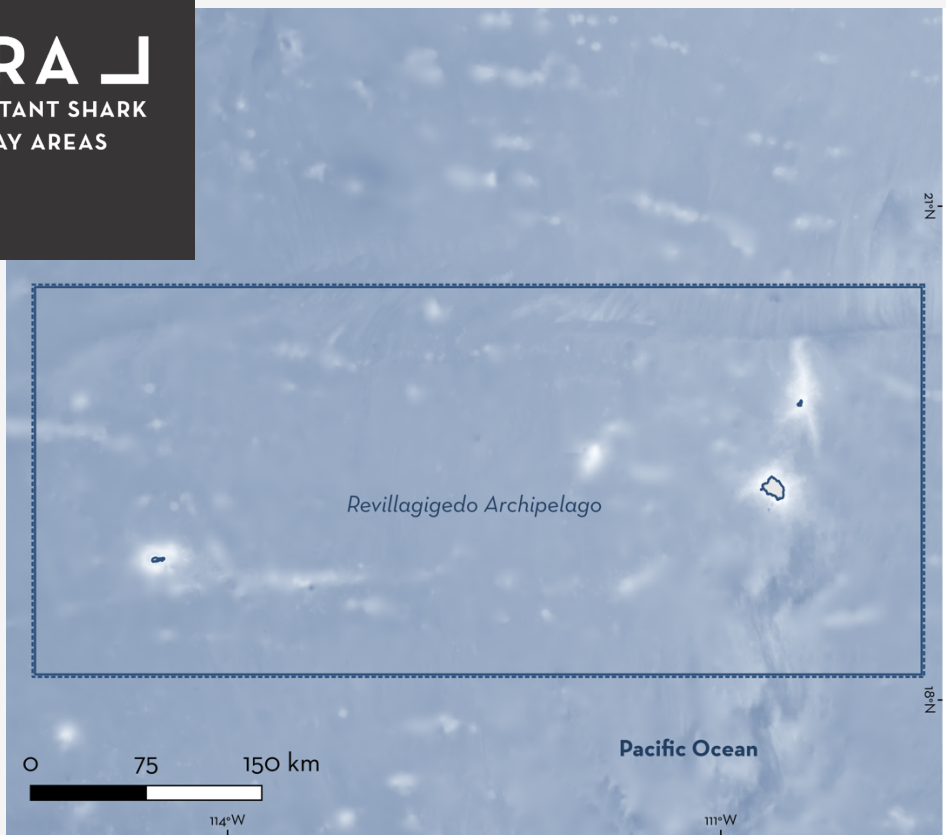
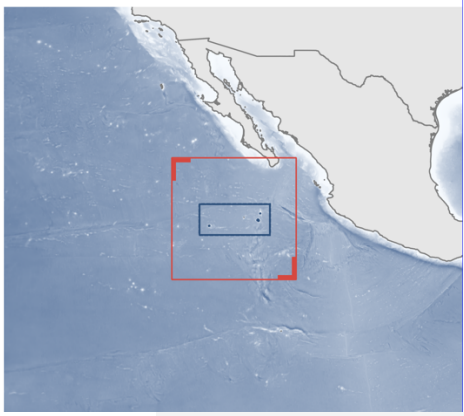
ISRA
IMPORTANT SHARK AND RAY AREAS





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

REVILLAGIGEDO ARCHIPELAGO ISRA

Central and South American Pacific Region

MEXICO

0–1,928 metres

159,647.5 km²

SUMMARY

Revillagigedo Archipelago is located in the Eastern Tropical Pacific, 400 km south of Baja California state, Mexico. This area is part of a Marine Protected Area (National Park Revillagigedo) and is a UNESCO World Heritage Site due to its high biodiversity and species endemism. The archipelago is composed of four islands: Socorro, Clarion, San Benedicto, and Roca Partida and is characterised by rocky habitats and domes near the islands as well as sandy and silt bottoms, and hydrothermal vents. Within this area there are: **threatened species** (e.g., Silky Shark *Carcharhinus falciformis*); **reproductive areas** (e.g., Galápagos Shark *Carcharhinus galapagensis*); **feeding areas** (e.g., Silvertip Shark *Carcharhinus albimarginatus*); **resting areas** (Whitetip Reef Shark *Triaenodon obesus*); areas important for **movement** (e.g., Whale Shark *Rhincodon typus*); and **distinctive attributes** (e.g., Tiger Shark *Galeocerdo cuvier*).

CRITERIA

Criterion A – Vulnerability; Sub-criterion C1 – Reproductive Areas; Sub-criterion C2 – Feeding Areas; Sub-criterion C3 – Resting Areas; Sub-criterion C4 – Movement; Sub-criterion D1 - Distinctiveness

DESCRIPTION OF HABITAT

Revillagigedo Archipelago is located in the Exclusive Economic Zone of Mexico, under the jurisdiction of Colima state, 400 km south of Baja California state. This area is part of a Marine Protected Area (National Park Revillagigedo) and is a UNESCO World Heritage Site due to its high biodiversity and species endemism. The archipelago comprises four volcanic islands: Socorro, Clarion, San Benedicto, and Roca Partida. These islands were formed from volcanoes rising from the Clarion Fracture Zone, a submarine fracture zone defined by numerous transform faults that traverse the northern part of the Eastern Pacific Rise. The islands are located on the southern tip of the north-westward moving Pacific plate just west of the junction between the East Pacific Rise, the Middle America Trench, and the Pacific, Rivera, and Cocos plates. It is thought that the islands date from early Pliocene to late Pleistocene (Brattstrom 1990; CONANP 2019).

The oceanography of Revillagigedo Archipelago is influenced by the California Current, the North Equatorial Current, and the Coastal Current of Costa Rica (Brattstrom 1990; CONANP 2019). During the boreal summer, sea surface temperatures average 28–29°C, while the winter temperature decreases to 22–25°C. The area is characterised by rocky habitats and domes near the islands, as well as sandy and silt bottoms and hydrothermal vents. This area overlaps with a protected area, the National Park Revillagigedo, one of the few fully protected marine areas in Mexico (CONANP 2019). In addition, this area includes one Ramsar site, Reserva de la Biósfera Archipiélago de Revillagigedo (Ramsar 2022), and one Key Biodiversity Area, Islas Revillagigedo (KBA 2022).

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 depth reported for Qualifying Species.

ISRA CRITERIA

CRITERION A – VULNERABILITY

Eight 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 four Vulnerable species; threatened rays comprise one Endangered species (IUCN 2022).

SUB-CRITERION C1 – REPRODUCTIVE AREAS

Revillagigedo Archipelago is an important reproductive area for three shark species. Acoustic telemetry studies from 2012–2015 have included the tagging of neonate and juvenile (n = 14; 80–200 cm total length [TL]) Silvertip Sharks showing that this species is regularly occurring around San Benedicto Island and Socorro Island (Muntaner 2016; Ketchum et al. 2020). The reported size-at-birth for the species is 63–81 cm TL (Ebert et al. 2021). Tagged individuals utilised shallow inshore waters of both islands, suggesting that these locations serve as nurseries. In addition, acoustic tagging from 2008–2015 revealed that adults are more common around Roca Partida Island, and there are reports of pregnant females moving to San Benedicto and Socorro islands, with larger juveniles moving from San Benedicto Island to the areas where adults regularly occur (Muntaner 2016; Lara-Lizardi 2018).

Females with recent mating scars and pregnant female Silvertip Shark, Silky Shark, and Galápagos Shark have been regularly observed during underwater visual census and during Baited Underwater Remote Video Surveys (BRUVS) around the different islands over multiple years (Lara-Lizardi 2018).

SUB-CRITERION C2 – FEEDING AREAS

Revillagigedo Archipelago is an important feeding area for three shark species. Based on stable isotope analysis (n = 26), young-of-the-year and juvenile Silvertip Sharks feed in the Revillagigedo Archipelago in benthic and pelagic habitats. Feeding in different habitats is related to ontogenetic movements described in the section above. This species moves between nursery areas around San Benedicto and Socorro islands, where benthic reef fish communities are available, to areas near Roca Partida Island, highly influenced by oceanic waters where there is a higher availability of pelagic fishes (LeCroizier et al. 2020).

Large feeding events have been observed in different parts of this area during underwater visual census (Lara-Lizardi et al. 2018). Silky Sharks (around 400 individuals) and Galápagos Shark form large feeding aggregations around bait balls formed by small pelagic fishes (Clupeidae). Silky Shark and Galápagos Shark are found year-round in the area, with higher residency in the boreal winter-spring and spring, respectively. From this area, these species move to other locations in the Mexican Pacific and Eastern Tropical Pacific, which indicates the seasonal importance of this area for feeding.

SUB-CRITERION C3 – RESTING AREAS

Revillagigedo Archipelago is an important resting area for Whitetip Reef Sharks. This species uses the crevices and caves of Roca Partida and San Benedicto islands to rest during the day, before moving away from these habitats at night to feed (Lara-Lizardi 2018).

SUB-CRITERION C4 – MOVEMENT

Revillagigedo Archipelago is an important movement area for five shark and one ray species. The area has been reported to support connectivity for many migratory species with other areas in the Eastern Tropical Pacific (e.g., Cortés-Fuentes 2018; Aldana-Moreno 2020; Aldana-Moreno et al. 2020; Becerril-García et al. 2020).

Acoustic telemetry revealed that Silky Shark move from Revillagigedo Archipelago to Cabo Pulmo, Baja California Sur, Mexico (Lara-Lizardi et al. 2018). In addition, two Silky Sharks tagged with satellite transmitters showed movements from the archipelago to areas near Clipperton Island and to coastal areas in Sinaloa and Islas Marías, Mexico (Ketchum et al. 2020; Lara-Lizardi et al. 2020).

Galápagos Sharks also move between Revillagigedo Archipelago and Cabo Pulmo, as revealed by acoustic tagging (Lara-Lizardi 2018). This connectivity has been confirmed based on genetic analyses (Pazmiño et al. 2019). In addition, one Galápagos Shark (180 cm TL) tagged with an acoustic transmitter travelled from Revillagigedo to Clipperton Island and to Darwin Island in the Galápagos, travelling ~3,000 km (Ketchum et al. 2020).

One satellite tagged Tiger Shark moved back and forth between Revillagigedo Archipelago to areas in the southern Gulf of California (Cabo Pulmo) during 2013, traveling 1,014 km during the roundtrip, suggesting connectivity for this species between both regions. Tiger sharks have a high residency to the Archipelago between July–November and less residency in the colder months (December–June), when this long-distance movement occurred (Ketchum et al. 2020).

Based on photo-identification, two Oceanic Manta Rays moved between Revillagigedo Archipelago and Isla Cerralvo in the Gulf of California (Kumli & Rubin 2011). In addition, acoustic telemetry revealed that individuals (n = 4) make movements back and forth between Revillagigedo and Bahía Banderas, Nayarit, Mexico (Preciado-González 2021).

A single acoustically tagged Whitenose Shark moved from Cabo Pulmo to Revillagigedo Archipelago, supporting the presence of connectivity between the Gulf of California and Revillagigedo Archipelago for this species. This report extended the known distribution of Whitenose Shark to 400 km off the mainland coast of the Americas (Lara-Lizardi et al. 2017).

Three Whale Sharks tagged with satellite transmitters showed movements from the southern Gulf of California (La Paz) to Revillagigedo Archipelago and from the archipelago to areas near San Blas, Nayarit (Ketchum et al. 2020).

SUB-CRITERION D1 – DISTINCTIVENESS

Revillagigedo Archipelago is an important area for the distinct behavior of seven shark species. The area encompasses cleaning stations for Silvertip Shark, Silky Shark, Galápagos Shark, Blacktip Shark, Tiger Shark, Scalloped Hammerhead, and Whitetip Reef Shark. These cleaning stations have been confirmed from underwater visual census between 2017–2021 and are considered distinctive since cleaning stations for these sharks have not been documented elsewhere in the Eastern Tropical Pacific.

Silvertip Shark serves as a host for Blacknosed Butterflyfish *Johnrandallia nigrirostris*, Blackjack *Caranx lugubris*, Mexican Hogfish *Bodianus diplotaenia*, and Cortez Rainbow Wrasse *Thalassoma lucasanum*. Silky Shark has one specific associated cleaner, Mexican Hogfish. Galápagos Shark has three associated cleaners: Blackjack, Blacknosed Butterflyfish, and Mexican Hogfish. Only Blacknosed Butterflyfish interact with Tiger Sharks. Scalloped Hammerhead has Blacknosed Butterflyfish and Blackjack as their cleaners. Whitetip Reef Sharks serves as a host for Blackjack (Nicolás-Chavez 2022).

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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												
Carcharhinus albimarginatus	Silvertip Shark	VU	0–800	X		X	X				X	
Carcharhinus falciformis	Silky Shark	VU	0–500	X		X	X		X		X	
Carcharhinus galapagensis	Galápagos Shark	LC	0–285			X	X		X		X	
Carcharhinus limbatus	Blacktip Shark	VU	0–140	X							X	
Galeocerdo cuvier	Tiger Shark	NT	0–1,136						X		X	
Nasolamia velox	Whitenose Shark	EN	0–192	X					X			
Rhincodon typus	Whale Shark	EN	0–1,928	X					X			
Sphyrna lewini	Scalloped Hammerhead	CR	0–1,043	X							X	
Triaenodon obesus	Whitetip Reef Shark	VU	0–330	X				X			X	
RAYS												
Mobula birostris	Oceanic Manta Ray	EN	0–1,000	X					X			

SUPPORTING SPECIES

Scientific Name	Common Name	IUCN Red List Category
SHARKS		
Alopias superciliosus	Bigeye Thresher	VU
Apristurus brunneus	Brown Catshark	DD
Apristurus nasutus	Largenose Catshark	LC
Carcharhinus altimus	Bignose Shark	NT
Carcharhinus obscurus	Dusky Shark	EN
Cephalurus cephalus	Lollipop Catshark	LC
Echinorhinus cookei	Prickly Shark	DD
Galeorhinus galeus	Tope Shark	CR
Prionace glauca	Blue Shark	NT
Somniosus pacificus	Pacific Sleeper Shark	NT
RAYS		
Bathyraja abyssicola	Deepsea Skate	DD
Diplobatis ommata	Pacific Dwarf Numbfish	LC
Hypanus dipterurus	Diamond Stingray	VU
Hypanus longus	Longtail Stingray	VU
Mobula tarapacana	Sicklefin Devil Ray	EN
Narcine entemedor	Cortez Numbfish	LC
CHIMAERAS		
Hydrolagus melanophasma	Eastern Pacific Ghostshark	LC
Hydrolagus trolli	Abyssal Ghostshark	LC

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

SUPPORTING INFORMATION

There are additional indications that Revillagigedo Archipelago is important for the Oceanic Manta Ray. Individuals have been observed feeding at depths ~130 m and in surface waters. It has been reported that seasonal use of the water column is related to the availability of zooplankton (Stewart et al. 2016), however, more information is needed to confirm the importance of this area for feeding.

REFERENCES

Aldana-Moreno A. 2020. Movimientos, residencia y preferencias ambientales del tiburón martillo en dos archipiélagos: Revillagigedo y Espíritu Santo, México. Unpublished PhD Thesis, Centro Interdisciplinario de Ciencias Marinas (CICIMAR), La Paz.

Aldana-Moreno A, Hoyos-Padilla EM, González-Armas R, Galván-Magaña F, Hearn A, Klimley AP, Winram W, Becerril-García EE, Ketchum JT. 2020. Residency and diel movement patterns of the endangered scalloped hammerhead *Sphyrna lewini* in the Revillagigedo National Park. *Journal of Fish Biology* 96(2): 543–548. https://doi.org/10.1111/jfb.14239

Becerril-García EE, Hoyos-Padilla EM, Henning B, Salinas-De León P. 2020. Sharks, rays, and chimaeras of the Revillagigedo National Park: An update of new and confirmed records. *Journal of Fish Biology* 97(4): 1228–1232. https://doi.org/10.1111/jfb.14457

Brattstrom BH. 1990. Biogeography of the Islas Revillagigedo, Mexico. *Journal of Biogeography* 17: 177–183. https://doi.org/10.2307/2845325

Comisión Nacional de Áreas Naturales Protegidas (CONANP). 2019. Programa de manejo Parque Nacional Revillagigedo. Mexico City: CONANP-SEMARNAT.

Cortés-Fuentes C. 2018. Distribución espacio-temporal y preferencias ambientales de tiburones en el Área Natural Protegida Archipiélago de Revillagigedo. Unpublished Master's Thesis, Centro de Investigaciones Biológicas del Noroeste, S.C. (CIBNOR), La Paz.

Ebert DA, Dando M, Fowler S. 2021. *Sharks of the world. A complete guide. Second edition.* Plymouth: Wild Nature Press.

IUCN. 2022. The IUCN Red List of Threatened Species. Version 2022-1. Available at: https://www.iucnredlist.org Accessed September 2022.

Ketchum JT, Hoyos-Padilla M, Aldana-Moreno A, Ayres K, Galván-Magaña F, Hearn A, Lara-Lizardi F, Muntaner-López G, Grau M, Trejo-Ramírez A, Whitehead DA, Klimley AP. 2020. Shark movement patterns in the Mexican Pacific: A conservation and management perspective. In: Larson S, Lowry D, eds. *Advances in Marine Biology 85: Sharks in Mexico: Research and Conservation Part B.* London: Academic Press, 1–37.

Key Biodiversity Areas (KBA). 2022. Key Biodiversity Areas factsheet: Islas Revillagigedo. Extracted from the World Database of Key Biodiversity Areas. Available at: www.keybiodiversityareas.org Accessed December 2022.

Kumli KR, Rubin RD. 2011. Photo-Identification of the Manta Ray, *Manta birostris*, in the Revillagigedo Islands, Mexico. Santa Rosa: Pacific Manta Research Group.

Lara Lizardi F. 2018. Distribution patterns of sharks in the Revillagigedo Archipelago and their connectivity in the Eastern Tropical Pacific. Unpublished PhD Thesis, Centro Interdisciplinario de Ciencias Marinas (CICIMAR), La Paz.

Lara-Lizardi F, Hoyos-Padilla M, Hearn A, Klimley AP. 2020. Shark movements in the Revillagigedo Archipelago. bioRxiv preprint. https://doi.org/10.1101/2020.03.02.972844

Lara-Lizardi F, Hoyos-Padilla M, Ketchum JT, Galván-Magaña F. 2017. Range expansion of the whitenose shark, *Nasolamia velox*, and migratory movements to the oceanic Revillagigedo Archipelago (west Mexico). *Journal of the Marine Biological Association of the United Kingdom* 98: 949–953. https://doi.org/10.1017/S0025315417000108

Le Croizier G, Lorrain A, Schaal G, Ketchum J, Hoyos-Padilla M, Besnard L, Munaron JM, Le Loc'h F, Point D. 2020. Trophic resources and mercury exposure of two silvertip shark populations in the Northeast Pacific Ocean. *Chemosphere* 253: 126645. https://doi.org/10.1016/j.chemosphere.2020.126645

Muntaner G. 2016. Movement patterns and habitat use of the silver tip shark (*Carcharhinus albimarginatus*) at the Revillagigedo Archipelago. Unpublished Bachelor's Thesis, Universidad de Las Palmas de Gran Canaria, Las Palmas.

Nicolás-Chávez A. 2022. Interacciones de limpieza y estructura de la comunidad de peces en arrecifes rocosos del archipiélago de Revillagigedo. Unpublished Master's Thesis, Centro de Investigación Científica y de Educación Superior de Ensenada, Baja California (CICESE), Ensenada.

Pazmiño DA, van Herderden L, Simpfendorfer CA, Junge C, Donnellan SC, Hoyos-Padilla EM, Duffy CAJ, Huveneers C, Gillanders BM, Butcher PA, Maes GE. 2019. Introgressive hybridisation between two widespread sharks in the east Pacific region. *Molecular Phylogenetics and Evolution* 136: 119–127. https://doi.org/10.1016/j.ympev.2019.04.013

Preciado-González PA. 2021. Movimientos y residencia de la manta gigante *Mobula birostris* en el Océano Pacífico mexicano. Unpublished Master's Thesis, Centro Interdisciplinario de Ciencias Marinas (CICIMAR), La Paz.

Ramsar. 2022. Reserva de la Biosfera Archipiélago de Revillagigedo. Available at: www.ramsar.org Accessed December 2022.

Stewart JD, Hoyos-Padilla EM, Kumli KR, Rubin RD. 2016. Deep-water feeding and behavioral plasticity in *Manta birostris* revealed by archival tags and submersible observations. *Zoology* 119: 406–413. https://doi.org/10.1016/j.zool.2016.05.010