Check List the journal of biodiversity data
NOTES ON GEOGRAPHIC DISTRIBUTION

# First eDNA-based record of *Carcharhinus melanopterus* (Quoy & Gaimard, 1824) (Carcharhiniformes, Carcharhinidae) from Mantanani Island, Sabah, Malaysia

**Cheng Ann Chen**[1], **Wei-Ling Ng**[1], **Juanita Joseph**[1], **Muhamad Arif Ng Abdullah**[2], **Tadashi Kajita**[3]

1 Institut Marin Borneo, Universiti Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu, Sabah, Malaysia
2 JSK Mantanani Island Resorts, Pulau Mantanani Besar, Kampong Mantanani, 89150 Kota Belud, Sabah, Malaysia
3 Iriomote Station, Tropical Biosphere Research Center, University of the Ryukyus, Uehara, Taketomi, Yaeyama, Okinawa, Japan

Corresponding author: Cheng Ann Chen (chengann@ums.edu.my)

**Abstract.** The first molecular occurrence record of the Blacktip Reef Shark, *Carcharhinus melanopterus* (Quoy & Gaimard, 1824), is documented from Mantanani Island, Sabah, Malaysia, based on environmental DNA (eDNA) metabarcoding. Surface seawater collected from two seagrass sites on 9 May 2024 and analyzed using MiFish 12S rRNA primers. A single 155-bp operational taxonomic unit matching *C. melanopterus* with 100% identity to MitoFish reference sequences was recovered exclusively from one of the sampled sites (20,881 reads). No reads were detected at the other site or in negative controls. Sequence data are deposited in NCBI SRA (BioProject PRJNA1460790).

**Keywords.** Blacktip Reef Shark, Coral Triangle, elasmobranch, MiFish, MitoFish, molecular occurrence, South China Sea

**Chen CA, Ng WL, Joseph J, Ng MAA, Kajita T** (2026) First eDNA-based record of *Carcharhinus melanopterus* (Quoy & Gaimard, 1824) (Carcharhiniformes, Carcharhinidae) from Mantanani Island, Sabah, Malaysia. Checklist 22 (4): 667–679. https://doi.org/10.15560/22.4.667

## Introduction

The Blacktip Reef Shark, *Carcharhinus melanopterus* (Quoy & Gaimard, 1824), is a shallow-water reef-associated shark in the family Carcharhinidae (order Carcharhiniformes). *Carcharhinus melanopterus* is widely distributed throughout the tropical Indo-Pacific, from the Red Sea and East Africa to Japan, Australia, Hawai'i, and the Tuamotu Archipelago. It has also been recorded from the eastern Mediterranean, having entered through the Suez Canal (Froese and Pauly 2026). This species has been reported to occupy marine and brackish environments (Froese and Pauly 2026). In addition, it is currently listed as Vulnerable on the IUCN Red List (Simpfendorfer et al. 2020) and is included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in November 2022 (CITES 2022).

Environmental DNA (eDNA) metabarcoding has become an established non-invasive approach for detecting elasmobranchs in tropical marine habitats, often recovering species that evade underwater visual census because of low probability for encounters or cryptic behaviour (Boussarie et al. 2018). In Sabah, *C. melanopterus* has been documented in surveys and fishery landings, but molecular occurrence records from specific offshore island systems remain scarce. Mantanani Island is a small island complex approximately 30 km off the northwest coast of Sabah, Malaysia, on the Sunda Shelf at the southern margin of the South China Sea. It was identified as one of the few remaining Dugong (*Dugong dugon* (Müller, 1776)) habitats in Sabah (Rajamani and Marsh 2010). However, the island's reef and seagrass ecosystem has been affected due to pressure from blast fishing; there have been more than 2,800 blast events recorded within 5 km of the island between 2014 and 2020 (Reef Check Malaysia 2025). While *C. melanopterus* is broadly distributed across the Indo-Pacific, no molecular occurrence record exists for Mantanani Island prior to this study. Therefore, in our study we report the

OPEN ACCESS

Academic editor: Paramasivam Kodeeswaran
Received: 9 May 2026
Accepted: 9 July 2026
Published: 24 July 2026

Copyright © The authors. This is an open-access article distributed under terms of the Creative Commons Attribution License (Attribution 4.0 International – CC BY 4.0)

eDNA-based detection of *C. melanopterus* from a broader fish-biodiversity survey based on MiFish 12S rRNA metabarcoding in Mantanani Island seagrass habitat. These findings are especially important given the species' status as Vulnerable and its Apendix II listing in CITES.

## Study area

Surface seawater was collected at Mantanani Island, Sabah, Malaysia, on 9 May 2024 (Figure 1). The sampling sites for this study are the seagrass area (Sites G1 and G2) located behind the reef flat. Both G1 and G2 sites had poor coverage by the seagrasses *Enhalus acoroides* (L. f.) Royle and *Halodule pinifolia* (Miki) Hartog. Sampling was conducted at 06°42.4267′N, 116°20.9433′E (G1) and 06°42.4274′N, 116°20.9429′E (G2). The sampling was carried out during the high tide.

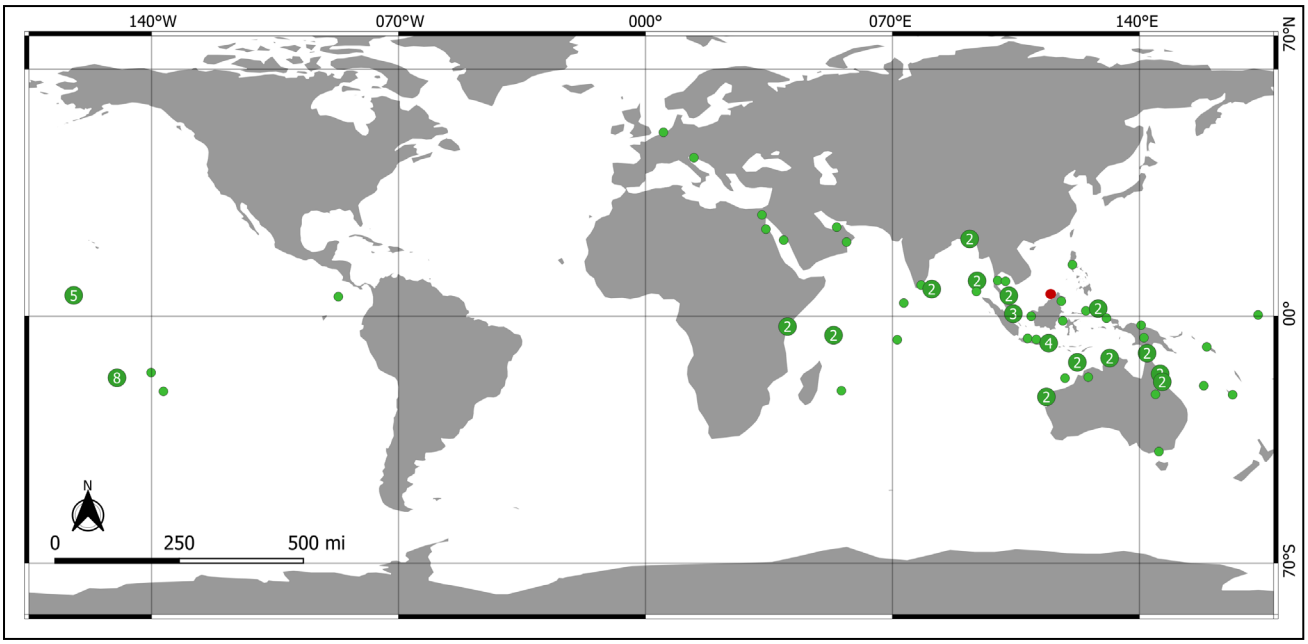


**Figure 1.** Map of previously known points of *C. melanopterus* occurrence (green dots) and the new record from current study (red dots). Numbered dots correspond to >1 nearby occurrences.

## Methods

**Sample collection.** A pre-bleached bucket and long-handled scoop were rinsed thoroughly with site water before sampling to prevent cross-contamination. Three replicates of 1 L surface water was filtered through a filter cartridge (Sterivex™-HV Pressure Filter Units 0.45 µm pore size) using a 50 mL lock-type syringe (Naputo et al. 2024). The cartridge was preserved by adding 2 mL of DNAiso Reagent (Takara Bio USA, Inc.) directly into the filter housing and stored chilled until transport to the laboratory. A distilled-water field blank was collected as a negative control.

**DNA extraction, library preparation, and sequencing.** Environmental DNA was extracted using the SPINeasy® DNA Kit for Water (MPBio) following the manufacturer protocol. A negative extraction control was processed in parallel. Extracted DNA concentrations were quantified using NanoDrop™ 2000 Spectrophotometer (Thermo Fisher Scientific), where the concentration of G1 shows 5.2 ng/µL, G2: 16.7 ng/µL, and no measurable DNA concentration were observed for the field blank and negative extraction control. Libraries were prepared using a two-step PCR approach with triplicates in the first-step targeting the hypervariable region of the fish mitochondrial 12S rRNA gene with two primer mixtures, MiFish-U and MiFish-Ev2 (Miya et al. 2015, 2020). Each of primer sets were carrying Illumina overhang adapter sequences. A no-template PCR negative control were included. In the first PCR, each reaction contained 2.5 µL of DNA template, 5 µL of forward primer (1 µM), 5 µL of reverse primer (1 µM), and 12.5 µL of 2× KAPA HiFi HotStart ReadyMix. Replicates were pooled and assessed by gel electrophoresis. No visible bands were observed in any controls, indicating the absence of detectable contamination or amplification, therefore were excluded for the next step. The pooled PCR products were then purified using 80% AMPure XP beads (Beckman Coulter 2023) and proceed to the second

PCR using 5 µL of the PCR1 product as the template, combined with 10 µL of Illumina Unique Dual Indices, 12.5 µL of 2× KAPA HiFi HotStart ReadyMix, and 2.5 µL of PCR-grade water to reach the final 25 µL volume. Thermal cycling conditions for the first PCR were initial denaturation at 95 °C for 3 min; 28 cycles of 95 °C for 30 s, 65 °C for 30 s, and 72 °C for 30 s; final extension at 72 °C for 5 min (Miya et al. 2015). Same thermocycling setting was used in second PCR but with 10 cycles only. Second PCR products were re-cleaned, quantified on a Qubit Fluorometer 4.0 (Thermo Fisher Scientific 2019), sized on a LabChip GX Touch Nucleic Acid Analyzer (Revvity 2022), normalised to 1 nM, pooled, and sequenced on an Illumina NovaSeq 6000 platform (Illumina 2024). Demultiplexing was performed using Illumina DRAGEN v. 4.3 (Illumina 2024).

**Bioinformatics and taxonomic assignment.** The sequencing reads were quality-assessed and trimmed using QIIME2 software package (Bolyen et al. 2019). In this step, adaptor and primer sequences were trimmed using Cutadapt (Martin 2011), and pair-end reads merging, denoising and chimera removing were carried out using DADA 2 (Callahan et al. 2016) with the parameters -p-trim-left-f 9 and -p-trunc-len-f 123 on the forward read while -p-trim-left-r 16 and -p-trunc-len-r 108 on the reverse read. After that, clustering of the sequences was performed at 99% similarity threshold by VSEARCH (Rognes et al. 2016) to generate operational taxonomic units (OTUs). This is to reduce redundancy and account for potential intraspecific mitochondrial variations (Miya et al. 2020). Quality-controlled reads were mapped against the MitoFish reference database (Sato et al. 2018), and taxonomic assignment was performed at the lowest possible rank, requiring a minimum sequence identity of 0.95 for species-level assignments. The OTU assigned to Carcharhinidae was cross verified against National Center for Biotechnology Information (NCBI) nucleotide records with the nearest-neighbour matched of other *Carcharhinus* spp., as well as the IUCN Red List (Simpfendorfer et al. 2020) and FishBase (Froese and Pauly 2026) for its distribution.

# Results

Illumina sequencing runs generated a total of 0.72 GB raw data, from which approximately 4.97 million paired-end reads across two stations (G1: ~2,101,239, G2: 2,866,518). Following quality filtering, denoising, read merging, and chimera removal using DADA2, 1,474,516 high-quality non-chimeric reads were retained for downstream analysis (G1: 698,509 reads, G2: 776,007 reads). Taxonomic assignment was successful for 99.86% of reads with 63.96% were classified as fish (Actinopterygii), while 35.89% reads corresponded to non-target taxa such as algae, bacteria and protist, and 0.14% of the reads were unable to be identified. Land animals like sheep, chimpanzees, and humans were also detected but these detections were insignificant (<0.00%).

OTU clustering at 99% similarity using VSEARCH yielded 65 fish OTUs in total, with only 44 OTUs corresponding to taxa previously reported from the study region or neighbour country (G1 with 24 OTUs, and G2 with 22 OTUs) were annotated to exist in or around the current study area. *Carcharhinus melanopterus* was detected in G2, representing 6.04% of fish-assigned reads at that site (Table 1).

Carcharhiniformes, Carcharhinidae

***Carcharhinus melanopterus* (Quoy & Gaimard, 1824)**

**New record.** MALAYSIA — Kota Belud District, Sabah • Mantanani Island; 06°42′30″N, 116°20′45″E; 9 May 2024; Chen CA obs.; surface seawater eDNA sample preserved on Sterivex 0.45 µm filter in DNAiso Reagent; sheltered seagrass back zone (Site G2); BioProject PRJNA1460790.

The detection lies well within the established Indo-Pacific distribution of *C. melanopterus* (Simpfendorfer et al. 2020; Froese and Pauly 2026). This is, to our knowledge, the first molecular (eDNA-based)

**Table 1.** Summary of read statistics per sample and the proportion of *Carcharhinus melanopterus* final reads.

| Sample | G1 | G2 |
|---|---|---|
| Raw reads | 2,101,239 | 2,866,518 |
| Post-filter reads | 698,509 | 776,007 |
| OTUs | 60 | 68 |
| Fish OTUs | 24 | 22 |
| Taxonomically assigned (%) | 47.37 | 52.49 |
| Fish reads (%) | 57.24 | 44.53 |
| *Carcharhinus melanopterus* reads (%) | 0 | 6.04 |

occurrence record of *C. melanopterus* from Mantanani Island seagrass habitat.

**Identification.** A single OTU (representative sequence identifier e235758e1732a2d5dcd69f04b532968b, 155-bp fragment of the mitochondrial 12S rRNA gene) yielded a 100% identity match (coverage 1.00) to the reference sequence of *C. melanopterus* (NCBI taxid 263686) in the MitoFish database (Table 2). The OTU was recovered with 20,881 reads exclusively at Site G2. No reads of this OTU were detected at the site G1. No visible bands were observed in either controls (field and lab), indicating the absence of detectable contamination or amplification.

Representative sequence (5′→3′): TATACGAGTAACTCATATTAACACACCCCGGCGTAAAGAGTGATTAAAGAATGACCTTTAACTACTAAAGTTTAGACCTCATAAAACTGTTATACGTACCCATGAGTGGAATAAACAATAACGAAAGTGACTTTATAAATCAAGGAACCTTGATGT

The OTU assigned to *C. melanopterus* was validated against both MitoFish and NCBI reference databases. In MitoFish, the nearest neighbour pattern is consistent: *C. melanopterus*, followed by other *Carchahinus* spp. such as *C. brachyurus*, *C. brevipinna*, and *C. leucas*, all with lower alignment scores. In NCBI BLAST, it shows 99.36% across 100% query cover with *C. melanopterus* sequences with accession number of KJ720818 and NC_024284 (Table 3). On the other hand, it shows lower identity with the closest non-target congeners, *C. leucas* (97.44%), *C. limbatus* (96.79%), *C. amblirhynchos* (94.87%), and *C. sorrah* (94.87%). The approximately 1.92% identity gap between *C. melanopterus* and the nearest heterospecific match supports the species-level assignment.

**Table 2.** Molecular identification details of the *Carcharhinus melanopterus* OTU recovered from Mantanani Island, Site G2.

| Parameter | Value |
|---|---|
| Representative OTU ID | e235758e1732a2d5dcd69f04b532968b |
| Target region | Mitochondrial 12S rRNA (MiFish amplicon) |
| Fragment length | 155 bp |
| Top reference match | *Carcharhinus melanopterus* |
| NCBI taxid | 263686 |
| Sequence identity | 100% |
| Coverage | 1.00 |
| Reads at G2 (back zone) | 20,881 |
| Reads at G1 (front zone) | 0 |
| IUCN Red List status | Vulnerable |
| CITES listing | Appendix II |

**Table 3.** The percentage identity between the *C. melanopterus* from current study and the nearest heterospecific match of *Carcharhinus* spp. from NCBI reference database.

| Species | Accession | Query coverage | Percent Identity |
|---|---|---|---|
| *Carcharhinus melanopterus* | KJ720818.1 | 100% | 99.36% |
| *Carcharhinus melanopterus hinus* | NC_024284.1 | 100% | 99.36% |
| *Carcharhinus leucas* | OP006990.1 | 100% | 97.44% |
| *Carcharhinus leucas* | OP007104.1 | 100% | 97.44% |
| *Carcharhinus limbatus* | MH248235.1 | 100% | 96.79% |
| *Carcharhinus limbatus* | LC327204.1 | 100% | 96.79% |
| *Carcharhinus amblirhynchos* | MT093205.1 | 100% | 94.87% |
| *Carcharhinus amblirhynchos* | NC_047238.1 | 100% | 94.87% |
| *Carcharhinus sorrah* | KF612341.1 | 100% | 94.87% |
| *Carcharhinus sorrah* | NC_023521.1 | 100% | 94.87% |

# Discussion

The present record confirms recent use of the Mantanani Island seagrass and reef interconnect ecosystem by *Carcharhinus melanopterus*. This species is Vulnerable according to the IUCN Red List (Simpfendorfer et al. 2020) and is included in Appendix II of CITES (2022). Detection of species through eDNA without visual observation is one of the recognized strengths of marine metabarcoding surveys (Boussarie et al. 2018). At Mantanani Island, the destructive fishing pressure is well documented (Reef Check Malaysia 2025) and current molecular confirmation of elasmobranch presence carries direct relevance for conservation and reinforces the island's broader status as a priority coastal habitat. Juvenile

*C. melanopterus* have been documented to use very shallow (<1 m) sandy reef flats and lagoonal habitats as nursery and predator-avoidance zones. They often move in synchronization with tidal cycles (Chin et al. 2013a, 2013b; George et al. 2019). The recovery of a strong *C. melanopterus* signal from the seagrass at Mantanani is, therefore, ecologically plausible.

Research carried out between 2015 and 2026 found that *C. melanopterus* maintains a widespread distribution, primarily cantered across the tropical and subtropical waters of the Indo-Pacific (Osgood and Baum 2015; Simpfendorfer et al. 2020). Studies of the population genomics of this species indicate that it originally emerged from the Indo-Australian Archipelago before undergoing significant historical demographic range expansions both eastward into the Pacific Ocean and westward into the Indian Ocean (Maisano Delser et al. 2019; Lesturgie et al. 2023). Within its core range across Oceania and Southeast Asia, *C. melanopterus* is highly abundant in shallow-nearshore reef nurseries, turbid coastal environments, and mangrove habitats, with extensive contemporary observation records from Australia, Indonesia, and Thailand (Chin et al. 2016; Ward-Paige et al. 2018; George et al. 2019; Di Tommaso et al. 2024; Froese and Pauly 2026; Kanno et al. 2024; Iqbal et al. 2026). Moving eastward, *C. melanopterus* acts as a dominant predator in isolated coral-reef and lagoon ecosystems throughout the Central Pacific, notably within Palmyra Atoll and the sprawling shark sanctuaries of French Polynesia (Papastamatiou et al. 2015; Bouyoucos et al. 2020; Sabando et al. 2020; Farabaugh et al. 2025). To the west, the species occurs throughout the Indian Ocean and the Middle East, where it has been documented in the Maldives and in the coastal artisanal fisheries of Kenya, the Red Sea, and the Arabian Gulf (Kiilu et al. 2019; Jabado et al. 2021; Wambiji et al. 2022; Al-Sabi et al. 2022; Parmegiani et al. 2023; Al-Khatib et al. 2025). Furthermore, recent aerial and submersible surveys have confirmed that the distribution of *C. melanopterus* occasionally extends to the extreme edge of the Eastern Tropical Pacific, with rare observations recorded as far as east as Isla del Coco in Costa Rica (Fernández-Martínez et al. 2024). For details on the distribution of *C. melanopterus* in recent decades, see Appendix (Table A1).

The eDNA record of *C. melanopterus* is based on water samples collected during a single sampling event; the detection of this species should be interpreted as molecular evidence of its recent occurrence at the sample site. Environmental DNA read counts are shaped by primer affinity, mitochondrial copy number, body size, and variable shedding rates, and should not be interpreted as a direct measure of organism abundance or biomass (Yates et al. 2019). The 20,881 reads recovered here constitute molecular evidence of recent occurrence, not an estimate of population size or density. The eDNA can be transported by water movement. The present detection provides a molecular baseline to guide future monitoring efforts. Replicated eDNA sampling across tidal states, seasons, and multiple habitat zones, combined with baited remote underwater video (BRUV) surveys or acoustic tagging would allow evaluation of how frequently *C. melanopterus* uses the Mantanani seagrass and reef system. These will later help to identify whether the species is a transient visitor or a resident of this habitat. The broader metabarcoding survey from which this record is drawn detected 35 fish species across 22 families at Mantanani Island; the complete community-level dataset is publicly accessible via NCBI SRA (BioProject PRJNA1460790). The present record supports the use of eDNA metabarcoding as a rapid, non-invasive screening tool for CITES-listed elasmobranchs in undersurveyed tropical coastal habitats, and it contributes a locality-specific molecular baseline relevant to ongoing conservation attention at this priority site.

# Acknowledgements

We sincerely thank the Academic Editor and the anonymous reviewers for their constructive comments and valuable suggestions, which greatly improved the quality and clarity of this manuscript. We also thank JSK Resort for logistical support during field sampling at Mantanani Island. Mr. See Sian Tian is gratefully acknowledged for providing local ecological information and guidance during fieldwork. Laboratory and bioinformatics facilities were provided by the Institut Marin Borneo, Universiti Malaysia Sabah (UMS). This study was conducted under research permit no. JKM/MBS.1000-2/2/1 JLD.1 (140) issued by the Sabah Biodiversity Centre (SaBC).

# Additional information

**Conflict of interest**

The authors declare that no competing interests exist.

**Ethical statement**
No ethical statement is reported.

**Use of artificial intelligence (AI)**
The authors used artificial intelligence (AI) tools to assist with language editing and improving the clarity and readability of the manuscript. All scientific content, interpretations, and conclusions were developed and verified by the authors, who take full responsibility for the final manuscript.

**Funding**
This study was financially supported by Universiti Malaysia Sabah under grant GUG0556-1/20223.

**Author contributions**
Conceptualization: CCA. Formal analysis and data curation: CCA, NWL, TK. Methodology: CCA. Investigation: CCA JJ, MANA. Writing – original draft: CCA. Writing – review and editing: CCA, NWL, TK. Resources: JJ, MANA. All authors reviewed and approved the final manuscript.

**Author ORCID iDs**
Chen Cheng Ann https://orcid.org/0000-0001-9168-1910
Ng Wei-Ling https://orcid.org/0009-0003-8626-8840
Tadashi Kajita https://orcid.org/0000-0003-1232-4179
Juanita Joseph https://orcid.org/0000-0002-6995-7973

**Data availability**
All data that support the findings of this study are available in the main text and Appendix.

# References

**Abd Haris Hilmi AA, Hamizah NA, Ahmad A, Kissol L, Rosdi MN, Sukri M** (2020) Terminal report data collection on sharks and rays by species in Tawau, Sabah (Phase I) October 2018–September 2019 (SEAFDEC/MFRDMD/SP/48). Southeast Asian Fisheries Development Center, Kuala Terengganu, Malaysia, 33 pp.

**Al-Khatib ZIM, Azab AM, El-Tabakh MAM, Afifi MAM** (2025) Quantitative morphometric analysis of dorsal fin for species identification in sharks (family: Carcharhinidae) from the Suez Gulf, Red Sea, Egypt. Mediterranean Aquaculture Journal 12 (1): 13–27.

**Al-Sabi MNS, Ibrahim MM, Al-Hizab F, Al-Jabr OA, Al-Shubaythi S, Huffman DG** (2022) *Huffmanela selachii* n. sp. (Nematoda: Trichosomoididae: Huffmanelinae): A new species infecting the skin of the Great Hammerhead Shark *Sphyrna mokarran* and the Blacktip Reef Shark *Carcharhinus melanopterus* in the Arabian Gulf, off-shore Saudi Arabia. Saudi Journal of Biological Sciences 29 (12): 103430. https://doi.org/10.1016/j.sjbs.2022.103430

**Ambo-Rappe R, La Nafie YA, Marimba AA, Rismayani A, Unsworth RKF** (2021) Bycatch from seagrass fisheries: implication for conservation. IOP Conference Series: Earth and Environmental Science 860: 012107. https://doi.org/10.1088/1755-1315/860/1/012107

**Amir F, Mallawa A, Tresnati J** (2020) Size structure and sex ratio of black tip reef shark *Carcharhinus melanopterus* landed in the TPI Paotere of Makassar City and TPI Beba of Takalar Regency, Province South Sulawesi. Jurnal Agribisnis Perikanan (AGRIKAN) 13 (2): 232–237.

**Amir F, Mallawa A, Tresnati J** (2021) Population dynamics of *Carcharhinus melanopterus* caught from southern Makassar Strait, Indonesia. Ecology, Environment and Conservation 27 (4): 1913–1917.

**Arisandi, Arsana IN, Sudaryati NLG** (2020) Composition of size and gender of Black Fin Coral Shark fish *Carcharhinus melanopterus* Bali export commodity. Widya Biologi 11 (1): 52–58.

**Bakhraibah AO** (2018) A comparison study between external parasites that infect *Scarus* fish (Osteichthyes) and *Carcharhinus melanopterus* fish (Chondrichthyes) in Red Sea coast of Jeddah, Saudi Arabia. Biosciences Biotechnology Research Asia 15 (4): 881–886. https://doi.org/10.13005/bbra/2698

**Barley SC, Meeuwig JJ, Meekan MG** (2020) Ecological redundancy between a predatory shark and large-bodied teleosts in the Indo-Pacific. Reviews in Fish Biology and Fisheries 30: 153–172. https://doi.org/10.1007/s11160-019-09588-6

**Beckman Coulter** (2023) AMPure XP beads: PCR cleanup and size selection reagent (Product P/N A63881). Beckman Coulter Life Sciences, USA. https://www.beckman.com/reagents/genomic/cleanup-and-size-selection/pcr. Accessed on: 2026-5-18.

**Bolyen E, Rideout JR, Dillon MR, et al.** (2019) Reproducible, interactive, scalable and extensible microbiome data science using QIIME 2. Nature Biotechnology 37 (8): 852–857. https://doi.org/10.1038/s41587-019-0209-9

**Boussarie G, Bakker J, Wangensteen OS, Mariani S, Bonnin L, Juhel J-B, Kiszka JJ, Kulbicki M, Manel S, Robbins WD, Vigliola L, Mouillot D** (2018) Environmental DNA illuminates the dark diversity of sharks. Science Advances 4 (5): eaap9661. https://doi.org/10.1126/sciadv.aap9661

**Bouyoucos IA, Weideli OC, Planes S, Simpfendorfer CA, Rummer JL** (2018) Dead tired: evaluating the physiological status and survival of neonatal reef sharks under stress. Conservation Physiology 6 (1): coy053. https://doi.org/10.1093/conphys/coy053

**Bouyoucos IA, Romain M, Azoulai L, Eustache K, Mourier J, Rummer JL, Planes S** (2020) Home range of newborn Blacktip Reef Sharks (*Carcharhinus melanopterus*), as estimated using mark-recapture and acoustic telemetry. Coral Reefs 39: 1209–1214. https://doi.org/10.1007/s00338-020-01965-z

**Bouyoucos IA, Trujillo JE, Weideli OC, Nakamura N, Mourier J, Planes S, Simpfendorfer CA, Rummer JL** (2021) Investigating links between thermal tolerance and oxygen supply capacity in shark neonates from a hyperoxic tropical environment. Science of the Total Environment 782: 146854. https://doi.org/10.1016/j.scitotenv.2021.146854

**Callahan BJ, McMurdie PJ, Rosen MJ, Han AW, Johnson AJA, Holmes SP** (2016) DADA2: High-resolution sample inference from Illumina amplicon data. Nature Methods 13(7): 581–583. https://doi.org/10.1038/nmeth.3869

**Chin A, Heupel MR, Simpfendorfer CA, Tobin AJ** (2013a) Ontogenetic movements of juvenile Blacktip Reef Sharks: evidence of dispersal and connectivity between coastal habitats and coral reefs. Aquatic Conservation: Marine and Freshwater Ecosystems 23 (3): 468–474. https://doi.org/10.1002/aqc.2349

**Chin A, Heupel MR, Simpfendorfer CA, Tobin AJ** (2016) Population organization in reef sharks: new variations in coastal habitat use by mobile marine predators. Marine Ecology Progress Series, 544, 197–211. https://doi.org/10.3354/meps11545

**Chin A, Tobin AJ, Heupel MR, Simpfendorfer CA** (2013b) Population structure and residency patterns of the Blacktip Reef Shark *Carcharhinus melanopterus* in turbid coastal environments. Journal of Fish Biology 82 (4): 1192–1210. https://doi.org/10.1111/jfb.12057

**CITES** (2022) Consideration of proposals for amendment of Appendices I and II: Proposal 37 — family Carcharhinidae. Nineteenth Meeting of the Conference of the Parties, Panama City, Panama,15 pp. https://cites.org/sites/default/files/documents/E-CoP19-Com-I-Rec-06-R1.pdf. Accessed on: 2026-5-18.

**Clua EEG, Haguenauer A** (2019) Nonfatal bites by a Sicklefin Lemon Shark (*Negaprion acutidens*) on a surfer in Makemo Atoll, French Polynesia. Journal of Forensic Sciences 65 (1): 304–308. https://doi.org/10.1111/1556-4029.14228

**Dapp DR, Huveneers C, Walker TI, Reina RD** (2017) Physiological response and immediate mortality of gill-net-caught blacktip reef sharks (*Carcharhinus melanopterus*). Marine and Freshwater Research 68 (9): 1734. https://doi.org/10.1071/MF16132

**Debaere SF, Weideli OC, Bouyoucos IA, Eustache KB, Trujillo JE, De Boeck G, Planes S, Rummer JL** (2023) Quantifying changes in umbilicus size to estimate the relative age of neonatal blacktip reef sharks *Carcharhinus melanopterus*. Conservation Physiology 11 (1): coad028. https://doi.org/10.1093/conphys/coad028

**Di Tommaso A, Sailar S, Leonetti FL, Sperone E, Giglio G** (2024) A proposed method for assessing the spatio-temporal distribution of *Carcharhinus melanopterus* (Quoy and Gaimard, 1824) in shallow waters using a UAV: a study conducted in Koh Tao, Thailand. Diversity 16 (10): 606. https://doi.org/10.3390/d16100606

**Effendi I, Sari RP, Amani MD** (2024) Identification, conservation status, trade and legal protection basis of *Carcharhinus* shark caught in the waters of Riau Islands Province, Indonesia. International Journal of Conservation Science 15 (4): 1871–1884.

**Eustache KB, van Loon E, Rummer JL, Planes S, Smallegange I** (2024) Spatial and temporal analysis of juvenile blacktip reef shark *Carcharhinus melanopterus* demographies identifies critical habitats. Journal of Fish Biology 104 (1): 92–103. https://doi.org/10.1111/jfb.15569

**Farabaugh NF, Bond ME, Chapman D, Clua E, Dedman S, Harborne AR, Kiszka JJ, Heupel M, Heithaus MR** (2025) Elasmobranch species richness and assemblage composition in the world's largest shark sanctuary. Marine Ecology Progress Series 753: 155–173. https://doi.org/10.3354/meps14770

**Ferdiansyah D, Hidayat MT** (2019) Fishermen's perception of shark conservation sustainable and its effect on shark catching: a case study on Madura Island. Journal of Aquaculture Development and Environment 2 (1): 38–44.

**Fernández-Martínez S, Madrigal-Mora S, Golfín-Duarte G, Espinoza M** (2024) Unoccupied aerial vehicle (UAV) observations of large-bodied fishes on a tropical oceanic island. https://ssrn.com/abstract=5261444. Accessed on: 2026-5-18.

**Freeman A, Wright A** (2021) Social grouping behaviour in early juvenile blacktip reef sharks around Milman Island in the far north of the Great Barrier Reef, Queensland. North Queensland Naturalist 51: 12–15.

**Frisch AJ, Rizzari JR** (2019) Parks for sharks: human exclusion areas outperform no-take marine reserves. Frontiers in Ecology and the Environment 17 (3): 145–150. https://doi.org/10.1002/fee.2003

**Froese R, Pauly D** (Eds) (2026) FishBase. World Wide Web electronic publication. http://www.fishbase.org, version (02/2026). Accessed on: 2026-5-19.

**Ganesh K, Geetha B** (2020) A study on the by-catch assessment of mature sharks (superorder Selachimorpha) in commercial fishing at Thoothukudi District fish landing centers, Tamil Nadu. International Journal of Engineering Research & Technology 9 (1): 577–580.

**George LW, Martins APB, Heupel MR, Simpfendorfer CA** (2019) Fine-scale movements of juvenile blacktip reef sharks *Carcharhinus melanopterus* in a shallow nearshore nursery. Marine Ecology Progress Series 623: 85–97. https://doi.org/10.3354/meps13010

**Gore MA, Ormond R, Clarke C, Kohler J, Millar C, Brooks E** (2020) Application of photo-identification and lengthened deployment periods to baited remote underwater video stations (BRUVS) abundance estimates of coral reef sharks. Oceans 1 (4): 274–299. https://doi.org/10.3390/oceans1040019

**Graham NAJ, Spalding MD, Sheppard CRC** (2010) Reef shark declines in remote atolls highlight the need for multi-faceted conservation action. Aquatic Conservation: Marine and Freshwater Ecosystems 20 (5): 543–548. https://doi.org/10.1002/aqc.1116

**Illumina** (2024) DRAGEN secondary analysis (version 4.3). Illumina, Inc. https://www.illumina.com/products/by-type/informatics-products/dragen-secondary-analysis.html. Accessed on: 2026-5-18.

**In-Depth Innovations** (2026) Darwin Harbour BioReef Trial: progress report (February 2026) https://indepthin.com/files/Darwin_BioReef_Trial_Progress_Report_March_2026.pdf. Accessed on: 2026-5-18.

**Ip YCA, Chang JJM, Lim KKP, Jaafar Z, Wainwright BJ, Huang D** (2021) Seeing through sedimented waters: environmental DNA reduces the phantom diversity of sharks and rays in turbid marine habitats. BMC Ecology and Evolution 21: 166. https://doi.org/10.1186/s12862-021-01895-6

**Iqbal M, Saputra RF, Setiawan A, Yustian I** (2019) First photographic inland record of Blacktip Reef Sharks *Carcharhinus melanopterus* (Carcharhiniformes: Carcharhinidae) in Indonesian waters. Ecologica Montenegrina 24: 6–10.

**Iqbal M, Sari HPE, Widayanti GA, Chodrijah U, Hidayat O, Aprillia I, Syafutra R, Sari DK, Baderan DWK, Arifah N, Pattiselanno F** (2026) Annotated checklist of sharks and rays (Chondrichthyes: Elasmobranchii) in Indonesia: a priority-based approach for conservation and research efforts. IOP Conference Series: Earth and Environmental Science 1581: 012028. https://doi.org/10.1088/1755-1315/1581/1/012028

**Jabado RW, Antonopoulou M, Moller M, Al Suweidi AS, Al Suwaidi AMS, Mateos-Molina D** (2021) Baited remote underwater video surveys to assess relative abundance of sharks and rays in a long-standing and remote marine protected area in the Arabian Gulf. Journal of Experimental Marine Biology and Ecology 540: 151565. https://doi.org/10.1016/j.jembe.2021.151565

**Javidani AA, MS Y, Ichsan M, Herawati T, Ihsan YN** (2026) Species diversity, conservation status, and policy gaps of landed elasmobranchs at Ujungbatu fish landing site, Jepara in support of SDG 14 Life Below Water. Jurnal Penelitian Pendidikan IPA 12 (3): 353–362. https://doi.org/10.29303/jppipa.v12i3.14685

**Jayathilaka RA., Haputhanthri SSK, Perera HACC** (2016). Identification of thirteen pelagic shark species of the Indian ocean occurring around Sri Lanka; using morphological characters of their fins (IOTC-2016-WPEB12-23 Rev_1). Indian Ocean Tuna Commission, Crow Island, Colombo 15, Sri Lanka, 1–23.

**Kanno S, Heupel MR, Hoel K, Schlaff A, Siddiqi A, Simpfendorfer CA** (2024) Performance and detection range of acoustic receivers in mangrove habitats. Journal of Fish Biology 106 (5): 1540–1553. https://doi.org/10.1111/jfb.15817

**Kiilu BK, Ndegwa SW** (2018) Preliminary assessment of shark bycatch from Kenya's nascent industrial tuna fisheries (IOTC-2018-WPEB14-28). Indian Ocean Tuna Commission, Kenya, 1–11.

**Kiilu BK, Kaunda-Arara B, Oddenyo RM, Thoya P, Njiru JM** (2019) Spatial distribution, seasonal abundance and exploitation status of shark species in Kenyan coastal waters. African Journal of Marine Science 41 (2): 191–201. https://doi.org/10.2989/1814232X.2019.1624614

**Kiszka JJ, Mourier J, Gastrich K, Heithaus MR** (2016) Using unmanned aerial vehicles (UAVs) to investigate shark and ray densities in a shallow coral lagoon. Marine Ecology Progress Series 560: 237–242. https://doi.org/10.3354/meps11945

**Kurniawan W, Oktaviyani S, Suparmo, Fahmi** (2022) Length–weight and length–length relationships for eight shark species from Indonesian waters. Journal of Applied Ichthyology 38: 557–560. https://doi.org/10.1111/jai.14346

**Lelono TD, Bintoro G, Rihmi MK, Pratiwi VD, Wiadnya DGR** (2021) The biological aspect of four shark species (*Galeocerdo cuvier*, *Sphyrna lewini*, *Atelomycterus marmoratus*, *Carcharhinus melanopterus*) of land in Muncar Coastal Fishing Port Banyuwangi East Java. IOP Conference Series: Earth and Environmental Science 718: 012064. https://doi.org/10.1088/1755-1315/718/1/012064

**Lennox RJ** (2016) Bonefish paradise. Fisheries 41 (10): 571–572. https://doi.org/10.1080/03632415.2016.1225477

**Lester E, Langlois T, Lindgren I, Birt M, Bond T, McLean D, Vaughan B, Holmes TH, Meekan M** (2022) Drivers of variation in occurrence, abundance, and behaviour of sharks on coral reefs. Scientific Reports 12: 728. https://doi.org/10.1038/s41598-021-04024-x

**Lesturgie P, Planes S, Mona S** (2021) Coalescence times, life history traits and conservation concerns: an example from four coastal shark species from the Indo-Pacific. Molecular Ecology Resources 21: 2354–2370. https://doi.org/10.1111/1755-0998.13487

**Lesturgie P, Braun CD, Clua E, Mourier J, Thorrold SR, Vignaud T, Planes S, Mona S** (2023) Like a rolling stone: colonization and migration dynamics of the Gray Reef Shark (*Carcharhinus amblyrhynchos*). Ecology and Evolution 13: e9746. https://doi.org/10.1002/ece3.9746

**Levina M, Sunarto, Pamungkas W, Ismail MR, Salim MG** (2025) Length distribution and abundance of sharks and relationship with temperature in the Bali Strait Waters. Egyptian Journal of Aquatic Biology & Fisheries 29 (2): 885–895.

**López-Garro A, Zanella I, Golfín-Duarte G, Pérez-Montero M** (2012) First record of the blacktip reef shark *Carcharhinus melanopterus* (Carcharhiniformes: Carcharhinidae) from the Tropical Eastern Pacific. Revista de Biología Tropical 60: 275–278.

**Maisano Delser P, Corrigan S, Duckett D, Suwalski A, Veuille M, Planes S, Naylor GJP, Mona S** (2019) Demographic inferences after a range expansion can be biased: the test case of the Blacktip Reef Shark (*Carcharhinus melanopterus*). Heredity 122 (6): 759–769. https://doi.org/10.1038/s41437-018-0164-0

**Maisano Delser P, Corrigan S, Hale M, Li C, Veuille M, Planes S, Naylor GJP, Mona S** (2016) Population genomics of *C. melanopterus* using target gene capture data: demographic inferences and conservation perspectives. Scientific Reports 6: 33753. https://doi.org/10.1038/srep33753

**Martin M** (2011) Cutadapt removes adapter sequences from high-throughput sequencing reads. EMBnet.journal 17(1): 10–12. https://doi.org/10.14806/ej.17.1.200

**McCauley DJ, Young HS, Dunbar RB, Estes JA, Semmens BX, Micheli F** (2012) Assessing the effects of large mobile predators on ecosystem connectivity. Ecological Applications 22 (6): 1711–1717. https://doi.org/10.1890/11-1653.1

**Miya M, Gotoh RO, Sado T** (2020) MiFish metabarcoding: a high-throughput approach for simultaneous detection of multiple fish species from environmental DNA and other samples. Fisheries Science 86 (6): 939–970. https://doi.org/10.1007/s12562-020-01461-x

**Miya M, Sato Y, Fukunaga T, Sado T, Poulsen JY, Sato K, Minamoto T, Yamamoto S, Yamanaka H, Araki H, Kondoh M, Iwasaki W** (2015) MiFish, a set of universal PCR primers for metabarcoding environmental DNA from fishes: detection of more than 230 subtropical marine species. Royal Society Open Science 2 (7): 150088. https://doi.org/10.1098/rsos.150088

**Mohanraj T, Jebarani Rajathy T, Sherly Cross SRT** (2025) Morphometric relationships of six vulnerable sharks from the southern coast of India. Thalassas: an International Journal of Marine Sciences 41: 40. https://doi.org/10.1007/s41208-025-00796-5

**Monjurul Hasan Md, Sarker BS, Rahman M, Shamsul Alam Patwary Md, Jahangir Sarker Md** (2015) Present yield status, percentage composition and seasonal abundance of shark in two geographically important zones of Bangladesh. Fisheries and Aquaculture Journal 6 (4): 1000144.

**Mopay M, Wullur S, Onibala H, Ginting EL, Rumengan IFM, Sondak CFA, Sumilat DA** (2021) Molecular identification and conservation status of sharks from the fins trade in Manado City, North Sulawesi. Jurnal Ilmiah Platax 9 (2): 347–355.

**Mourier J, Planes S** (2013) Direct genetic evidence for reproductive philopatry and associated fine-scale migrations in female blacktip reef sharks (*Carcharhinus melanopterus*) in French Polynesia. Molecular Ecology 22 (1): 201–214. https://doi.org/10.1111/mec.12103

**Mourier J, Claudet J, Planes S** (2021) Human-induced shifts in habitat use and behaviour of a marine predator: the effects of bait provisioning in the blacktip reef shark. Animal Conservation 24 (2): 230–238.

**Mukharror DA, Fadli R, Ghiffari F** (2021) The COVID-19 pandemic and the impact on the absence of diver-shark interaction on Blacktip Reef Sharks agonistic behavior: Morotai case. IOP Conference Series: Earth and Environmental Science 777: 012038. https://doi.org/10.1088/1755-1315/777/1/012038

**Mukharror DA, Baiti IT, Ichsan M, Pridina N, Triutami S** (2017) Correlation between existence of reef sharks with abundance of reef fishes in south waters of Morotai Island, north Moluccas. IOP Conference Series: Earth and Environmental Science 89: 012006. https://doi.org/10.1088/1755-1315/89/1/012006

**Naputo CFP, Isowa Y, Gerona-Daga ME, Artigas MD, Kajita T, Salmo SG III** (2024) Application of eDNA metabarcoding in the assessment of fish biodiversity in Philippine mangroves: challenges and opportunities. Regional Studies in Marine Science 77: 103642. https://doi.org/10.1016/j.rsma.2024.103642

**Osgood GJ, Baum JK** (2015) Reef sharks: recent advances in ecological understanding to inform conservation. Journal of Fish Biology 87 (6): 1489–1523. https://doi.org/10.1111/jfb.12839

**Papastamatiou YP, Watanabe YY, Bradley D, Dee LE, Weng K, Lowe CG, Caselle JE** (2015) Drivers of daily routines in an ectothermic marine predator: hunt warm, rest warmer? PLoS ONE 10 (6): e0127807. https://doi.org/10.1371/journal.pone.0127807

**Parmegiani A, Gobbato J, Seveso D, Galli P, Montano S** (2023) First record of the bull shark *Carcharhinus leucas* (Valenciennes, 1839) from the Maldivian archipelago, central Indian Ocean. Journal of Fish Biology 103 (5): 1242–1247. https://doi.org/10.1111/jfb.15518

**Pogoreutz C, Gore M, Perna G, Ormond R, Clarke CR, Voolstra CR** (2025) Microenvironments of Blacktip Reef Sharks (*Carcharhinus melanopterus*) provide niche habitats for distinct bacterial communities. Coral Reefs 44: 145–162. https://doi.org/10.1007/s00338-024-02593-7

**Poniente JA, Pereda JMR, Dela Pena JT, Ventolero MFH, Santos MD** (2022) Mitochondrial DNA-based species testing of confiscated aquatic wildlife in the Philippines. Forensic Science International: Animals and Environments 2: 100051. https://doi.org/10.1016/j.fsiae.2022.100051

**Popa D, Beach N, Sadler C** (2020) A Blacktip Reef Shark bite to the hand in the remote Solomon Islands. The Journal of Emergency Medicine 60 (1): 1–4. https://doi.org/10.1016/j.jemermed.2020.09.009

**Rajamani L, Marsh H** (2010) Using parallel regional- and local-scale initiatives to inform conservation management of rare wildlife: a case study of the dugong *Dugong dugon* in Sabah, Malaysia. Endangered Species Research 13 (1): 17–23. https://doi.org/10.3354/esr00310

**Reef Check Malaysia** (2025) Status of coral reefs in Malaysia 2025: annual survey report. Reef Check Malaysia, Kuala Lumpur, Malaysia, 238 pp. https://reefcheck.org.my/wp-content/uploads/2026/01/2025-Annual-Survey-Report.pdf. Accessed on: 2026-5-18.

**Revvity** (2022) LabChip GX Touch nucleic acid analyzer user guide (PN CLS151164). Revvity Inc. https://www.revvity.com/product/labchip-gx-touch-24-cls138162. Accessed on: 2026-5-19.

**Rognes T, Flouri T, Nichols B, Quince C, Mahé F** (2016) VSEARCH: A versatile open source tool for metagenomics. PeerJ 4: e2584. https://doi.org/10.7717/peerj.2584

**Sabando MA, Rieucau G, Bradley D, Caselle JE, Papastamatiou YP** (2020) Habitat-specific inter and intraspecific behavioral interactions among reef sharks. Oecologia 193: 371–376. https://doi.org/10.1007/s00442-020-04676-y

**Sabarros PS, Tellier C** (2026) Sharks and rays basic indicators from the French purse seine and longline fisheries in the western Indian Ocean (IOTC-2026-WPEB22DP-04). In: Proceedings of the 22e Groupe de travail sur les écosystèmes et les prises accessoires (GTEPA). 15–17 avril 2026 [22nd Working Group on Ecosystems and Bycatch (WGEPA). April 15-17, 2026] Virtual/online, 113759. https://iotc.org/sites/default/files/documents/2026/04/IOTC-2026-WPEB22DP-04_-_FR_PS_sharks.pdf. Accessed on: 2026-5-20.

**Sato Y, Miya M, Fukunaga T, Sado T, Iwasaki W** (2018) MitoFish and MiFish pipeline: a mitochondrial genome database of fish with an analysis pipeline for environmental DNA metabarcoding. Molecular Biology and Evolution 35 (6): 1553–1555. https://doi.org/10.1093/molbev/msy074

**Schlaff AM, Heupel MR, Udyawer V, Simpfendorfer CA** (2017) Biological and environmental effects on activity space of a common reef shark on an inshore reef. Marine Ecology Progress Series 571: 169–181. https://doi.org/10.3354/meps12107

**Schwieterman GD, Bouyoucos IA, Potgieter K, Simpfendorfer CA, Brill RW, Rummer JL** (2019) Analysing tropical elasmobranch blood samples in the field: blood stability during storage and validation of the HemoCue haemoglobin analyser. Conservation Physiology 7 (1): coz081. https://doi.org/10.1093/conphys/coz081

**Simpfendorfer C, Yuneni RR, Tanay D, Seyha L, Haque AB, Fahmi, Bin Ali A, Bineesh KK, Gautama DA, Maung A, Sianipar A, Utzurrum JAT, Vo VQ** (2020) *Carcharhinus melanopterus*. The IUCN Red List of Threatened Species 2020: e.T39375A58303674. https://doi.org/10.2305/iucn.uk.2020-3.rlts.t39375a58303674.en. Accessed on: 2026-5-19.

**Speed CW, Cappo M, Meekan MG** (2018) Evidence for rapid recovery of shark populations within a coral reef marine protected area. Biological Conservation 220: 308–319. https://doi.org/10.1016/j.biocon.2018.01.010

**Speed CW, Meekan MG, Field IC, McMahon CR, Harcourt RG, Stevens JD, Babcock RC, Pillans RD, Bradshaw CJA** (2015) Reef shark movements relative to a coastal marine protected area. Regional Studies in Marine Science 3: 58–66. https://doi.org/10.1016/j.rsma.2015.05.002

**Stevenson C, Katz LS, Micheli F, Block B, Heiman KW, Perle C, Weng K, Dunbar R, Witting J** (2007) High apex predator biomass on remote Pacific islands. Coral Reefs 26 (1): 47–51. https://doi.org/10.1007/s00338-006-0158-x

**Subhan AM, Husain AAA, Burhanuddin AI, Budimawan, Bahar A** (2025) Diversity, distribution and conservation status of shark species from the waters of Langkai Island, Spermonde Archipelago. Jurnal Ilmu Kelautan Spermonde 12 (1): 1–8.

**Syafruddin R, Tolen N, Yusuf Y, Rusli MU, Bachok Z, Abdullah MM** (2024) Diversity and abundance of coral reef fishes, giving emphasis on the large predators at Chagar Hutang Bay, Redang Island. Universiti Malaysia Terengganu Journal of Undergraduate Research 6 (3): 40–49.

**Tapilatu ME, Siburian RHS, Tapilatu, JR** (2026) The potential role of shark tourism in raising ublic awareness for conservation in Raja Ampat. BIO Web of Conferences 213: 01011. https://doi.org/10.1051/bioconf/202621301011

**Thermo Fisher Scientific** (2019) Qubit 4 Fluorometer user guide (pub. no. MAN0017209). Invitrogen, Thermo Fisher Scientific, Singapore, 75 pp. https://documents.thermofisher.com/TFS-Assets%2FLSG%2Fmanuals%2FMAN0017209_Qubit_4_Fluorometer_UG.pdf. Accessed on: 2026-5-19.

**Thiele M, Mourier J, Papastamatiou Y, Ballesta L, Chateauminois E, Huveneers C** (2020) Response of Blacktip Reef Sharks (*Carcharhinus melanopterus*) to shark bite mitigation products. Scientific Reports 10: 3563. https://doi.org/10.1038/s41598-020-60062-x

**Tolen N, Then AYH, Abdullah MM** (2026) Spatiotemporal patterns and habitat associations of Blacktip Reef Shark in a shallow tropical bay. Environmental Biology of Fishes 109: 66.

**Tyabji Z, Wagh T, Patankar V, Jabado RW, Sutaria D** (2020) Catch composition and life history characteristics of sharks and rays (Elasmobranchii) landed in the Andaman and Nicobar Islands, India. PLoS ONE 15 (4): e0231069. https://doi.org/10.1371/journal.pone.0231069

**Vignaud T, Clua E, Mourier J, Maynard J, Planes S** (2013) Microsatellite analyses of Blacktip Reef Sharks (*Carcharhinus melanopterus*) in a fragmented environment show structured clusters. PLoS ONE 8 (4): e61067. https://doi.org/10.1371/journal.pone.0061067

**Vignaud TM, Maynard JA, Leblois R, Meekan MG, Nañez-James S, Planes S, Mourier J** (2014) Blacktip Reef Sharks, *Carcharhinus melanopterus*, have high genetic structure and varying demographic histories in their Indo-Pacific range. Molecular Ecology 23 (21): 5193–5207. https://doi.org/10.1111/mec.12936

**Wambiji N, Kadagi NI, Everett BI, Temple AJ, Kiszka JJ, Kimani E, Berggren P** (2022) Integrating long-term citizen science data and contemporary artisanal fishery survey data to investigate recreational and small-scale shark fisheries in Kenya. Aquatic Conservation: Marine and Freshwater Ecosystems 32 (8): 1306–1322. https://doi.org/10.1002/aqc.3829

**Ward-Paige CA, Westell A, Sing B** (2018) Using eOceans diver data to describe contemporary patterns of marine animal populations: a case study of sharks in Thailand. Ocean and Coastal Management 163: 1–10. https://doi.org/10.1016/j.ocecoaman.2018.05.023

**Weideli OC, Mourier J, Planes S** (2015) A massive surgeonfish aggregation creates a unique opportunity for reef sharks. Coral Reefs 34: 835. https://doi.org/10.1007/s00338-015-1290-2

**Wetherbee BM, Crow GL, Lowe CG** (1997) Distribution, reproduction and diet of the Gray Reef Shark *Carcharhinus amblyrhynchos* in Hawaii. Marine Ecology Progress Series 151: 181–189. https://doi.org/10.3354/meps151181

**Yates MC, Fraser DJ, Derry AM** (2019) Meta-analysis supports further refinement of eDNA for monitoring aquatic species-specific abundance in nature. Environmental DNA 1 (1): 5–13. https://doi.org/10.1002/edn3.7

**Yon A, Meekan MG, Andrzejaczek S, Martinez S, Speed CW** (2020) Shark and ray community structure in a turbid, nearshore coral reef habitat. Marine and Freshwater Research 71: 930–942. https://doi.org/10.1071/mf19301

# Appendix

**Table A1.** Global distribution records of the blacktip reef shark *Carcharhinus melanopterus* (Quoy & Gaimard, 1824) compiled from published and grey literature (2015-2026). Records are organized by biogeographic region and country. Column headers are defined as follows: Region: broad biogeographic zone following recognized marine classifications; Country: sovereign nation or territory of record; Area/State: sub-national locality, reef system, island, or landing site; Observation Method: primary technique used to confirm species presence (see abbreviations below); Remarks: contextual ecological, fisheries, or methodological notes pertaining to the record; Reference(s)

| No. | Region | Country | Area / state | Observation method | Remarks | Reference(s) |
|---|---|---|---|---|---|---|
| 1 | Indo-Pacific: Oceania | Australia | Western Australia: Ashmore Reef | Baited Remote Underwater Video Stations (BRUVS) | Confirmed at Ashmore Reef during 2004 fished-period surveys and 2016 post-MPA-enforcement surveys | Speed et al. (2018) |
| 2 | | Australia | Western Australia: Scott Reefs | BRUVS | Recorded as a reef shark component; subject to targeted Indonesian artisanal fishing for fins | Speed et al. (2018) |
| 3 | | Australia | Western Australia: Rowley Shoals | BRUVS | Part of the resident assemblage in a near-baseline unfished shark community | Speed et al. (2018) |
| 4 | | Australia | Western Australia: Ningaloo Marine Park | BRUVS | Third most abundant reef shark in shallow deployments. No-Take Area zoning had no significant effect on occurrence | Lester et al. (2022) |
| 5 | | Australia | Western Australia: Ningaloo Reef | Passive acoustic telemetry | Strong site fidelity recorded, with juveniles highly protected within the Mangrove Bay Sanctuary Zone | Speed et al. (2015) |
| 6 | | Australia | Western Australia: Kimberley Region | Non-lethal catch-and-release | Confirmed distribution in Western Australia extending beyond offshore reef systems | Barley et al. (2020) |
| 7 | | Australia | Queensland: Great Barrier Reef (GBR) | Underwater Visual Surveys (SCUBA) | One of the three most abundant reef shark species across the Indo-Pacific, documented in no-entry, no-take, and fished zones. | Frisch and Rizzari (2019); Osgood and Baum (2015) |
| 8 | | Australia | Queensland: Milman Island | Direct in-water visual observation | Neonates and juveniles observed circling sea turtles in very shallow water, identified as a likely pupping/nursery area | Freeman and Wright (2021) |
| 9 | | Australia | Queensland: Orpheus Island | Passive and active acoustic telemetry | Juveniles confirmed using mangrove root habitats during high tides for predator avoidance; high site fidelity demonstrated. | Schlaff et al. (2017); George et al. (2019) |
| 10 | | Australia | Queensland: Pioneer Bay, Orpheus Island | Passive acoustic telemetry | Tracked inside dense mangrove root habitat; detection range inside mangroves limited to ≤20 m | Kanno et al. (2024) |
| 11 | | Australia | Queensland: Torres Strait | Non-lethal catch-and-release | Confirmed presence distinct from the broader GBR study area during a reef predator gape ecology study | Barley et al. (2020) |
| 12 | | Australia | Northern Territory: Cobourg Peninsula | Stereo-BRUVS | Most abundant elasmobranch at surveyed sites, with juvenile and neonate presence indicating possible nursery function | Yon et al. (2020) |
| 13 | | Australia | Northern Territory: Darwin Harbour | BRUVS | Recorded at the Natural Rock Reef reference site during an artificial reef ecological monitoring programme | In-Depth Innovations (2026) |
| 14 | | Australia | Western Australia, Northern Territory, Queensland | Population genomics (target gene capture/NGS) | Australian populations showed highest genetic diversity, consistent with an Indo-Australian Archipelago origin | Maisano Delser et al. (2019) |
| 15 | | New Caledonia (France) | Noumea and Chesterfield Reefs | Population genomics | Confirmed stepping-stone metapopulation model with intermediate genetic diversity | Maisano Delser et al. (2019); Lesturgie et al. (2021) |
| 16 | | Kiribati | Kiribati island group | Population genomics | Included in the eastward Pacific colonisation wave, showing moderate connectivity | Maisano Delser et al. (2019) |
| 17 | | Solomon Islands | Remote islands | Clinical case report / direct observation | Healthy populations found throughout the island nation; recorded via an unprovoked bite incident | Popa et al. (2020) |
| 18 | | Australia | Tropical Coastline | Commercial gill-net fishery bycatch analysis | Encountered frequently in tropical gill-net fisheries; studies on immediate mortality indicate a high survival rate if released quickly | Dapp et al. (2017) |
| 19 | Indo-Pacific: Southeast Asia | Malaysia | Terengganu: Chagar Hutang Bay, Redang Island | BRUVS, UAV (drone), SCUBA | Sole shark species recorded at the bay; juveniles strongly associated with shoreline zones; noted as potential sea turtle hatchling predators | Syafruddin et al. (2024); Tolen et al. (2026) |
| 20 | | Malaysia | Sabah: Tawau | Fish market and jetty landing data collection | Verified as part of a 12-month data collection project on chondrichthyans landed in Tawau. | Abd Haris Hilmi et al. (2020) |
| 21 | | Singapore | Nine southern coastal and reef localities | Environmental DNA (eDNA) metabarcoding | Dominant elasmobranch sequence detected across turbid coastal habitats | Ip et al. (2021) |
| 22 | | Thailand | Gulf of Thailand: Koh Tao Island | UAV aerial surveys and underwater video | Only shark species regularly present; high abundance at morning low tide; massive aggregations previously recorded in Maya Bay upon beach closure | Di Tommaso et al. (2024) |

| No. | Region | Country | Area / state | Observation method | Remarks | Reference(s) |
|---|---|---|---|---|---|---|
| 23 | | Thailand | Andaman Sea and Gulf of Thailand | Citizen science diver-reported UVC | Most frequently encountered shark species in Thailand, recorded on 31% of all visited dive sites | Ward-Paige et al. (2018) |
| 24 | | Indonesia | East Java: Muncar and Brondong Harbors | Direct port observation and landing census | Heavily impacted by fishing pressure, with catches dominated by undersized juveniles sampled directly from the heads of Muncar and Brondong harbors | Lelono et al. (2021); Levina et al. (2025) |
| 25 | | Indonesia | Bali Province | Field observation at export company facilities | Extensively traded commercially, with the vast majority of exported individuals being undersized | Arisandi et al. (2020) |
| 26 | | Indonesia | West Lombok and Pontianak | Commercial fishery specimen | Landed at multiple regional ports, yielding length-weight relationship parameters | Kurniawan et al. (2022) |
| 27 | | Indonesia | South Sulawesi: Southern Makassar Strait | Fisheries landing data | Bycatch in gillnets and longlines; local models indicate the population is currently underexploited | Amir et al. (2020, 2021) |
| 28 | | Indonesia | South Sulawesi: Langkai Island | Direct survey aboard fishing vessels | Constituted 20% of caught sharks in targeted/bycatch surveys | Subhan et al. (2025) |
| 29 | | Indonesia | South Sulawesi: Selayar Island | Bycatch from traditional sero fisheries | Caught incidentally in permanent fish-fence traps placed over seagrass beds | Ambo-Rappe et al. (2021) |
| 30 | | Indonesia | North Sulawesi: Manado City | DNA barcoding of traded fins | Market record. Detected from illegal dried fin trade via COI gene sequencing. | Mopay et al. (2021) |
| 31 | | Indonesia | East Java: Sumenep Regency | Landing site observations and fisher interviews | Dominant catch for small-scale fishers in Sumenep; sold fresh and as dried fins. | Ferdiansyah and Hidayat (2019) |
| 32 | | Indonesia | Central Java: Jepara Regency (Ujungbatu) | Purposive sampling at landing port | Recorded among mixed elasmobranch catches entering the Java Sea fisheries. | Javidani et al. (2026) |
| 33 | | Indonesia | North Maluku: Morotai Island (South Waters) | Audible Stationary Count, UVC, DOV | Formed significant aggregations with high density compared to other Pacific regions. | Mukharror et al. (2017) |
| 34 | | Indonesia | North Maluku: Mitita Island (Blacktip Point) | Diver-Operated Video | Supports a highly valuable shark diving ecotourism industry; exhibits significant agonistic display elements during hand-feeding | Mukharror et al. (2021) |
| 35 | | Indonesia | West Papua: Kri Island, Raja Ampat | Direct visual observation | Stable populations confirmed inside Indonesia's only designated shark sanctuary | Tapilatu et al. (2026) |
| 36 | | Indonesia | Papua Province: Sentani | Photographic evidence | Unusual inland freshwater record following a flash flood | Iqbal et al. (2019) |
| 37 | | Indonesia | Riau Islands Province: Bintan Island | Catch observations | Heavily traded for consumption and fin trade in the Riau Archipelago | Effendi et al. (2024) |
| 38 | | Indonesia | Nationwide Distribution | Annotated checklist compilation | Broad presence confirmed across Sumatra, Kalimantan, Java, Bali, Sulawesi, Lombok, West Timor, Papua, and Maluku | Iqbal et al. (2026) |
| 39 | | Philippines | Metro Manila (Confiscated specimens) | Mitochondrial DNA identification | Confirmed involvement in the illegal aquatic wildlife trade via confiscated specimens | Poniente et al. (2022) |
| 40 | Indo-Pacific: South Asia | India | Tamil Nadu: Southeastern coast | Fortnightly bycatch surveys | Predominantly juveniles captured by trawlers in the Gulf of Mannar; provided first biometric data for Indian waters | Mohanraj et al. (2025) |
| 41 | | India | Tamil Nadu: Tuticorin District | Landing centre monitoring | Recorded as mature bycatch from pelagic longline fisheries | Ganesh and Geetha (2020) |
| 42 | | India | Andaman and Nicobar Islands | Landing records | Part of landed elasmobranch bycatch in the islands | Tyabji et al. (2020) |
| 43 | | Bangladesh | Bay of Bengal: Chittagong and Cox's Bazar | Field survey at landing centres | Captured in mixed gear; lowest yield among recorded shark species | Monjurul Hasan et al. (2015) |
| 44 | | Sri Lanka | Coastal and offshore waters | Fisheries landings data and fin morphology | Listed among commonly occurring shark species; identifiable by distinctive fin markings | Jayathilaka et al. (2016) |
| 45 | Middle East/ Western Asia | Saudi Arabia | Arabian Gulf: Eastern Region | Veterinary inspection of shrimp trawl bycatch | Commonly bycaught and found infected with novel external nematode parasites (*Huffmanela selachii*) | Al-Sabi et al. (2022) |
| 46 | | United Arab Emirates | Southern Arabian Gulf: Sir Bu Nair Island | BRUVS | Most frequently encountered species at the MPA; suspected to serve as a critical nursery area | Jabado et al. (2021) |
| 47 | | Saudi Arabia | Red Sea: Jeddah Coast | Field collection | Specimen collection conducted to examine external parasitological infections | Bakhraibah (2018) |
| 48 | | Oman | Unspecified (Local fish markets) | Population genomics (target gene capture / NGS) | Muscle tissue sampled from dead specimens collected at local fish markets to infer the demographic history and metapopulation structure of the species across the Indian Ocean | Maisano Delser et al. (2016) |
| 49 | North Africa | Egypt | Suez Gulf, Red Sea | Quantitative morphometric analysis | Utilizing dorsal fin biometrics from local catches for species identification. | Al-Khatib et al. (2025) |
| 50 | Middle East/ North Africa | Egypt, Saudi Arabia, Sudan | Red Sea (Range-wide) | Population genetics | Red Sea populations exhibit greater genetic diversity and higher effective population sizes than isolated Pacific reefs | Mourier and Planes (2013); Vignaud et al. (2013, 2014); Osgood and Baum (2015) |
| 51 | Western Indian Ocean | Kenya | Coastal waters (Kipini, Kiunga, Watamu, Vanga, etc.) | Artisanal landings, trawler surveys, tagging | Coast-wide distribution in artisanal fisheries; mostly immature specimens harvested, indicating vulnerability to overexploitation | Kiilu et al. (2019); Wambiji et al. (2022) |
| 52 | | Kenya | Kenyan EEZ and Southern Indian Ocean high seas | Industrial offshore longline catch logbook | Second most abundant species bycatch in the offshore EEZ operations | Kiilu and Ndegwa et al. (2018) |
| 53 | | Seychelles | Amirante Islands: D'Arros Island and St. Joseph Atoll | BRUVS, wild capture | Most abundant reef shark in the region; high residency and repeat visits over long periods documented | Gore et al. (2020); Pogoreutz et al. (2025) |
| 54 | | Seychelles | Seychelles archipelago | Population genomics | Supports a westward range expansion from the Indo-Australian Archipelago origin | Maisano Delser et al. (2019) |

| No. | Region | Country | Area / state | Observation method | Remarks | Reference(s) |
|---|---|---|---|---|---|---|
| 55 | | France | Southwestern Indian Ocean (Reunion Island longline operations) | Onboard observer programmes | A rare bycatch species in pelagic swordfish-targeting operations | Sabarros and Tellier (2026) |
| 56 | Indian Ocean | British Indian Ocean Territory | Chagos Archipelago | Underwater Visual Censuses | Only carcharhinid reef shark to exhibit specific population declines at this remote atoll system over a 30-year dataset | Graham et al. (2010); Osgood and Baum (2015) |
| 57 | | Maldives | Multiple atolls | Literature/checklist records | Maintained as a known established species in Maldivian waters | Parmegiani et al. (2023) [secondary/indirect; primary focus on *C. leucas*] |
| 58 | Central Pacific | France | French Polynesia: Sanctuary-wide | BRUVS | Dominates the shark assemblages across the entire French Polynesian shark sanctuary | Farabaugh et al. (2025) |
| 59 | | France | French Polynesia: Moorea | Photo-ID, mark-recapture, UAV, telemetry | The most thoroughly studied population globally; highly structured social networks, agonistic behaviors, and dense lagoon aggregations documented | Weideli et al. (2015); Kiszka et al. (2016); Bouyoucos et al. (2018, 2021); Schwieterman et al. (2019); Mourier et al. (2021); Debaere et al. (2023); Eustache et al. (2024) |
| 60 | | France | French Polynesia: Anaa Atoll | In-water visual observation | Documented heavily predating on catch-and-release bonefish on shallow reef flats | Lennox (2016) |
| 61 | | France | French Polynesia: Makemo Atoll | DNA barcoding | Tissue samples maintained for positive-control bite identification studies | Clua and Haguenauer (2019) |
| 62 | | France | French Polynesia: Fakarava Atoll | In-situ deterrence testing | Very large site-associated population conditioned to provisioning | Thiele et al. (2020) |
| 63 | | France | French Polynesia: Tetiaroa, Vahanga, Fakahina | Population genomics | Genetically confirmed presence across multiple isolated Tuamotu atolls | Maisano Delser et al. (2019) |
| 64 | | USA | Palmyra Atoll | Bio-logging, telemetry, UVC | Distinct trophic ecologies and a "hunt cold, rest warm" behavioural thermoregulation strategy mapped inside the atoll | Papastamatiou et al. (2010, 2015); McCauley et al. (2012); Osgood and Baum (2015); Sabando et al. (2020) |
| 65 | | USA | Hawaii: Northwestern Hawaiian Islands | UVC | Highly abundant at remote unpopulated reefs but largely extirpated from the main populated Hawaiian Islands | Wetherbee et al. (1997); Stevenson et al. (2007); Osgood and Baum (2015) |
| 66 | Eastern Tropical Pacific | Costa Rica | Isla del Coco National Park: Bahía Wafer | UAV aerial survey | Represents a rare confirmed Eastern Tropical Pacific record far outside the standard Indo-Pacific range; observed specifically utilizing the freshwater discharge of the Río Genio | López-Garro et al. (2012); Fernández-Martínez et al. (2024); |
| 67 | Range-Wide | Indo-Australian Archipelago (Origin) | Range-wide analysis | RAD-sequencing population genomics | Global analyses confirm the Indo-Australian Archipelago as the ancestral origin of the species before eastward and westward geographic expansion. | Maisano Delser et al. (2019); Lesturgie et al. (2023) |

***Abbreviations:** BRUVS, Baited Remote Underwater Video Stations; stereo-BRUVS, BRUVS with paired cameras for length estimation; UVS, Underwater Visual Survey (SCUBA-based transect); UAV, Unmanned Aerial Vehicle (drone-based aerial survey); eDNA, environmental DNA metabarcoding using next-generation sequencing; CO1, cytochrome c oxidase subunit I gene used for DNA barcoding and forensic species identification; NGS, next-generation sequencing for population genomics.