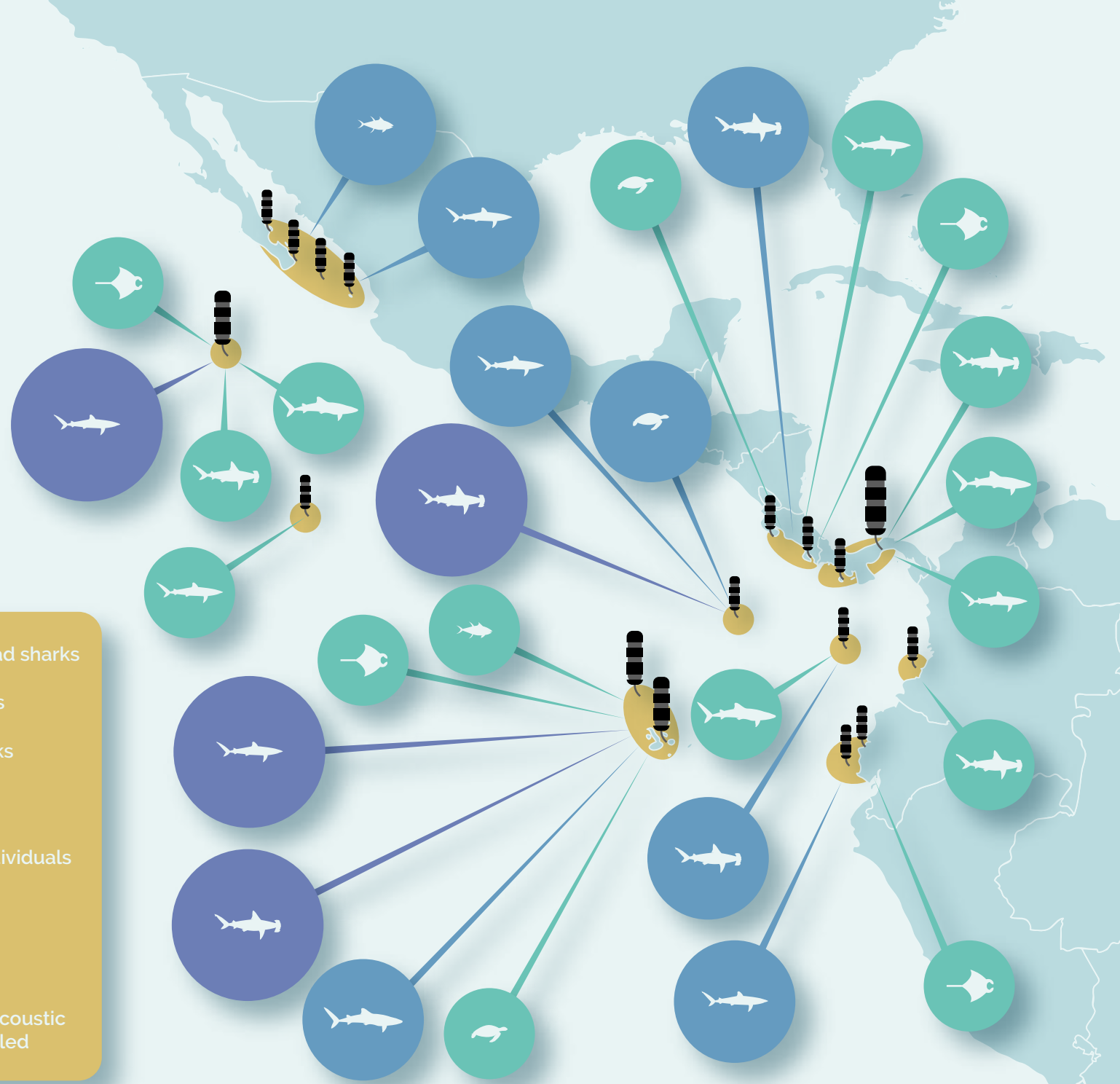
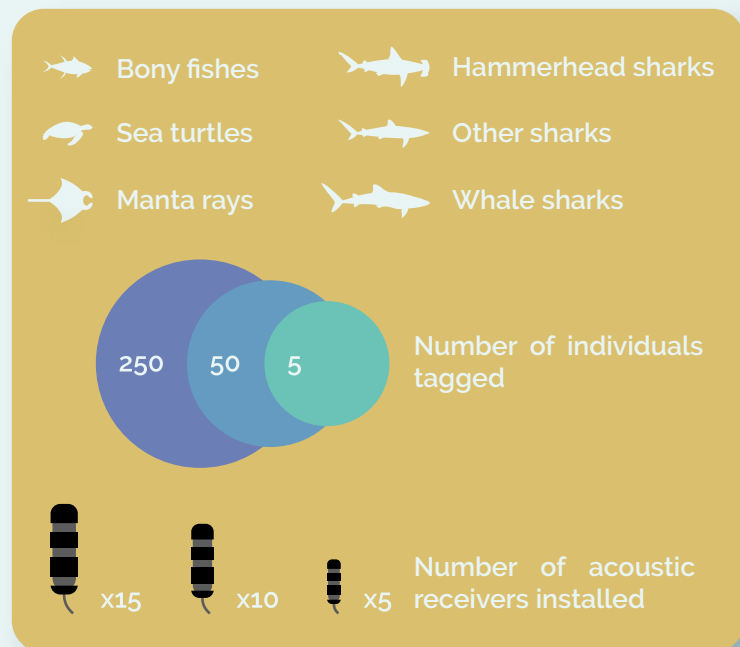


This information is used subsequently to create key habitat maps and migration routes, and to generate hypotheses regarding factors related to the biology and ecology of each species.

Tagging in numbers

During its first decade of work, MigraMar has successfully tagged over a thousand individuals of different migratory species in the Eastern Pacific with both acoustic and satellite tags.

Furthermore, around 100 receivers of acoustic signals have been installed, thus creating a network that stretches the length and breadth of the Marine Corridor, which will facilitate the continued study of these species.

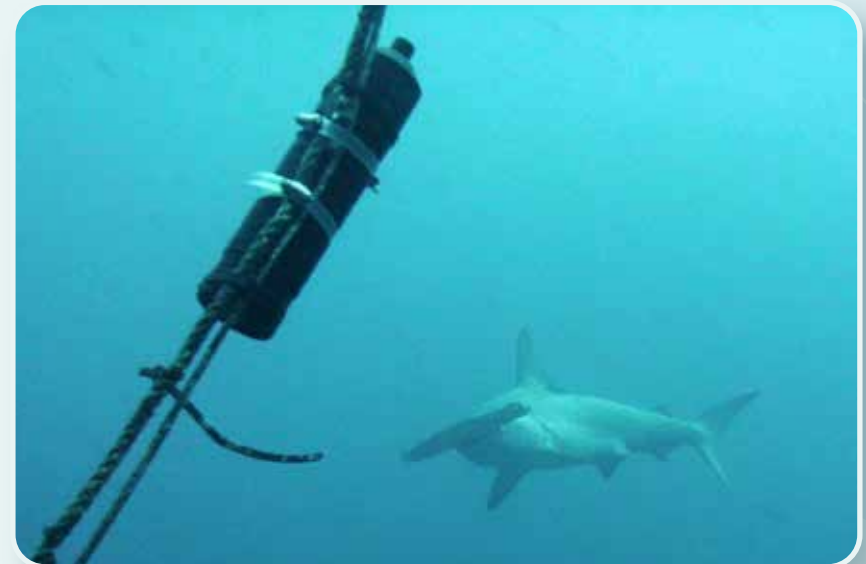


Connected ecosystem

Through analysis of the biotelemetry data, MigraMar has shown repeatedly that the Marine Corridor is ecologically connected. Thus, many migratory species frequently move between the different archipelagos and islands, and even far beyond the limits of the Corridor.

Some of these movements are related to feeding or territorial behaviors, others are linked to the different life stages of each species, and the reasons for many other movements are still unknown.

In the following pages, we highlight some of the results and conclusions from our tracking studies.



Hammerhead sharks

Aggregation sites

The islands of Darwin and Wolf in the Galapagos archipelago, Coco Island and Malpelo Island have all been identified as aggregation sites for this species for a large part of the year. In these places it is common to see schools of hundreds of hammerhead sharks, mostly adult females, near the coasts during the daytime. These sharks generally disperse at night to feed on squid in open water areas.

Migration between islands in the Galapagos archipelago

There is frequent movement between the islands of Darwin and Wolf located in the north of the archipelago, and intensive use of the open waters around them, extending even to an area of underwater seamounts outside the limits of the Galapagos Marine Reserve. At certain times of year, some sharks make short journeys back and forth to Roca Redonda, in the west of the archipelago.

Connectivity between the Galapagos Islands, Coco Island and Malpelo Island

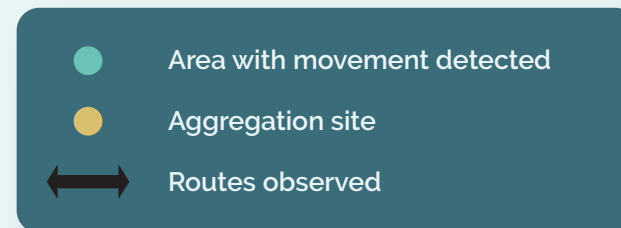
In March, 2007, two female hammerhead sharks were recorded simultaneously at Coco Island 14 days after last being recorded off Darwin Island, where they were first tagged. They were both detected briefly, and after a month one of them returned to Darwin. A shark tagged at Malpelo Island travelled to Coco Island and then on to Galapagos, where it stayed close to Darwin and Wolf over several months. In total, 11 movements of hammerhead sharks have been detected between the three marine reserves. MigraMar is working to establish the movement patterns between these areas and the large juvenile areas off the coasts of Panama and Costa Rica.



Coco Island, Costa Rica

Malpelo Island, Colombia

Darwin and Wolf, Galapagos Islands, Ecuador



Connected ecosystem

Silky sharks

Residence

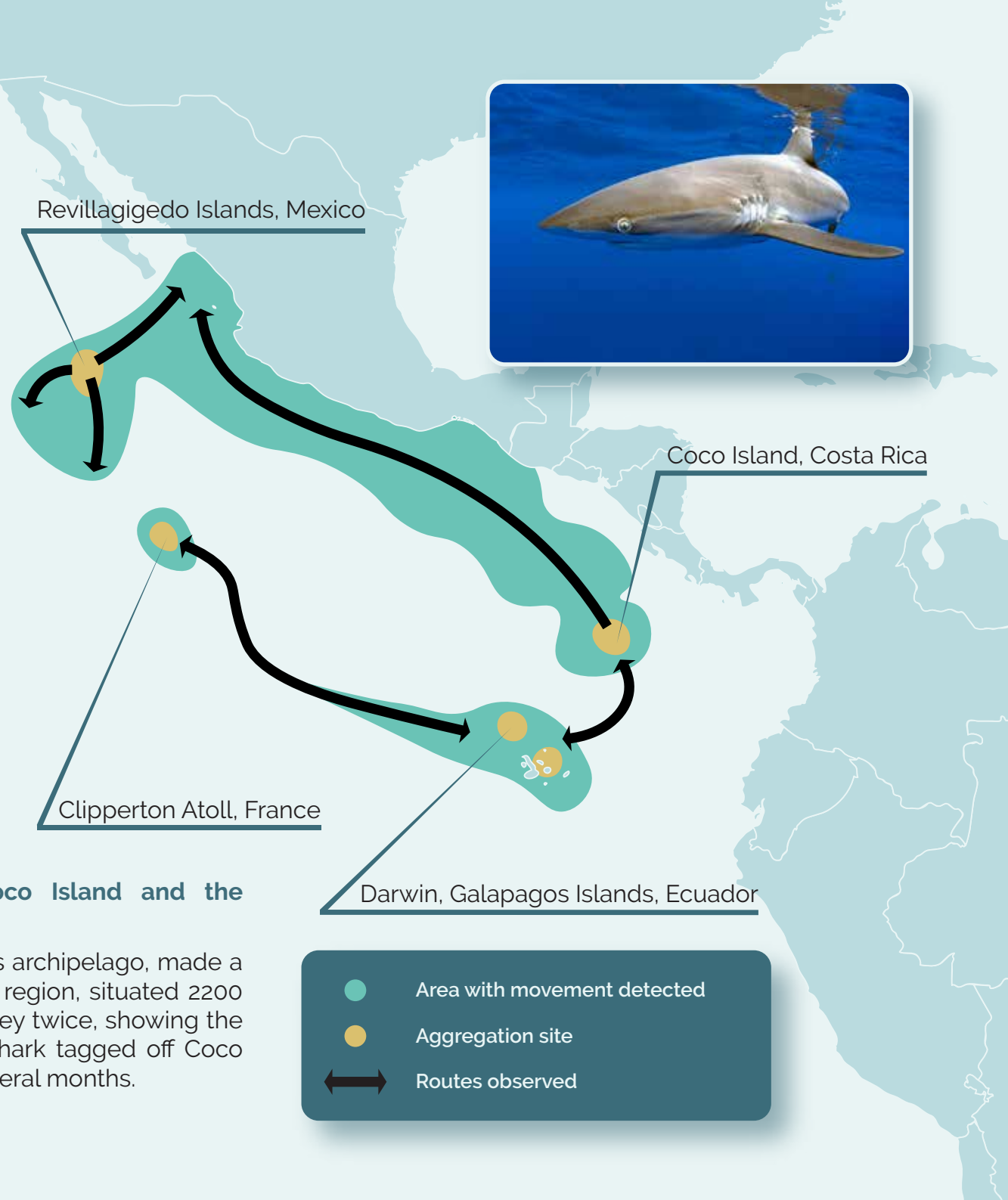
This species is traditionally considered as an open ocean nomad. It is particularly vulnerable to fishing, as it is linked to the Fish Aggregating Devices (FADs) used by the tuna fleet, and therefore it is one of the species most affected by by-catch. However, individuals tagged in the Galapagos Islands have shown periods of residence of over three years, in some cases staying close to the same island, in others using the entire marine reserve. Similar patterns have been recorded in the Revillagigedo Islands, with periods of residence of several months, at Roca Partida as well as Socorro Island and San Benedicto.

Long-distance migrations

In spite of the residential behavior of several sharks, some individuals move over large distances from Coco Island, the Revillagigedo Islands and the Galapagos Islands, moving along the edge of the Central American continental platform.

Connectivity between the Galapagos Islands, Coco Island and the Clipperton Atoll

A silky shark tagged off Darwin Island, in the Galapagos archipelago, made a return journey to Clipperton, the only coral atoll in the region, situated 2200 kilometers away. The same shark made the same journey twice, showing the acute navigational skill of this species. Another silky shark tagged off Coco Island migrated to Darwin Island, where it stayed for several months.



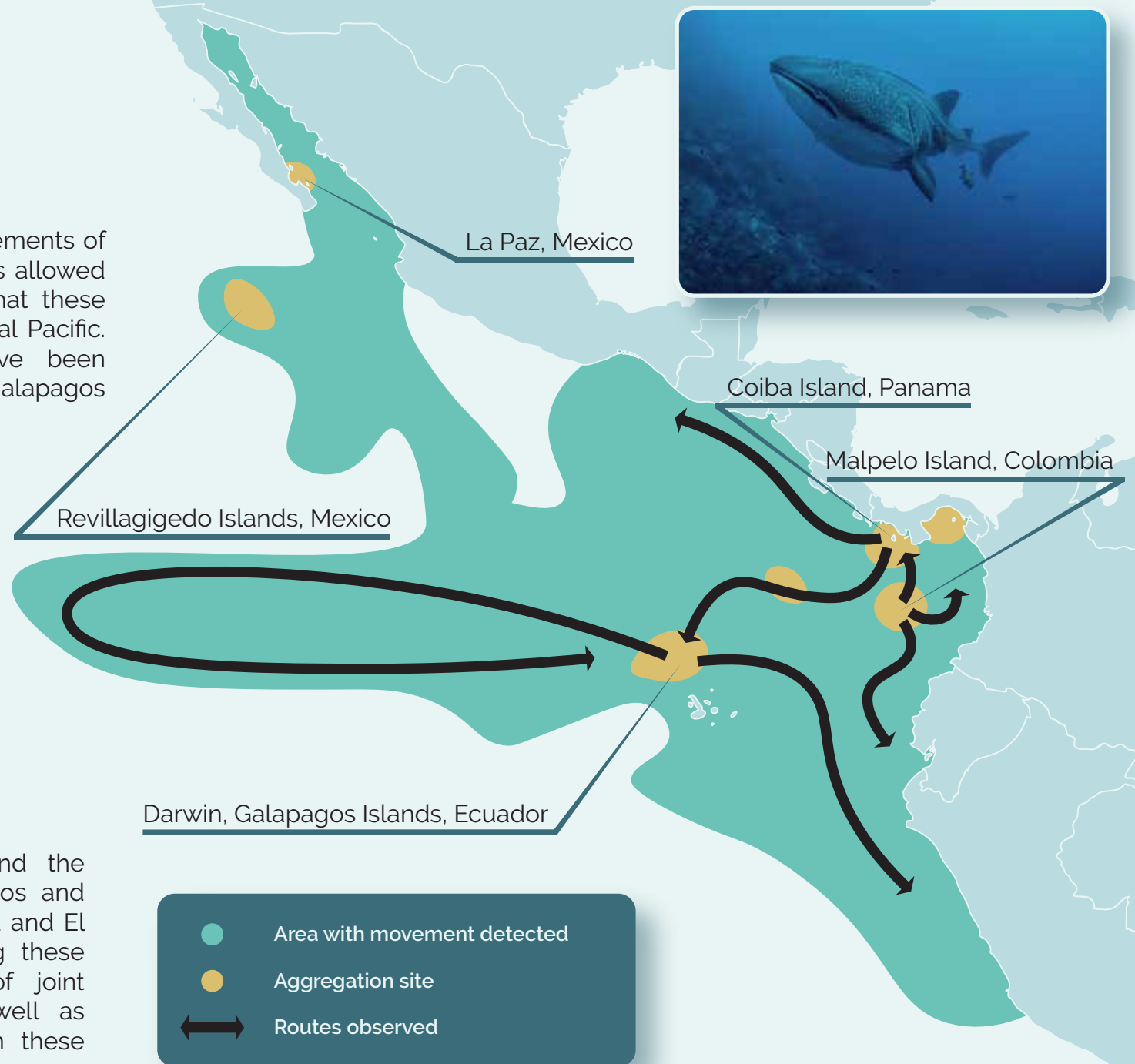
Whale sharks

Great migrations

MigraMar has been recording the movements of these ocean giants since 2011. This has allowed us to map out the great migration that these sharks undertake in the Eastern Tropical Pacific. Specifically, movement patterns have been identified from Coiba Island, the Galapagos Archipelago and Malpelo Island.

Whale sharks of both sexes and all sizes disperse from their aggregation sites in Malpelo and Coiba. However, Galapagos receives the visit of a very specific sector of the population. Each year, between July and October, over 600 apparently pregnant female whale sharks, migrate past Darwin to the Equatorial Front, over 1500 kilometers west of Galapagos, and then return to the coasts of Ecuador and the north of Peru.

The movements of this species, and the connectivity shown between Galapagos and Peru, and between Panama, Nicaragua and El Salvador, highlight the need to bring these countries into the regional view of joint management of these waters, as well as incorporate groups of scientists from these countries into the MigraMar network.



Connected ecosystem

Green sea turtles

Connectivity between Coco Island and the Galapagos Islands

The ecological connection that exists between Coco Island and the Galapagos archipelago is well-known and has been documented on several occasions. Among these the case of Sanjay, the green sea turtle, stands out. In 2014 this turtle was tagged off Coco Island and 14 days later it was recorded in the waters of the Galapagos Marine Reserve.

In a similar fashion, this connection has been demonstrated by biologists from Costa Rica by means of analysis of genetic material extracted from turtles present in both island areas. They concluded that there was over 90% genetic coincidence among them. Furthermore, in view of the low numbers of green sea turtles that nest on Coco Island, the results suggest that most green sea turtles present in the waters around this island come from the Galapagos archipelago.

Connectivity between Coco Island and Malpelo Island

In addition to this, green sea turtles tagged with ultrasonic transmitters at Coco Island have been detected by acoustic receivers set up around Malpelo Island, Colombia. With this information, once again the existence of movement of green sea turtles is confirmed between the three groups of islands.



Coco Island, Costa Rica

Malpelo Island, Colombia

Galapagos Islands, Ecuador

● Area with movement detected

● Aggregation site

↔ Routes observed

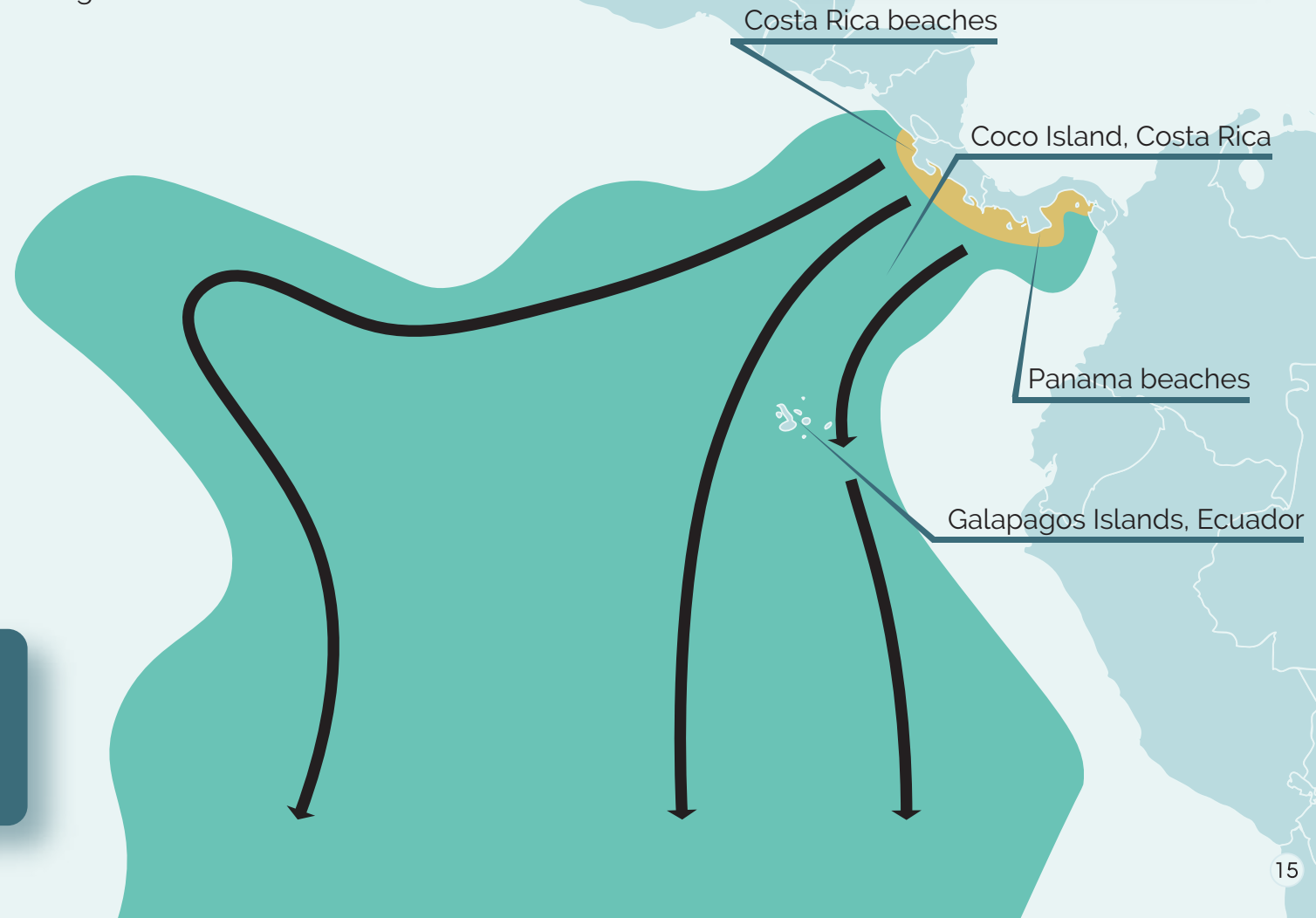
Leatherback turtles

Movement between Coco Island, the Galapagos archipelago, Costa Rica and Panama.

The Eastern Pacific population of leatherback turtles has experienced a catastrophic decline of up to 95% in recent years. In this region, this species has its main nesting sites located on the beaches of Costa Rica and Panama.

Through tagging individuals in nesting sites, MigraMar has been able to identify hundreds of movement patterns, which indicate the connection existing between the continental regions of Costa Rica and Panama, Coco Island and the Galapagos archipelago, in what could be a corridor used by this species.

Furthermore, it has become possible to verify the lengthy journeys undertaken by leatherback turtles, reaching latitudes of 40° south, over 5000 kilometers from their nesting sites.



● Area with movement detected

● Aggregation site

↔ Routes observed

Present and Future of MigraMar

Application of MigraMar studies

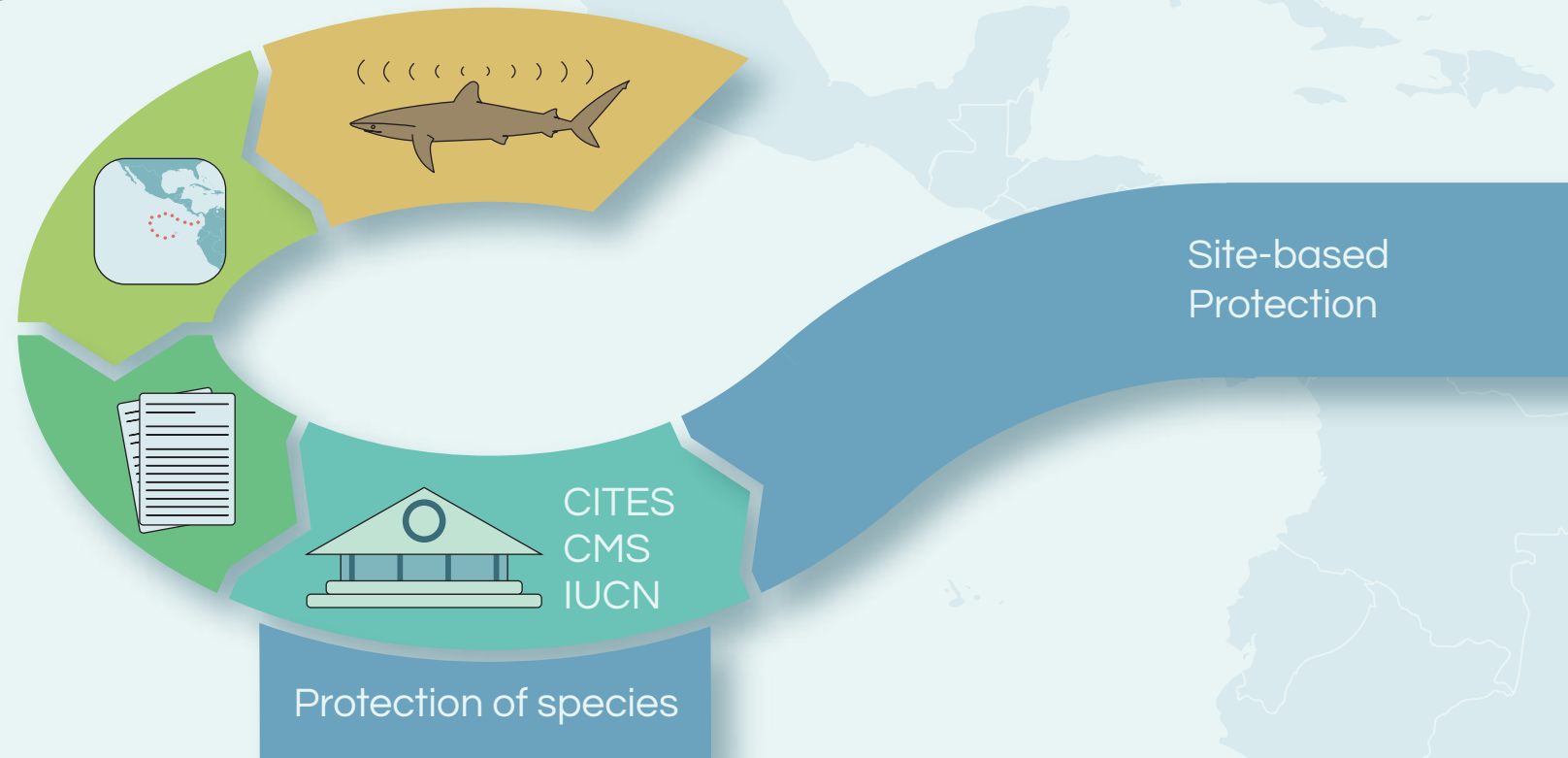
At present, the information obtained by MigraMar is used to feed into different organizations aimed at the conservation of migratory marine species in the Eastern Tropical Pacific.

First, species are tagged and geo-referenced data is gathered.

The data is analyzed and new information is generated.

The information is interpreted and becomes new knowledge.

The knowledge is used to advise governments directly or to participate in international forums.



Inclusion of the hammerhead shark and the silky shark in Appendix II of CMS.

Ban on shark fishing in Colombia.

Inclusion of the whale shark as an Endangered species on the Red List of Endangered Species, IUCN.

Support for National and Regional Action Plans for sharks.

Inclusion of manta rays and mobulas in CITES and CMS.

Inclusion of the hammerhead shark and silky shark in Appendix II of CITES.



Temporal fishing closures in the Gulf of Nicoya.

Declaration of the Revillagigedo Islands as a UNESCO World Heritage Site.

Presidential decree in Panama for the protection of whale sharks.

Creation of No-Take Areas in open waters off the Coiba Ridge.

Extension of the Coco Island Marine Conservation Area.

Declaration of Malpelo Island as a UNESCO World Heritage Site.

Setting up new marine zoning in the Galapagos Marine Reserve.

Protection of turtle nesting sites in Ecuador.

In the near future, MigraMar is committed to ...

Improving collaborative research and policy advice for the management of trans-boundary marine species.

Using spatial information to create and expand Marine Protected Areas in the Eastern Pacific.

Being the prime scientific reference for the study and conservation of migratory species.

Seeking funding to move forward in the development of its strategic plan.

Acknowledgements

The members of MigraMar would like to offer special thanks to Zdenka Piskulich, Pamela Castillo and Heiner Acevedo, from *Costa Rica por Siempre*, for their unconditional support during this process.

The consolidation of MigraMar would not have been possible without the generous support of The Leona M. and Harry B. Helmsley Charitable Trust, provided via the PACIFICO network and its Coordinator, Carlos Chacón.

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