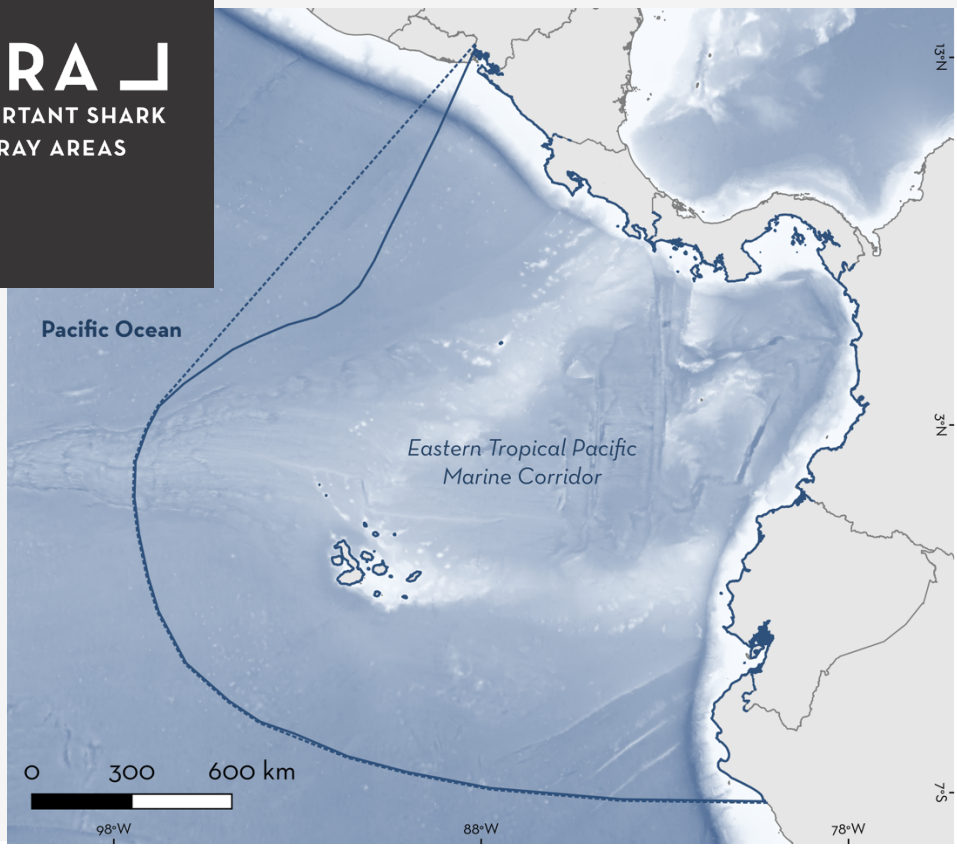
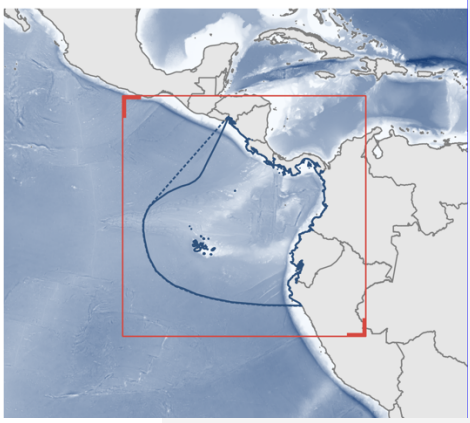
ISRA
IMPORTANT SHARK AND RAY AREAS





Blue lines indicate the area meeting the ISRA Criteria; dashed lines indicate the suggested buffer for use in the development of appropriate place-based conservation measures

EASTERN TROPICAL PACIFIC MARINE CORRIDOR ISRA

Central and South American Pacific Region

SUMMARY

The Eastern Tropical Pacific Marine Corridor covers a large area of the south-central Eastern Tropical Pacific Ocean. This area encompasses the exclusive economic zones of Costa Rica, Panama, Colombia, Nicaragua, Honduras, and Ecuador, along with part of northern Peru and extends seaward into Areas beyond national jurisdiction (ABNJ). This area contains five World Heritage Sites, four Biosphere Reserves, multiple protected areas, Ecologically or Biologically Significant Marine Areas (EBSA), and Wetlands of International Importance (Ramsar sites). This area includes several warm and cold-water habitat types, from coastal to pelagic, benthic, seamounts, and abyssal plains, with the area structurally connected via three underwater ridges. Within this area there are: **threatened species** (e.g., Pelagic Thresher *Alopias pelagicus*); **reproductive areas** (e.g., Scalloped Hammerhead *Sphyrna lewini*); **feeding areas** (e.g., Tiger Shark *Galeocerdo cuvier*); and areas important for **movement** (e.g., Silky Shark *Carcharhinus falciformis*).

CRITERIA

Criterion A – Vulnerability; Sub-criterion C1 – Reproductive Areas; Sub-criterion C2 – Feeding Areas; Sub-criterion C4 – Movement

HONDURAS
NICARAGUA
COSTA RICA
PANAMA
COLOMBIA
ECUADOR
PERU
ABNJ

0–1,928 metres

3,191,603 km²

DESCRIPTION OF HABITAT

The Eastern Tropical Pacific Marine Corridor covers a large area of the south-central Eastern Tropical Pacific Ocean. This area encompasses the exclusive economic zones of Costa Rica, Panama, Colombia, Nicaragua, Honduras, and Ecuador, along with part of northern Peru and extends seaward into international waters (i.e., Areas Beyond National Jurisdiction [ABNJ]). The area lies principally on the Cocos Plate and Nazca Plate and has an average regional depth of ~ 3,500 m. The shallower zones (0–200 m) are mostly found on the continental shelf of Central and South America. The area is structurally connected via: (1) the Cocos Ridge, that originates in the coast of Costa Rica and connects it with Cocos Island and the Galápagos Islands; (2) the Carnegie Ridge, that connects Galápagos with coastal Ecuador; and (3) the Coiba Ridge, that connects Coiba Island with Malpelo Island via the Yuruparí and Malpelo Ridges (Peñaherrera-Palma et al. 2018). Along these ridges there are several coastal and oceanic seamounts that host important aggregations of shark species (Cambra et al. 2021).

This area is located between two subtropical gyres (Kessler 2006), with the central region characterised by warm waters with annual average temperatures above 27.5°C. To the south, the Humboldt Current limits the tropical range of this area with cold, saline water that comes from the Antarctic and upwellings off the coasts of Peru and Chile. In the central part of the area, the Panama Current washes the Central American coasts and northern South America with warm, low-salinity water, that then spins toward the Equatorial zone (Amador et al. 2016).

Four upwelling processes are found within or at the extent of the Eastern Tropical Pacific Marine Corridor. These fuel exceptionally productive and distinctive ecosystems across the region: (1) the Humboldt Current brings nutrient rich cold waters from the coasts of Peru north-westwards and washes the southern limit of the area along the Equator year-round (Fiedler & Lavín 2017); (2) the Galápagos primary upwelling increases the primary productivity mainly to the west of Isabela and Fernandina Islands, and along with the Humboldt Current, boosts the productivity of the Equatorial Front towards the west along the Equator (Karnauskas at al. 2007); (3) the seasonal upwelling of the Panama Gulf increases the productivity of the Panama and Colombian coasts from January to April (Rodríguez-Rubio et al. 2007); and (4) the seasonal upwelling of the Costa Rica Thermal Dome increases the productivity off the Nicaraguan and Costa Rican coasts from January to April (Fiedler & Lavín 2017).

The confluence of marine surface currents (such as the Humboldt, Panama, and Equatorial Currents), in interaction with these four upwelling processes creates a unique oceanographic setting that favours several types of warm and cold-water habitats (Fiedler & Lavín 2017) and allows the area to host some of the most functionally diverse ecosystems in the world (Stuart-Smith et al. 2013).

This Important Shark and Ray Area is delineated from inshore and surface waters (0 m) to a depth of 1,928 m based on the maximum known depth range of the Qualifying Species.

ISRA CRITERIA

CRITERION A – VULNERABILITY

Six Qualifying Species considered threatened with extinction according to the IUCN Red List of Threatened Species™ regularly occur in this area. Threatened sharks comprise one Critically Endangered species, two Endangered species, and two Vulnerable species; threatened rays comprise one Endangered species (IUCN 2022).

SUB-CRITERION C1 – REPRODUCTIVE AREAS

The Eastern Tropical Pacific Marine Corridor is an important reproductive area for one shark species. Areas have been identified based on data consisting of high abundance of Scalloped Hammerhead neonates and young-of-the-year through scientific monitoring studies or fishery-dependent surveys. Most often, these reproductive areas are found in shallow inshore waters. Reproductive areas and potential nursery grounds have been confirmed in Colombia (Estupiñán-Montaño et al. 2021a, 2021b), Costa Rica (Arauz et al. 2008; Mongeon et al. 2013; Zanella et al. 2012, 2016, 2019; Zanella & López-Garro 2015), Ecuador (Espinoza et al. 2021; Chiriboga-Paredes et al. 2022), Nicaragua (Bejarano Álvarez 2007), and Panama (Vega et al. 2023; YN Rodríguez-Arriatti et al. unpubl. data 2022).

SUB-CRITERION C2 – FEEDING AREAS

The Eastern Tropical Pacific Marine Corridor is an important feeding area for three shark and one ray species. Evidence comes from a variety of observational (visual and video) and dietary studies (stomach content and stable isotopes analyses) of these migratory species.

Tiger Sharks have been recorded feeding near turtle nesting beaches in the Galápagos Islands, Ecuador, with isotopic data confirming turtles comprise a large proportion of the diet of resident individuals (Acuña-Marrero et al. 2017; Salinas-de-León et al. 2019).

Whale Sharks have been reported feeding in Colombia (Melany Villate obs. pers. 2022; Fundación MarAdentro unpubl. data 2022), Costa Rica (Pacheco-Polanco et al. 2015), Ecuador (Ryan et al. 2017), Peru (Maguiño et al. 2016), and Panama (Guzmán et al. 2022). In many cases, feeding occurs predictably in areas with seasonally high productivity. For example, from June to October within the Pacific Equatorial Front (Ryan et al. 2017; Guzmán et al. 2022), and during the austral spring and summer off northern coastal Peru within the Northern Humboldt Current System (Maguiño et al. 2016, 2019), where Whale Shark presence increases at high chlorophyll-a and sea surface temperature values (Gonzalez-Pestana et al. 2020).

Oceanic Manta Rays have been observed feeding in surface waters in Ecuador (Burgess 2017; Guerrero & Hearn 2017) and Costa Rica (Pacheco-Polanco et al. 2015), and isotopic analyses in Ecuador have identified dietary intake of mesopelagic origin during nocturnal foraging (Burgess et al. 2016, 2018). Moreover, fishery bycatch data show increased captures are linked to coastal and seasonal upwelling systems (coastal Peru, Galápagos, and Costa Rica Thermal Dome) where waters contain rich dietary resources (Lezama-Ochoa et al. 2019).

In Colombia, Scalloped Hammerhead have been determined as feeding in the area through isotopic studies, highlighting ontogenetic dietary shifts from coastal to oceanic, then back to coastal food sources (Estupiñán-Montaño 2021a, 2021b).

SUB-CRITERION C4 – MOVEMENT

The Eastern Tropical Pacific Marine Corridor is recognised as a migratory pathway and is used by seven shark species for predictable movement and migrations, e.g., connecting productive offshore feeding grounds with inshore reproductive areas. Often these movements span multiple political jurisdictions. Movement data are mostly derived from extensive acoustic and satellite tagging studies that have been conducted in the area and wider region.

Tagging of Pelagic Thresher (n = 7 individuals) indicates extensive movements between the Colombian coast to Cocos Island (Peñaherrera-Palma et al. 2018; Malpelo Foundation unpubl. data 2022)

Silky Shark movements from 28 satellite-tagged individuals have been found to be extensive and have been recorded from Malpelo Island in the east of the area to oceanic islands, e.g., Galápagos, and beyond to islands (Clipperton Atoll) outside the boundaries of the area (Peñaherrera-Palma et al. 2018; Lara-Lizardi et al. 2020).

Tagged Tiger Shark (n = 12 individuals) have shown movements linking Cocos and the Galápagos Islands to coastal Ecuador and Colombia (Acuña-Marrero et al. 2017; Peñaherrera-Palma et al. 2018).

Smalltooth Sand Tiger sharks have been recorded making regular movements in Colombian waters including migrating between coastal areas and the offshore Malpelo Island (Mejía-Falla et al. 2014; Peñaherrera-Palma et al. 2018; Malpelo Foundation unpubl. data 2022).

Over 100 tagged Whale Sharks have demonstrated extensive migrations across the whole Eastern Tropical Pacific area, often making regular migrations from coastal areas and continental shelf margins to oceanic areas, and often tracking resource-rich high productivity waters (Ryan et al. 2017; Hearn et al. 2016, 2017, 2021; Guzmán et al. 2022; Malpelo Foundation unpubl. data 2022).

Extensive Scalloped Hammerhead tagging studies have shown seasonal migrations across Colombian, Costa Rican, and Ecuadorian waters, often from coastal nursery sites to oceanic islands and seamount for reproductive purposes (during warmer months), as well as inter-island movements over shorter timescales (Hearn et al. 2009, 2010, 2017; Bessudo et al. 2011; Ketchum et al. 2014; Quintanilla et al. 2015; Nalesso et al. 2019; Estupiñán-Montaño et al. 2021a, 2021b; Elizondo-Sancho et al. 2022).

Oceanic Manta Rays have been recorded migrating across multiple jurisdictions, between coastal Ecuador and Peru, and oceanic islands (Galápagos) and seamounts (Guerrero & Hearn 2017; Guerrero 2019; Peñaherrera-Palma et al. 2018; Palomino et al. 2020; Harty et al. 2022).

Acknowledgments

César R. Peñaherrera-Palma (MigraMar), Elpis J. Chávez (CREMA; MigraMar), Randall Arauz (Marine Watch International; MigraMar), Mario Espinoza (Universidad de Costa Rica; MigraMar), Jenifer Suarez (Dirección del Parque Nacional Galápagos), Felipe Ladino (Fundación Malpelo), and Mark Priest (IUCN SSC Shark Specialist Group - ISRA Project) contributed and consolidated information included in this factsheet. We thank the participants of the 2022 ISRA Region 12 – Central and South American Pacific workshop for their contributions to this process.

This factsheet has undergone review by the ISRA Independent Review Panel prior to its publication.

This project was funded by the Shark Conservation Fund, a philanthropic collaborative pooling expertise and resources to meet the threats facing the world's sharks and rays. The Shark Conservation Fund is a project of Rockefeller Philanthropy Advisors.

Suggested citation

IUCN SSC Shark Specialist Group. 2023. Eastern Tropical Pacific Marine Corridor ISRA Factsheet. Dubai: IUCN SSC Shark Specialist Group.

QUALIFYING SPECIES

Scientific Name	Common Name	IUCN Red List Category	Global Depth Range (m)	ISRA Criteria/Sub-criteria Met								
				A	B	C1	C2	C3	C4	C5	D1	D2
SHARKS												
Alopias pelagicus	Pelagic Thresher	EN	0–300	X					X			
Carcharhinus falciformis	Silky Shark	VU	0–500	X					X			
Galeocerdo cuvier	Tiger Shark	NT	0–1,136				X		X			
Odontaspis ferox	Smalltooth Sand Tiger	VU	10–1,051	X					X			
Rhincodon typus	Whale Shark	EN	0–1,928	X			X		X			
Sphyrna lewini	Scalloped Hammerhead	CR	0–1,043	X		X	X		X			
RAYS												
Mobula birostris	Oceanic Manta Ray	EN	0–1,000	X			X		X			

SUPPORTING SPECIES

Scientific Name	Common Name	IUCN Red List Category
SHARKS		
Alopias vulpinus	Common Thresher	EN
Alopias superciliosus	Bigeye Thresher	VU
Apristurus kampae	Longnose Catshark	DD
Bythaelurus giddingsi	Galápagos Catshark	LC
Carcharhinus albimarginatus	Silvertip Shark	VU
Carcharhinus altimus	Bignose Shark	NT
Carcharhinus brachyurus	Copper Shark	VU
Carcharhinus cerdale	Pacific Smalltail Shark	CR
Carcharhinus galapagensis	Galápagos Shark	LC
Carcharhinus leucas	Bull Shark	VU
Carcharhinus limbatus	Blacktip Shark	VU
Carcharhinus longimanus	Oceanic Whitetip Shark	CR
Carcharhinus obscurus	Dusky Shark	EN
Centrophorus squamosus	Leafscale Gulper Shark	EN
Centroscyllium nigrum	Combtooth Dogfish	LC
Echinorhinus cookei	Prickly Shark	DD
Galeorhinus galeus	Tope Shark	CR
Ginglymostoma unami	Pacific Nurse Shark	EN
Heterodontus quoyi	Galápagos Bullhead Shark	LC
Hexanchus griseus	Bluntnose Sixgill Shark	NT
Isistius brasiliensis	Cookie-cutter Shark	LC
Isurus oxyrinchus	Shortfin Mako	EN
Isurus paucus	Longfin Mako	EN
Megachasma pelagios	Megamouth Shark	LC
Mustelus dorsalis	Sharptooth Smoothhound	VU
Mustelus henlei	Brown Smoothhound	LC
Mustelus lunulatus	Sicklefin Smoothhound	LC
Mustelus mento	Speckled Smoothhound	CR
Mustelus whitneyi	Humpback Smoothhound	CR
Nasolamia velox	Whitenose Shark	EN

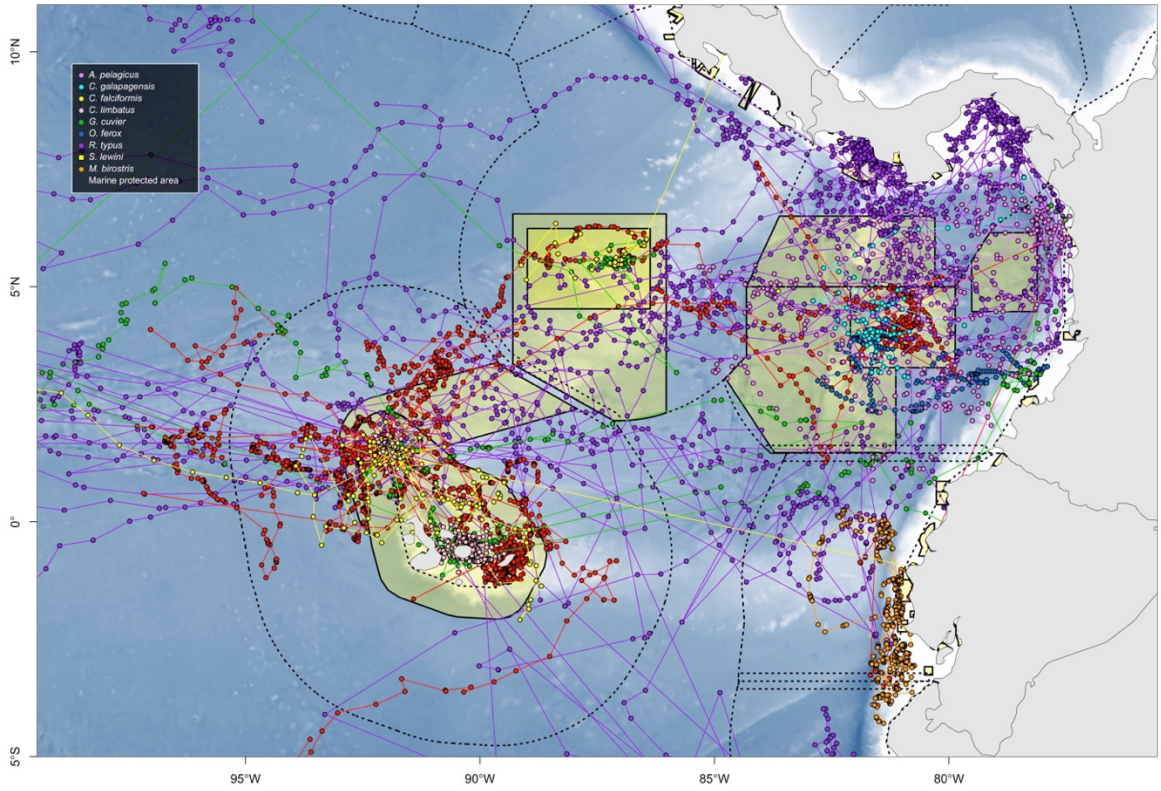
Negaprion brevirostris	Lemon Shark	VU
Notorynchus cepedianus	Broadnose Sevengill Shark	VU
Prionace glauca	Blue Shark	NT
Pseudocarcharias kamoharai	Crocodile Shark	LC
Rhizoprionodon longurio	Pacific Sharpnose Shark	VU
Sphyrna corona	Scalloped Bonnethead	CR
Sphyrna media	Scoophead Shark	CR
Sphyrna mokarran	Great Hammerhead	CR
Sphyrna tiburo	Bonnethead Shark	EN
Sphyrna zygaena	Smooth Hammerhead	VU
Squatina armata	Chilean Angelshark	CR
Squatina californica	Pacific Angelshark	NT
Triaenodon obesus	Whitetip Reef Shark	VU
Triakis maculata	Spotted Houndshark	CR
Nasolamia velox	Whitenose Shark	EN
Negaprion brevirostris	Lemon Shark	VU
Notorynchus cepedianus	Broadnose Sevengill Shark	VU
Prionace glauca	Blue Shark	NT
Pseudocarcharias kamoharai	Crocodile Shark	LC
Rhizoprionodon longurio	Pacific Sharpnose Shark	VU
Sphyrna corona	Scalloped Bonnethead	CR
Squatina armata	Chilean Angelshark	CR
Squatina californica	Pacific Angelshark	NT
Sphyrna media	Scoophead Shark	CR
Sphyrna mokarran	Great Hammerhead	CR
Sphyrna tiburo	Bonnethead Shark	EN
Sphyrna zygaena	Smooth Hammerhead	VU
Triaenodon obesus	Whitetip Reef Shark	VU
Triakis maculata	Spotted Houndshark	CR
RAYS		
Aetobatus laticeps	Pacific Eagle Ray	VU
Aetomylaeus asperrimus	Roughskin Eagle Ray	DD
Amblyraja hyperborea	Boreal Skate	LC
Bathyraja spinosissima	Pacific White Skate	LC

Diplobatis ommata	Pacific Dwarf Numbfish	LC
Gymnura crebripunctata	Mazatlán Butterfly Ray	NT
Hypanus dipterurus	Diamond Stingray	VU
Hypanus longus	Longtail Stingray	VU
Mobula mobular	Spinetail Devil Ray	EN
Mobula munkiana	Munk's Pygmy Devil Ray	VU
Mobula tarapacana	Sicklefin Devil Ray	EN
Mobula thurstoni	Bentfin Devil Ray	EN
Myliobatis longirostris	Longnose Eagle Ray	VU
Myliobatis peruvianus	Peruvian Eagle Ray	VU
Narcine entemedor	Cortez Numbfish	VU
Narcine leoparda	Leopard Numbfish	VU
Pristis pristis	Largetooth Sawfish	CR
Pseudobatos glaucostigma	Grey-spotted Guitarfish	VU
Pseudobatos leucorhynchus	Whitesnout Guitarfish	VU
Pseudobatos planiceps	Pacific Guitarfish	VU
Pseudobatos prahli	Gorgona Guitarfish	VU
Pteroplatytrygon violacea	Pelagic Stingray	LC
Rajella eisenhardti	Galápagos Skate	LC
Rhinoptera steindachneri	Pacific Cownose Ray	NT
Rostroraja equatorialis	Equatorial Skate	VU
Rostroraja velezi	Rasptail Skate	VU
Styracura pacifica	Pacific Chupare	VU
Tetronarce tremens	Chilean Torpedo	LC
Urotrygon aspidura	Spinytail Round Ray	NT
Urotrygon chilensis	Blotched Round Ray	NT
Urotrygon reticulata	Reticulate Round Ray	CR
Urotrygon rogersi	Rogers' Round Ray	NT
Urotrygon simulatrix	Fake Round Ray	VU
Zapteryx xyster	Southern Banded Guitarfish	VU
CHIMAERAS		
Hydrolagus alphus	Whitespot Ghostshark	LC
Hydrolagus mccoskeri	Galápagos Ghostshark	LC

IUCN Red List categories: *CR, Critically Endangered; EN, Endangered; VU, Vulnerable; NT, Near Threatened; LC, Least Concern; DD, Data Deficient.*

SUPPORTING INFORMATION

The below map highlights relocations (point data) of sharks and rays tracked with satellite telemetry in the Eastern Tropical Pacific area. Data from MigraMar (www.migramar.org) based on (Peñaherrera-Palma et al. 2018).



REFERENCES

Acuña-Marrero D, Smith ANH, Hammerschlag N, Hearn A, Anderson MJ, Calich H, Pawley MDM, Fischer C, Salinas-de-León P. 2017. Residency and movement patterns of an apex predatory shark (*Galeocerdo cuvier*) at the Galápagos Marine Reserve. *PLoS One* 12: e0183669. https://doi.org/10.1371/journal.pone.0183669

Amador JA, Rivera ER, Durán-Quesada AM, Mora G, Sáenz F, Calderón B, Mora M. 2016. The easternmost tropical Pacific. Part I: A climate review. *Revista de Biologia Tropical* 64: S1-S22. https://doi.org/10.15517/rbt.v64i1.23407

Arauz R, López A, Zanella I, Ballestero J, López E. 2008. Fostering a responsible spotted rose snapper (*Lutjanus guttatus*) fishery in the Marine Protected Area of the Caletas-Arío Wildlife Refuge and surrounding waters, Guanacaste, Costa Rica. California: Sustainable Fisheries Fund.

Bejarano Álvarez OM. 2007. Biología reproductiva del tiburón martillo *Sphyrna lewini* (Griffith y Smith, 1834) Salina Cruz, Oaxaca, México. Unpublished PhD Thesis, Centro Interdisciplinario de Ciencias Marinas del Instituto Politécnico Nacional, La Paz.

Bessudo S, Soler GA, Klimley AP, Ketchum JT, Hearn A, Arauz R. 2011. Residency of the scalloped hammerhead shark (*Sphyrna lewini*) at Malpelo Island and evidence of migration to other islands in the Eastern Tropical Pacific. *Environmental Biology of Fishes* 91: 165–176. https://doi.org/10.1007/s10641-011-9769-3

Burgess K. 2017. Feeding ecology and habitat use of the giant manta ray *Manta birostris* at a key aggregation site off mainland Ecuador. Unpublished PhD Thesis, University of Queensland, Brisbane.

Burgess KB, Couturier LI, Marshall AD, Richardson AJ, Weeks SJ, Bennett MB. 2016. *Manta birostris*, predator of the deep? Insight into the diet of the giant manta ray through stable isotope analysis. *Royal Society Open Science* 3: 160717. https://doi.org/10.1098/rsos.160717

Burgess KB, Guerrero M, Marshall AD, Richardson AJ, Bennett MB, Couturier LIE. 2018. Novel signature fatty acid profile of the giant manta ray suggests reliance on an uncharacterised mesopelagic food source low in polyunsaturated fatty acids. *PLoS One* 13(1): e0186464. https://doi.org/10.1371/journal.pone.0186464

Cambra M, Lara-Lizardi F, Peñaherrera-Palma C, Hearn A, Ketchum JT, Zarate P, Chacón C, Suárez-Moncada J, Herrera E, Espinoza M. 2021. A first assessment of the distribution and abundance of large pelagic species at Cocos Ridge seamounts (Eastern Tropical Pacific) using drifting pelagic baited remote cameras. *PLoS One* 16: e0244343. https://doi.org/10.1371/journal.pone.0244343

Chiriboga-Paredes Y, Palomino Á, Goodman L, Córdova F, Páez V, Yépez M, Jorgensen S, Armijos D, Pazmiño D, Hearn A. 2022. Discovery of a putative scalloped hammerhead shark *Sphyrna lewini* (Carcharhiniformes: Sphyrnidae) nursery site at the Galápagos Islands, Eastern Tropical Pacific. *Environmental Biology of Fishes* 105: 181–192. https://doi.org/10.1007/s10641-021-01207-3

Elizondo-Sancho M, Rodríguez-Arriatti Y, Albertazzi FJ, Bonilla-Salazar A, Arauz-Naranjo D, Arauz R, Areano E, Avalos-Castillo CG, Brenes Ó, Chávez EJ, et al. 2022. Population structure and genetic connectivity of the scalloped hammerhead shark (*Sphyrna lewini*) across nursery grounds from the Eastern Tropical Pacific: implications for management and conservation. *PloS One* 17(12): e0264879. https://doi.org/10.1371/journal.pone.0264879

Espinoza E, Moreira J, Alvarez R, Garduño C. 2021. Baby shark project. Annual report (3rd year). Ocean Blue Tree, MIGRAMAR.

Estupiñán-Montaño C, Tamburin E, Delgado-Huertas A. 2021a. Stable isotope evidence for movements of hammerhead sharks *Sphyrna lewini*, connecting two natural protected areas in the Colombian Pacific. *Marine Biodiversity* 51: 74. https://doi.org/10.1007/s12526-021-01215-7

Estupiñán-Montaño C, Galván-Magaña F, Elorriaga-Verplancken FR, Zetina-Rejón MJ, Sánchez-González A, Polo-Silva CJ, Villalobos-Ramírez DJ, Rojas-Cundumí J, Delgado-Huertas A. 2021b. Ontogenetic feeding ecology of the scalloped hammerhead shark *Sphyrna lewini* in the Colombia Eastern Tropical Pacific. *Marine Ecology Progress Series* 663: 127–143. https://doi.org/10.3354/meps13639

Fiedler PC, Lavín MF. 2017. Oceanographic conditions of the Eastern Tropical Pacific. In: Glynn PW, Manzello DP, Enochs IC, eds. *Coral reefs of the Eastern Tropical Pacific: Persistence and loss in a dynamic environment*. Dordrecht: Springer Netherlands, 59–83.

Gonzalez-Pestana A, Maguiño R, Mendoza A, Kelez S, Ramírez-Macías, D. 2020. Distribution of whale shark (*Rhincodon typus*) off northern Peru based on habitat suitability. *Aquatic Conservation: Marine and Freshwater Ecosystems* 30(7): 1325–1336. https://doi.org/10.1002/aqc.3330

Guerrero M. 2019. Resumen de resultados obtenidos en los estudios sobre Manta Rayas Oceánicas (*Mobula birostris*) en Ecuador. Informes técnico presentado al Ministerio de Ambiente de Ecuador. Quito: Fundacion Megafauna Marina de Ecuador.

Guerrero M, Hearn A. 2017. Manta rayas gigantes (*Manta birostris*) como indicador de la salud del ecosistema marino en el Parque Nacional Machalilla, Ecuador. Quito: Conservación Internacional Ecuador.

Guzmán HM, Collatos CM, Gomez CG. 2022. Movement, behavior, and habitat use of whale sharks (*Rhincodon typus*) in the tropical eastern Pacific Ocean. *Frontiers in Marine Science* 9: 793248. https://doi.org/10.3389/fmars.2022.793248

Harty K, Guerrero M, Knochel AM, Stevens GMW, Marshall A, Burgess K, Stewart JD. 2022. Demographics and dynamics of the world's largest known population of oceanic manta rays *Mobula birostris* in coastal Ecuador. *Marine Ecology Progress Series* 700: 145–159. https://doi.org/10.3354/meps14189

Hearn A, Ketchum J, Klimley P, Soler G, Bessudo S, Arauz R, Peñaherrera C. 2009. Interisland movement of hammerhead sharks in the Galápagos Marine Reserve and Eastern Tropical Pacific. Oral Presentation, 25th American Elasmobranch Society Symposium, Portland, USA.

Hearn A, Ketchum J, Klimley AP, Espinoza E, Peñaherrera C. 2010. Hotspots within hotspots? Hammerhead shark movements around Wolf Island, Galápagos Marine Reserve. *Marine Biology* 157: 1899–1915. https://doi.org/10.1007/s00227-010-1460-2

Hearn A, Green J, Roman MH, Acuña-Marrero D, Espinoza E, Klimley AP. 2016. Adult female whale sharks make long distance movements past Darwin Island (Galápagos, Ecuador) in the Eastern Tropical Pacific. *Marine Biology* 163: 213–224. https://doi.org/10.1007/s00227-016-2991-y

Hearn A, Espinoza E, Ketchum J, Green J, Peñaherrera C, Arauz R, Fischer C, Steiner T, Shillinger G, Henderson S, et al. 2017. Una década de seguimiento de los movimientos de tiburones resalta la importancia ecológica de las islas del norte: Darwin y Wolf. In: *Informe Galápagos 2015-2016*. Puerto Ayora, Galápagos, Ecuador: DPNG, CGREG, FCD y GC, 132–142.

Hearn AR, Green JR, Peñaherrera-Palma C, Reynolds S, Rohner CA, Román M, Sequeira AM. 2021. Whale shark movements and migrations. In: Dove ADM, Pierce SJ, eds. *Whale sharks: biology, ecology, and conservation*. Boca Raton: CRC Press, 105–127.

Karnauskas KB, Murtugudde R, Busalacchi AJ. 2007. The effect of the Galápagos Islands on the Equatorial Pacific Cold Tongue. *Journal of Physical Oceanography* 37: 1266–1281. https://doi.org/10.1175/JPO3048.1

Kessler WS. 2006. The circulation of the Eastern Tropical Pacific: A review. *Progress in Oceanography* 69: 181–217. https://doi.org/10.1016/j.pocean.2006.03.009

Ketchum JT, Hearn A, Klimley AP, Peñaherrera C, Espinoza E, Bessudo S, Soler G, Arauz R. 2014. Interisland movements of scalloped hammerhead sharks (*Sphyrna lewini*) and seasonal connectivity in a marine protected area in the eastern tropical Pacific. *Marine Biology* 161: 939–951. https://doi.org/10.1007/s00227-014-2393-y

Lezama-Ochoa N, Hall M, Román M, Vogel N. 2019. Spatial and temporal distribution of mobulid ray species in the eastern Pacific Ocean ascertained from observer data from the tropical tuna purse-seine fishery. *Environmental Biology of Fishes* 102: 1–17. https://doi.org/10.1007/s10641-018-0832-1

Maguiño R, Mendoza A, Kelez S, Vélez-Zuazo X, Ramírez-Macías D. 2016. Unveiling a new foraging area for the threatened whale shark. QScience Proceedings (The 4th International Whale Shark Conference). https://doi.org/10.5339/qproc.2016.iwsc4.32

Maguiño R, Mendoza A, Kelez S, Ramírez-Macías D. 2019. El norte de Perú se convierte en una nueva área de agregación para los tiburones ballena. Primer congreso latinoamericano de tiburones, rayas y quimeras. Mexico.

Mejía-Falla PA, Navia AF, Lozano R, Narvaez K, Tobon A, Muñoz LA, Mejía-Ladino LM, López-García J. 2014. Uso de hábitat de *Triaenodon obesus* (Carcharhiniformes: Carcharhinidae), *Rhincodon typus* (Orectolobiformes: Rhincodontidae) y *Manta birostris* (Myliobatiformes: Myliobatidae) en el Parque Nacional Natural Gorgona, Pacífico colombiano. *Revista de Biología Tropical* 62 (Suppl. 1): 329–342.

Mongeon C, Granek EF, Arauz R. 2013. Hook selectivity in an artisanal spotted rose snapper *Lutjanus guttatus* fishery on the Nicoya Peninsula, Costa Rica. *Marine and Coastal Fisheries* 5(1): 270–280. https://doi.org/10.1080/19425120.2013.811133

Nalesso E, Hearn A, Sosa-Nishizaki O, Steiner T, Antoniou A, Reid A, Bessudo S, Soler G, Klimley AP, Lara F, et al. 2019. Movements of scalloped hammerhead sharks (*Sphyrna lewini*) at Cocos Island, Costa Rica and between oceanic islands in the Eastern Tropical Pacific. *PLoS One* 14(3): e0213741. https://doi.org/10.1371/journal.pone.0213741

Pacheco-Polanco JD, Herra-Miranda D, Oviedo-Correa L, Quirós-Pereira W, Figgener C. 2015. Whale shark, *Rhincodon typus* (Orectolobifoms: Rhincodontidae) feeding aggregations in Golfo Dulce, Osa Peninsula, Costa Rica. *Revista de Biología Tropical* 63: 299–306. https://doi.org/10.15517/RBT.V63I1.23109

Palomino A, Guerrero M, Hearn A. 2020. Informe final sobre monitoreo de megafauna marina (*Mobula birostris* y *Rhincodon typus*) usando métodos satelitales y acústicos para entender los patrones de distribución poblacional y movimientos migratorios para optimizar las medidas de conservación. Proyecto IKU. Quito: Fundación Megafauna Marina del Ecuador y World Wide Fund.

Peñaherrera-Palma C, Arauz R, Bessudo S, Bravo-Ormaza E, Chassot O, Chinacalle-Martínez N, Espinoza E, Forsberg K, García-Rada E, Guzmán H, et al. 2018. Justificación biológica para la creación de la MigraVía Coco-Galápagos. Portoviejo, Manabí, Ecuador: MigraMar y Pontificia Universidad Católica del Ecuador Sede Manabi.

Quintanilla S, Gómez A, Mariño-Ramírez C, Sorzano C, Bessudo S, Soler G, Bernal JE, Caballero S. 2015. Conservation genetics of the scalloped hammerhead shark in the Pacific coast of Colombia. *Journal of Heredity* 106: 448–458. https://doi.org/10.1093/jhered/esv050

Rodríguez-Rubio E, Ortiz J, Rueda J. 2007. Aspectos oceanográficos. In: DIMAR-CCP, UAESPNN-DTSO, eds. *Santuario de Fauna y Flora Malpelo: Descubrimiento en marcha.* Bogotá, Colombia: DIMAR, 29–44.

Ryan JP, Green JR, Espinoza E, Hearn AR. 2017. Association of whale sharks (*Rhincodon typus*) with thermo-biological frontal systems of the eastern tropical Pacific. *PLoS One* 12(8): e0182599. https://doi.org/10.1371/journal.pone.0182599

Salinas-de-León P, Fierro-Arcos D, Suarez-Moncada J, Proaño A, Guachisaca-Salinas J, Páez-Rosas D. 2019. A matter of taste: Spatial and ontogenetic variations on the trophic ecology of the tiger shark at the Galápagos Marine Reserve. *PloS One* 14: e0222754. https://doi.org/10.1371/journal.pone.0222754

Stuart-Smith RD, Bates AE, Lefcheck JS, Duffy JE, Baker SC, Thomson RJ, Stuart-Smith JF, Hill NA, Kininmonth SJ, Airoldi L, et al. **2013.** Integrating abundance and functional traits reveals new global hotspots of fish diversity. *Nature* 501: 539–542. https://doi.org/10.1038/nature12529

Vega AJ, Robles YA, Quezada F, Montes L, Del Cid A, Quintero O. 2023. Incidencia de elasmobranquios en la pesca artesanal en los golfos de Chiriquí y Montijo, Pacífico Panameño. *Scientia* 33: 144–172.

Zanella I, López-Garro A. 2015. Abundance, reproduction and length of scalloped hammerhead shark *Sphyrna lewini* (Carcharhiniformes: Sphyrnidae) in the artisanal fishery in Golfo Dulce, Pacific of Costa Rica. *Revista de Biología Tropical* 63: 307–317. https://doi.org/10.15517/rbt.v63i1.23110

Zanella I, López-Garro A, Golfín-Duarte G, Saenz JC. 2012. Abundancia, tamaño y estructura poblacional del tiburón punta blanca de arrecife, *Triaenodon obesus* (Carcharhiniformes: Carcharhinidae), en Bahía Chatham, Parque Nacional Isla del Coco, Costa Rica. *Revista de Biología Tropical* 60: 339–346. https://doi.org/10.15517/rbt.v60i3.28408

Zanella I, López-Garro A, Mccomb-Kobza DM, Golfín-Duarte G, Pérez-Montero M, Morales J. 2016. First record of young-of-the-year scalloped hammerhead shark, *Sphyrna lewini* (Carcharhiniformes: Sphyrnidae) from Isla del Coco National Park, Costa Rica. *Revista de Biología Tropical* 64: 201–204. https://doi.org/10.15517/rbt.v64i1.23448

Zanella I, López-Garro A, Cure K. 2019. Golfo Dulce: critical habitat and nursery area for juvenile scalloped hammerhead sharks *Sphyrna lewini* in the Eastern Tropical Pacific seascape. *Environmental Biology of Fishes* 102: 1291–1300. https://doi.org/10.1007/s10641-019-00907-1