

## Review

# Doomed to Isolation or Just Exploiting Spatial Benefits? A Global Review of the Galapagos Shark *Carcharhinus galapagensis* (Snodgrass & Heller, 1905) (Pisces: Carcharhinidae), a Species with a Widespread but Fragmented Distribution

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## Abstract

The Galapagos shark (*Carcharhinus galapagensis*) is a large carcharhinid shark that occurs around the oceanic islands of tropical, subtropical, and warm-temperate regions of the world. *Carcharhinus galapagensis* shows a striking disjunct distribution and strong affinity to remote and isolated oceanic islands. Its distribution includes some of the most remote island ecosystems of the world (e.g., Easter Island), yet this unusual distribution pattern is poorly understood. Hence, it requires a plausible explanation and makes this species a subject for biogeography for the better understanding of phylogeography, movements, habitat connectivity, and gene flow. The purpose of this review, which is based on an extensive citing of the literature and an analysis of public databases, is to provide a comprehensive list of global records and reports of this species and a distribution map as a base for conservation strategies. This survey identified 69 verified and 27 unconfirmed global Galapagos shark records. The verified records included 53 around oceanic islands and 16 at continental coasts. Additionally, a voucher specimen that was collected in 1965 during an expedition to Easter Island and was formerly misidentified, was revised by the author and positively identified as *C. galapagensis*. This voucher specimen represents the first record of this species from Easter Island.

**Keywords:** biogeography; carcharhinid species discrimination; Chondrichthyes; conservation; cosmopolitan species; distribution; elasmobranchs; insular species; oceanic island species



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## 1. Introduction

Carcharhinidae (requiem sharks) is one of the most diverse shark families that is spread worldwide in tropical, subtropical, and temperate waters [1,2]. The speciose and cosmopolitan-distributed type genus *Carcharhinus* Blainville, 1816 (whaler sharks) currently comprises 34 to 35 valid species [3–5]. Thus, as one of 12 genera in the family Carcharhinidae, the genus *Carcharhinus* contains over half of the species of this family therein. Several species of this widespread and diverse genus are cosmopolitan-distributed and show a worldwide circumglobally range, especially the large (>300 cm Total Length) and strong-swimming taxa, with the smaller species often confined to ocean sub-basins or particular regions. Although a recent literature review [6] revealed that the most studied genus among sharks is *Carcharhinus*, many aspects of the biology, life history, and the distribution of the whaler sharks remain unexplored and understudied, and there are many unresolved questions left regarding all

aspects of their biology and ecology. This applies also to the Galapagos shark, *Carcharhinus galapagensis* (Snodgrass & Heller, 1905), of which many aspects of its behaviour, biology, distribution, and life history have not been studied yet [7–9].

The Galapagos shark, which is reported to attain a maximum size of 300 cm Total Length (TL), but possibly reaching up to 370 cm TL, is a shark with a circumglobally but scattered distribution with distant populations across all major ocean basins [6,10]. This species is often encountered around and associated with oceanic islands, mainly in the tropical but also the subtropical and warm-temperate seas, where it is apparently confined to [1,7,11–16]. *Carcharhinus galapagensis* shows one of the most striking distribution patterns of all extant shark species, with a distribution composed of widely separated and geographically isolated populations. This unique and unusual global distribution pattern of the Galapagos shark belongs to the many unresolved questions in shark research. Therefore, this shark is considered as one of the numerous mysteries in the shark world. In this context, it was recognized that *C. galapagensis* occurs at specific oceanic islands but is absent from certain other islands for unknown reasons [17]. Its disjunct distribution cannot be a coincidence and, therefore, from a biogeographical point of view, this noticeable distribution pattern requires a plausible explanation. An attempt to enlighten these unknown reasons for this so-far-unexplained distribution is one of the objectives of this study, beside others.

*Carcharhinus galapagensis* can be very abundant in the areas where it occurs [18]. Although *C. galapagensis* is sometimes the most abundant of local sharks where it occurs, e.g., as has been reported for the Galápagos Archipelago [19–21], for Malpelo Island [22], for Cocos Island [20], for Clipperton Island [23], for the Hawaiian Archipelago [24], and for Ascension [25], due to its unusual and unique distribution, this species is considered by experts to be one of the least understood requiem sharks [26]. The scattered distribution pattern of *C. galapagensis* is hard to understand regarding its affecting factors, and, to date, no attempt has been made to explain this phenomenon in detail.

Currently, *C. galapagensis* is considered one of the marine top predators whose population trend is unknown over much of its global range [27]. Although generally associated with reef habitats, little is known about the Galapagos sharks' exact distribution, its habitat use, its movements, and the status of local populations. Understanding the environmental niche and core habitat of shark species is considered key for promoting conservation and successful protection efforts. For accurate Red List assessments and the conception of management plans, conservation measures, and shark sanctuaries, accurate distribution data is essential and required. Despite their important role for the health and stability of reef ecosystems, which has been highlighted by numerous studies [28], the numbers of reef sharks have been declining dramatically worldwide during the last half century due to intensive fishing activities that threaten reef sharks with extinction [29]. Thus, there is an urgent need for the conception and development of effective conservation plans for reef-associated sharks.

Although the number of scientific publications about sharks has been increased significantly over the past 50 years, the overwhelming part of these contributions were dealing with topics such as conservation, population management, fisheries impact, biology, and life history [6], but the distribution of sharks is not of top priority. However, the mapping of shark ranges is an ongoing process necessary for an up-to-date knowledge level in fish biogeography. Elucidating gaps in the knowledge about shark species distribution is helpful for inventing and planning conservation plans and the authorization of protection zones, e.g., marine reserves for sharks. Accurate distributional data are essential for reliable scientific studies, e.g., regarding the inference of the origin of shark fins that end in the global shark fin trade [30].

A brief look at the numerous available distribution maps for *C. galapagensis* [1,7,10,14,31–37] reveals a very noticeable distribution pattern of this shark: All these distribution maps are showing numerous geographic isolated occurrences with widely separated subpopulations. Therefore, the global distribution pattern of the Galapagos shark was described by many scientists correctly, accurately, and consistently as “scattered” [11], “spotty” [38,39], “patchy” [7,10,14,40–43], and “disjunct” [44–46], all attributes that refer to its widespread distribution at many widely distant islands and archipelagos. However, geographic isolation may promote diversification in this species and might be of consequence regarding the connectivity of populations and its global gene pool.

In this context, the analysis of the movements and the identification of possibly existing migration paths are important for the conservation management of sharks because they have direct effects on the connectivity of populations and subsequently on gene flow. One important question is the influence of geographical isolation on gene flow in sharks that inhabit remote oceanic islands. For understanding and analysis of the genetic structure of the global population of *C. galapagensis*, verifiable data about the distribution are the necessary base for a reliable description of different subpopulations and genotypes. The present study deals with the worldwide distribution of *C. galapagensis*, a circumglobally carcharhinid, and displays the recent stand of knowledge about its distribution to characterize the global-scale environmental niche of this species. The author also attempts to reconstruct the presumed historic dispersal and the pathway of colonization of oceanic island habitats by this species across ocean basins. This is based on a spatial analysis that helps support the result of genetic investigations that were conducted worldwide on several local Galapagos shark populations. One key question of matter is how this species manages genetic exchange between the widely separated subpopulations at the oceanic islands where it occurs [47,48].

Conclusions on the phylogeography and conservation of the Galapagos shark are summarized, and the vulnerability of this species is highlighted by one example of a near extinction of a local population around an equatorial Atlantic archipelago. Additionally, a non-correct determined voucher specimen that has been collected in 1965 at Easter Island was revised by the author and positively identified as *C. galapagensis*. This specimen has been previously misidentified as the grey reef shark, *Carcharhinus amblyrhynchos* (Bleeker, 1856), emphasizing the ongoing value of museum collections. This revised specimen now presents the first scientific record for the Galapagos shark from Chile’s remote Easter Island (Rapa Nui) in the Southeast Pacific. Moreover, the present study provides a historic chronology of the discovering of the Galapagos shark from all the locations from where it has been reported yet. Therefore, the investigation of references in their course over time also aims to describe the worldwide history of this species in shark science.

## 2. Methods

This study is mainly based on an extensive literature review of references that deal with *Carcharhinus galapagensis* as a topic. The analysis of the literature included published primary references and subsequent reports, and further unpublished “gray literature” (theses, technical and fisheries reports). It represents a global review of the available distributional data as well as ecological parameters for *C. galapagensis*. For his review, the author has used public scientific literature databases such as Web of Science, Google Scholar, Semantic Scholar, and ResearchGate. Important fish and shark species bibliographies such as FishBase [49,50] and Shark Reference [51], and other repositories and open access digital libraries such as the Biodiversity Heritage Library [52] were also included and investigated. Nevertheless, it should not be unspoken here that not all the produced literature, technical reports, and thesis that mention the Galapagos shark could be reviewed by the author due

to restricted public access to some of the literature items, especially to the rare historic literature. Therefore, the present review did not claim total completeness.

The investigation conducted by the author included, besides the literature references, public and partly museum-supported databases containing distributional data and information about fish, such as Atlas of Living Australia [53], EncicloVida [54], Eschmeyer's Catalog of Fishes [55], Field Museum's online Zoological Collections Database [56], Guide of Fish Collections [57], Shorefishes of the Tropical Eastern Pacific Online Information System [58], Shorefishes of the Greater Caribbean Online Information System [59], and World Register of Marine Species—WoRMS [60]. However, the author refrained from indiscriminately and uncritically adopting data from the numerous online information systems that now exist for marine organisms. These often contain unvalidated data entries that were accepted without a critical review, which in the case of a species that is hard to determine such as the Galapagos shark considered here, can prove disastrous and undermine the credibility of the information.

It is apparent that data and information about a circumglobally shark species, whose distribution spans many countries, are widespread and have been published in many single publications, essays, and reports, and in different languages. Therefore, for producing a general overview of the Galapagos shark's distribution, a union and summarization of distributional data following a detailed review of relevant works concerning this species was conducted. The distributional data about *C. galapagensis*, and the references from which the information has been derived, are listed in tables separated for each major ocean basin that combines the recorded and reported occurrences of this species for the transparent traceability of information (Supplementary Materials S1–S3). The investigated references summarized in the lists are sorted chronologically by appearance date and, subsequently, alphabetically. Publications from the same author(s) deriving from different publishing years are merged in the tables. Both the first reference and subsequent reports are mentioned in this review, even those references that are referring to the first confirmed report of *C. galapagensis* for each locality. Thus, the listing of references does not automatically represent continuous confirmations of *C. galapagensis* records for a specific locality over time. Nevertheless, the references, listed chronologically, allow a conclusion to be drawn about the ongoing chronology of reports of this species for the locality in question.

In the scientific world, which is nowadays dominated by the English language, non-English literature is hardly recognized. Hence, non-English literature is often virtually unnoticed and consistently disregarded in English-dominated scientific and scholarly output. This often leads to the incompleteness of studies due to the non-consideration of important data. Therefore, for the warranting of a high completeness of this present study, the extensive literature review conducted by the author included scientific journal articles, monographs, and theses written in English but also in Chinese (1), French (17), German (5), Japanese (6), Korean (1), Portuguese (35), and Spanish (90). The present review considers historical (>100 years), old (>50 years), recent (>10 years), and very recent (<10 years) publications.

There appear to be only a few existing synonyms of *C. galapagensis*, although this species was recorded for many localities under false names before as well as after it became its valid name and species description in 1905 [19]. For data integrity and completeness, the review of the historical literature included reports where *C. galapagensis* was mentioned under its few synonymised, ancient, or erroneous names that were used in historic references and treatises, mainly in the Eastern Pacific region [11,55,60,61], and they are:

*Carcharias galapagensis* (Snodgrass & Heller, 1905)—unaccepted name;

*Carcharinus galapagensis* (Snodgrass & Heller, 1905)—unaccepted (misspelling);

*Eulamia galapagensis* (Fowler, 1932)—unaccepted (senior synonym).

At a few locations (e.g., the Bermuda Islands), the Galapagos shark was mentioned in the historical literature with erroneous or false scientific names, or was reported mistakenly

as *C. obscurus* (Lesueur, 1818) (including old synonyms of *C. obscurus*). For these localities, in cases when material was collected, the true identity of the sharks could be unveiled later by examining voucher specimens (e.g., by J. A. F. Garrick during his monumental revision of the genus *Carcharhinus*). Several of these voucher specimens determined in first instance as *C. obscurus* could be revised as *C. galapagensis*. The mentioning of the Galapagos shark under its accurate, current, and valid name *Carcharhinus galapagensis* was often much later than these first historical records and reports (because scientists were not aware that *C. galapagensis* is a separate species and as such, it was not yet described at that time). Therefore, there is often an apparent time lag between the year of the first report of the Galapagos shark under its current scientific name for a particular locality and its first mention in historical references.

When necessary, the author reviewed museum specimens of *C. galapagensis* in cases of either putative misidentifications or doubtful records by an examination of photographic material of these specimens. Information on museum specimens and catalogue numbers for each locality was largely obtained from VertNet [62] but also from the literature [11], including several of the cited references. Catalogue numbers of specimens housed in museum collections are also provided in the tables (Supplementary Materials S1–S3). The spatial information from the literature, databases, and museum records were collated and gathered to produce profound distribution maps. They were produced with QGIS Desktop (version 3.16).

Because the Galapagos shark is a hard-to-determine species which can be easily confused with similar-looking congeneric members of *Carcharhinus*, the author paid special attention to the reliability and verifiability of the information provided in the references. Regarding both the accuracy and reliability of an occurrence of *C. galapagensis* from a particular locality, it is necessary to differentiate between “records” and “reports”, as these terms comprise different qualities of information. According to the understanding of the author, a record contains that the species’ evidence is either documented by a proofed voucher specimen and/or by verified photographic material and/or by appropriate DNA-sampling methods (that are based on the use of single nucleotide polymorphisms—SNPs). A report means that the species’ information is derived only from an unsustained visual observation or a narrative report and regularly demands verification.

Where necessary and helpful, important details on the occurrence and the locality are provided in the comments. When using the tables provided in the Supplementary Materials that summarize the global records and reports of *C. galapagensis*, it should be considered that the Galapagos shark was collected already in the 19th century by several natural history museums from many locations around the world and reported under different names before this shark was described for the first time under its valid current name from the Galápagos Archipelago by R. E. Snodgrass and E. Heller in 1905. In his accurate revision of the genus *Carcharhinus*, J. A. F. Garrick [11] examined plenty of these collected voucher specimens and revised several specimens that were archived under false names. However, it should not be denied that some of the voucher specimens of *C. galapagensis* may well have been collected at an earlier date than the date on which this species has been reported for the first time from a particular locality in the literature. The point that matters is that a record of *C. galapagensis* for a particular locality in the Supplementary Materials can be derived not only from the literature, but also from a collected specimen housed in a museum collection, and that the time when a specimen was collected is sometimes earlier than when the Galapagos shark was reported in the literature for this location for the first time. It should also be recognized that in a few cases, there is sometimes a delay regarding the first record of *C. galapagensis* for a specific locality, resulting from the date of the catch and the following publication of this record some years after.

Examinations of populations of cosmopolitan-distributed whaler sharks (*Carcharhinus* spp.) have shown that sizes in divergent life history stages, sizes at the age of maturity, and maximum sizes can differ significantly across ocean basins for each species. It has been reported for the Hawaiian Archipelago that males of *C. galapagensis* reach maturity between 205 and 239 cm TL, and females between 215 and 245 cm TL [63]. Other authors gave information that males of the Galapagos shark mature at 210–230 cm TL and females at about 250 cm TL [18], and the older literature references provided information for *C. galapagensis* that males mature at smaller sizes between 170 and 236 cm TL and females are maturing at about 235 cm TL [1]. However, as this study attempts to classify the population structure at specific locations for an evaluation of their importance as nurseries and information on life history stages for *C. galapagensis* differ in the available literature, the author has formed median values considering credible information.

Unfortunately, there exists no homogeneous standard for the measurement of fish in general and chondrichthyans such as sharks in particular [64]. Therefore, in the literature examined by the author, divergent information on the size of *C. galapagensis* specimens is provided due to different measurement units that are used in the references for specimens' measurements such as Total, Standard, Precaudal, and Fork Length. As such, for homogeneity, the author converted all measurement units into Total Length (TL) because it is the most common length unit for the measurement of chondrichthyan fish. Regarding the converting process, the author has used the conversion parameters for *C. galapagensis* provided by FishBase [65]. All information on the specimen's length in this survey is given in cm TL. In the tables provided in this study (Supplementary Materials S1–S3), information on the size is given when available to gain insights into population structure and distribution of age classes.

#### Abbreviations

Abbreviations of life history stage categories of *C. galapagensis* that are used in the Supplementary Materials; size classes determined largely according to [1,11,18,63]:

|     |                                                                             |
|-----|-----------------------------------------------------------------------------|
| n   | Neonate (fish with visible umbilical scars, usually <80 cm);                |
| juv | Juvenile (fish with no umbilical scar present, size between 80 and 130 cm); |
| sub | Subadults (fish with size between 130 and 235 cm);                          |
| ad  | Adults (fish with size > 235 cm);                                           |
| u   | Unknown.                                                                    |

Abbreviations and codes used for voucher specimens and photographic voucher material of Galapagos shark specimens housed in institutional depositories or private, museum, and natural history collections in ichthyology [66]:

|       |                                                                                                                                                                                                  |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AB    | Anton Bruun catalogued collection (private), Copenhagen, Denmark                                                                                                                                 |
| AIM   | Auckland War Memorial Museum, Auckland, New Zealand;                                                                                                                                             |
| AMNH  | American Museum of Natural History, New York, USA;                                                                                                                                               |
| AMS   | Australian Museum, Sydney, Australia;                                                                                                                                                            |
| ANSP  | Academy of Natural Sciences of Philadelphia, Philadelphia, USA;                                                                                                                                  |
| BAMZ  | Bermuda Aquarium, Natural History Museum and Zoo, Flatts Village, Bermuda;                                                                                                                       |
| BMNH  | British Museum (Natural History), London, United Kingdom;                                                                                                                                        |
| BPBM  | Bernice Pauahi Bishop Museum, Honolulu, Hawaii, USA;                                                                                                                                             |
| CAS   | California Academy of Sciences, Ichthyological Collection, San Francisco, USA; [incl. specimens from the historical collection of Stanford University (SU), now housed at CAS, cited as CAS-SU]; |
| CMNFI | Canadian Museum of Nature, Fish Collection, Ottawa, Canada;                                                                                                                                      |
| CSIRO | The Commonwealth Scientific and Industrial Research Organization, Australian National Fish Collection, Canberra, Australia;                                                                      |
| FMNH  | Field Museum of Natural History, Chicago, USA (formerly: CNHM = Chicago Natural History Museum, Fish Collection);                                                                                |

|         |                                                                                                                                                                                                                                                                                                                                                                                              |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IZUA    | Instituto de Zoología, Universidad Austral de Chile, Collection of Fishes, Valdivia, Chile;                                                                                                                                                                                                                                                                                                  |
| LACM    | Natural History Museum of Los Angeles County, Los Angeles, USA (incl. LACM SIO);                                                                                                                                                                                                                                                                                                             |
| LJVC    | L. J. V. Compagno catalogued collection (private), Cape Town, South Africa;                                                                                                                                                                                                                                                                                                                  |
| MCZ     | Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA;                                                                                                                                                                                                                                                                                                            |
| MHNF    | Museu de História Natural do Funchal, Madeira, Portugal (also known as: MMF = Museu Municipal do Funchal);                                                                                                                                                                                                                                                                                   |
| MNHN    | Muséum National d'Histoire Naturelle, Paris, France;                                                                                                                                                                                                                                                                                                                                         |
| MSR     | Marine Fishery Resources Development and Management Department, Southeast Asian Fisheries Development Center, Kuala Terengganu, Malaysia;                                                                                                                                                                                                                                                    |
| MSR IPP | Fisheries Research Institute, Bintawa, Sarawak, Malaysia;                                                                                                                                                                                                                                                                                                                                    |
| MOVI    | Museu Oceanográfico do Vale do Itajaí, Itajaí, Brazil;                                                                                                                                                                                                                                                                                                                                       |
| NMNZ    | Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand;                                                                                                                                                                                                                                                                                                                            |
| NMV     | Naturhistorisches Museum, Vienna, Austria;                                                                                                                                                                                                                                                                                                                                                   |
| NSMT    | National Museum of Nature and Science, Department of Zoology, Tokyo, Japan;                                                                                                                                                                                                                                                                                                                  |
| NZOI    | New Zealand Oceanographic Institute, Wellington, New Zealand;                                                                                                                                                                                                                                                                                                                                |
| ORI     | Oceanographic Research Institute, South African Association for Marine Biological Research (SAAMBR), Durban, KwaZulu-Natal, South Africa (also as ORID);<br>Scripps Institution of Oceanography, San Diego, USA (also SIO-UCSD = University of California, San Diego; contains fishes (mostly marine) transferred from UCLA, but parts of fish collection subsequently transferred to LACM); |
| SIO     |                                                                                                                                                                                                                                                                                                                                                                                              |
| SMF     | Senckenberg Naturmuseum und Forschungsinstitut, Frankfurt, Germany;                                                                                                                                                                                                                                                                                                                          |
| SU      | Stanford University Natural History Museum, Fish Collection, California, USA (now housed at CAS);                                                                                                                                                                                                                                                                                            |
| UCLA    | University of California at Los Angeles, Los Angeles, USA (fish collection largely transferred to LACM and SIO);                                                                                                                                                                                                                                                                             |
| UF      | University of Florida, Gainesville, Florida, United States;                                                                                                                                                                                                                                                                                                                                  |
| UMMZ    | University of Michigan, Museum of Zoology, Ann Arbor, Michigan, USA;                                                                                                                                                                                                                                                                                                                         |
| UPRM    | University of Puerto Rico Mayagüez, Puerto Rico, USA;                                                                                                                                                                                                                                                                                                                                        |
| USNM    | United States National Museum, Smithsonian Institution, National Museum of Natural History, Washington, D.C., USA (also as NMNH; incl. USNM FIN = USNM Fish Illustration Collection & USNM RAD = USNM Radiograph Collection);                                                                                                                                                                |
| ZMO     | Zoology Museum, Oxford University, Oxford, United Kingdom;                                                                                                                                                                                                                                                                                                                                   |
| ZUMT    | University Museum, University of Tokyo, Tokyo, Japan.                                                                                                                                                                                                                                                                                                                                        |

### 3. Background: Remarks on Genetics, Anatomy, and Identification of *Carcharhinus galapagensis*

Carcharhinidae is a diverse family of sharks that has plenty of look-alike species. Identification of *Carcharhinus galapagensis* is challenging due to its large number of similarities with other members of the genus *Carcharhinus* as well as the lack of prominent and distinctive fin markings, features that also apply to other species contained in this genus. This may explain the large proportion of unconfirmed and dubious records of this shark, which results mainly from misidentifications. For a better understanding of this matter as well as the results comprised in the present study, the following passages are devoted to this specific problem, together with deliberations on the origin of this species and its currently known phylogeny.

Apparently, the difficulties in recognizing and distinguishing were the reasons why this shark was discovered relatively late by scientists at the beginning of the 20th century. The Galapagos shark was originally described as *Carcharias galapagensis* [19] from a type specimen (holotype: embryo/fetus, 650 mm, CAS-SU 12324, apparently lost) that was collected at the Galápagos Archipelago, the type locality of this species, where this shark is relatively common (Figure 1). Besides the diagnosis from this type specimen, the species description is based on two further specimens (paratypes) also collected at the Galápagos Archipelago (paratypes: CAS-SU 12325, CAS-SU 12326, apparently lost) [1,11,55]. Thus, the name of this shark refers to this Ecuadorian archipelago where it was first recognized by scientists.



**Figure 1.** Two adult female Galapagos sharks (*Carcharhinus galapagensis*) of ~230 cm patrolling the coastal waters over soft bottom at North Seymour Island in the Galápagos Archipelago, Ecuador. In this specimen in the foreground, an inconspicuous white band on the flank is visible which is sometimes of diagnostic value when recognizable. © Louis David.

### 3.1. Similarities with *Carcharhinus obscurus*

Due to the lack of distinctive fin markings, many sharks that belong to the genus *Carcharhinus* are notoriously difficult to distinguish by their appearance. There are serious issues regarding the identification of closely related requiem sharks that are hard to tease apart from each other only by visual observations, and their taxonomy can affect their detection rate even for shark experts [67]. The similarities of *C. galapagensis* with other members of the speciose genus *Carcharhinus* include morphological as well as genetic similarities, especially with its presumed ancestor, *C. obscurus*. The Galapagos shark has been described as a typical *Carcharhinus* shark with all the characteristics that make this group difficult to identify [68]. Hence, *C. galapagensis* can easily be confused with similar-looking congeneric taxa such as *C. amblyrhynchos*, *C. perezi* (Poey, 1876), and especially with the sibling *C. obscurus* that is regarded as its phylogenetic nearest relative [69,70]. Therefore, misidentifications of *C. galapagensis* with other taxa of *Carcharhinus* have occurred numerous times [44,71,72]. However, regarding the determination of species of *Carcharhinus* lacking distinctive fin markings, the presence/absence of an interdorsal ridge is considered a good starting point for further determination when trying to identify/separate members of this genus [1,32].

*Carcharhinus obscurus* is very similar and very difficult to separate from *C. galapagensis* without direct comparison [73–75]. It can be challenging to distinguish *C. galapagensis* and *C. obscurus* not only morphologically but also genetically at the mitochondrial level [69]. Based on their striking morphological similarity, scientists suspected early on that

*C. galapagensis* and *C. obscurus* might be relatives. This suspicion was strengthened when even conventional DNA studies based exclusively on mitochondrial DNA (mtDNA) did not allow for differentiation between these two taxa, although both clearly differed in the number of precaudal vertebrae (Table 1), a feature assessed to be of high discriminating power and high taxonomic significance [11]. However, it should be considered that no *Carcharhinus* species is recognizable by its vertebral number alone and that this character is only of value when combined with further external characteristics [76].

A tabular comparison is intended here to provide an aid for identification in the field based on anatomical and morphological characteristics that may enable a distinction to be made between *C. galapagensis* and the most likely species to be confused with, *C. obscurus* (Table 1). Dorsal fin heights and precaudal vertebral counts are the main morphological characteristics used to distinguish both species [11]. The latter requires the investigation of dead shark specimens, which is of ethical and animal-rights concern when the specimen does not derive from incidental bycatch or naturally caused strandings. In the meantime, genetic investigation methods based on the use of SNPs have proven to be reliable regarding a clear distinction between these two sibling species. Nevertheless, the use of morphological characteristics can be of nearly equal importance regarding its identification success in comparison with special genetic investigation methods such as special DNA markers. The key difference between both identification methods remains that vertebral counting usually requires the killing of the specimen, while genetic testing requires only blood or tissue sampling that allows the individual to survive. Distinguishing *C. galapagensis* and *C. obscurus* is challenging without direct comparison. Thus, for providing a helpful aid for differentiation of each other, the main distinguishing features between both species are compared in Table 1.

**Table 1.** Comparison of diagnostic morphometric features of both *Carcharhinus galapagensis* and *C. obscurus* according to [1,10,11,26,76–81].

| Feature                                                         | Taxon                                                                                                                                                                                                                     |                                                                                                                            |
|-----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
|                                                                 | <i>Carcharhinus galapagensis</i>                                                                                                                                                                                          | <i>Carcharhinus obscurus</i>                                                                                               |
| Precaudal vertebra numbers                                      | 103–109                                                                                                                                                                                                                   | 86–97                                                                                                                      |
| First dorsal fin height                                         | less than 3 times in distance between its origin and snout tip and 9.1–12.1% of TL                                                                                                                                        | more than 3 times in distance between its origin and snout tip and 5.8–9.9% of TL                                          |
| Second dorsal fin height                                        | 2.1–3.3% of TL                                                                                                                                                                                                            | 1.5–2.3% of TL                                                                                                             |
| First dorsal fin origin                                         | opposite to pectoral fins inner margin—over posterior third of inner pectoral margin (first dorsal fin usually over midlengths of pectoral inner margin and therefore slightly more anterior than in <i>C. obscurus</i> ) | over/slightly behind pectoral fins free rear tip (first dorsal fin originates more behind than in <i>C. galapagensis</i> ) |
| Shape of the first dorsal fin/rear edge of the first dorsal fin | more erect/straight                                                                                                                                                                                                       | sloping/curved                                                                                                             |
| Apex of first dorsal fin                                        | acute to sharply rounded                                                                                                                                                                                                  | pointed or narrowly rounded                                                                                                |
| Pectoral fin shape                                              | roughly straight                                                                                                                                                                                                          | curved, falcate                                                                                                            |
| Pectoral fin origin                                             | well behind first dorsal fin                                                                                                                                                                                              | slightly behind first dorsal fin                                                                                           |
| Maximum recorded size (in cm TL)                                | 305 (possibly 370)                                                                                                                                                                                                        | 420?                                                                                                                       |
| Maximum recorded weight (in kg)                                 | 195                                                                                                                                                                                                                       | 450                                                                                                                        |
| Tooth formula *                                                 | usually<br>14-1-14<br>14-1-14                                                                                                                                                                                             | usually<br>14-1-14<br>14-1-14                                                                                              |
|                                                                 | but varying from<br>(13-15)-1(2)-(13-15)<br>(13-15)-1(2)-(13-15)                                                                                                                                                          | but varying from<br>(14-15)-1-(14-15)<br>(13-15)-1-(13-15)                                                                 |

\* It has been noted for *C. galapagensis* collected from Walters Shoals that the central teeth varied between one and two in each of 18 jaws examined but were usually single [77].

The smallest, apparently free-living specimen of *C. galapagensis* ever seen was 66.5 cm [11]. Litter size in Galapagos sharks from Hawaii ranged from 4 to 16 pups, with an average of 8.7 [63]. For Walters Shoals (southwestern Indian Ocean), the smallest recorded specimen was 78 cm and had a visible umbilical scar, indicating that it was born recently [77]. In Hawaiian waters, Galapagos sharks are born at just over 80 cm [63]. Here, mating and parturition apparently occur early in the year, and gestation is estimated to be about 12 months, with a possible biennial or triennial reproductive cycle [63]. The maximum age for *C. galapagensis* was estimated as 24 years [82,83], and the maximum length as 370 cm for the Hawaiian Archipelago, based on counting of the presumed annual growth rings of vertebrae [84]. Age at maturity was reported to be 6–8 years for males and 6.5–9 years for females [63] for the Hawaiian Archipelago, although it was estimated that first reproduction for both sexes is reached earliest in 10 years [84].

It was reported for *C. galapagensis* that it is missing distinctive fin markings [85,86], which are generally associated with visual functions regarding interactions of sharks with other shark specimens of the same or another species [86]. For 34 individuals of *C. galapagensis* from Walters Shoals, it was noted that the fins are plain but with slightly dusky tips in some individuals [77]. The body colour of this shark is dark grey dorsally and pale ventrally, showing the typical countershading present in most sharks. In *C. galapagensis*, the tips of the fins, particularly the pectoral fins, are reported to be frequently dusky [11], but this is not a feature of strong discriminating power because it applies to many congeneric species (e.g., *C. obscurus*, *C. amblyrhynchos*, and *C. perezi*). The first and second dorsal fins of *C. galapagensis* are, on average, higher than those of *C. obscurus* (Table 1). The second dorsal fin is relatively large for a shark of the genus *Carcharhinus* (Table 1). Although just slightly developed, a distinctive median interdorsal ridge is present on the back, which is also present in *C. obscurus*. Due to its typical fusiform “reef shark” shape, which resembles other reef sharks such as *C. amblyrhynchos* and *C. perezi*, and the lack of distinctive markings on the fin tips, complexity in the identification of the Galapagos shark is reality [87]. As such, the need for appropriate tools based on genetic investigation methods for safely distinguishing between *C. galapagensis* and *C. obscurus* was highlighted [34,88] and would aid accurate determination of these sister taxa [89–93]. However, both can be clearly separated on precaudal vertebrae numbers (103–109 in *C. galapagensis*, 86–97 in *C. obscurus*; Table 1).

A specimen of *C. obscurus* from Ascension Island was of more than 300 kg in weight [94] and a female of *C. obscurus* of 284 cm Precaudal Length was reported with 450 kg in weight from the southwestern Indian Ocean of South Africa [78]. However, it cannot be excluded that the weight of the latter specimen was extraordinary due to pregnancy (comment by the author), which is far above the maximum recorded weight (195 kg) for the close relative but slenderer *C. galapagensis* (Table 1). The Galapagos shark has a relatively streamlined body [95] (Figure 1). The anatomical differences in the recorded number of precaudal vertebrae, the morphological deviations in the comparison between *C. galapagensis* and *C. obscurus*, as well as the formation of a separate and distinct range area are good arguments for legitimizing the delimitation of these two species at the species level and the treatment of the Galapagos shark as a distinct species despite the anatomical and morphological similarities of both [96].

### 3.2. Genetics

Genetic investigations of the genus *Carcharhinus* indicated that *C. galapagensis* is part of a monophyletic group of large ridge-backed carcharhinids, including *C. altimus* (Springer, 1950), *C. falciformis* (Müller & Henle, 1839), *C. longimanus* (Poey, 1861), *C. perezi*, *C. obscurus*, and *C. plumbeus* (Nardo, 1827), even including *Prionace glauca* (Linnaeus, 1758) [90]. Herein,

*C. galapagensis* is genetically very close and similar to *C. obscurus*, and also morphological investigations of this group suggested that these both (*C. galapagensis* and *C. obscurus*) were the centre of this group [11].

Due to their close relativeness, the genetic similarity of both *C. galapagensis* and *C. obscurus* significantly complicates their distinction. Investigations based on NADH2 (a mitochondrial gene) failed to distinguish between *C. galapagensis* and *C. obscurus*, leading to the presumption that *C. galapagensis* may merely represent the oceanic form of *C. obscurus* [69]. Moreover, it raised questions regarding the species' validity of both. Later, investigations which added to the NADH2 mitochondrial investigation the use of SNPs, were able to distinguish successfully between both taxa and confirmed their status as distinct species [33]. In addition to the results of those genetic investigations, the author of the present study refers to the morphological and anatomical features of *C. galapagensis* and *C. obscurus*, and here particularly their apparent differences in precaudal vertebrae (Table 1). As morphological and genetic investigations in biological sciences should always go together, now with the tool of effective distinguishing methods based on the use of SNPs, the results of both genetic and morphometric investigation approaches are now in harmony regarding the differentiation between *C. galapagensis* and *C. obscurus*, justifying their assessment as separate species.

Focusing on the genetics of both species, the finding that *C. obscurus* is genetically similar to *C. galapagensis* for mtDNA first indicated these two species may be one and the same and left the unresolved question of their species boundaries [69]. A genetic study conducted in the past using mtDNA sequencing has found that specimens identified as *C. galapagensis* from oceanic islands in the northwestern Atlantic Ocean were indistinguishable from specimens identified as *C. obscurus* collected off the U.S. east coast from New Jersey to Florida [97]. These findings were interpreted as the result of an ancient hybridization event where there has been a directional transfer of mitochondrial genes from one species to another through the females [33,98]. The result that these species could not be differentiated with the use of mtDNA only suggested that hybridization had occurred among distant ancestors of the current population [98]. In this context, the question raised whether these two species could interbreed [97], i.e., if timing and location of opposite sexes ever co-occur during the mating season, or if they are able to produce viable offspring, which is unknown. Further, the event of hybridization is remarkable in this respect because a recent study [99] has shown in this context that sharks are generally characterized by only slow rates of evolution, and hybridization can be assessed as one form of evolution in species that contributes to adaptive capacities to different environments and to promote the distribution of taxa [100].

From this point, the knowledge grew that DNA barcoding methods alone are not sufficient for safely distinguishing *C. galapagensis* and *C. obscurus* because they share mtDNA. Studies based on simple mtDNA barcoding failed to distinguish successfully between *C. galapagensis* and *C. obscurus* [101,102]. Genetically, both sibling species share mtDNA haplotypes [93], but they are distinguishable through studies based on SNPs [33]. Thus, every scientist should be aware that completely different pictures can emerge in genomic data about *C. galapagensis* when using mtDNA or genome-wide SNPs [103]. However, the genetic investigations suggested that *C. obscurus* and *C. galapagensis* have been divided just recently (quaternary) in the evolution of carcharhinid sharks, which makes *C. galapagensis* a relatively young taxon [93,104].

The rising knowledge that *C. galapagensis* and *C. obscurus* share mtDNA was supported by genetic investigations on five *C. galapagensis* populations in the Southwest Pacific aiming to elucidate their relationship with the closely related *C. obscurus* by using SNP markers in combination with mtDNA analysis [105,106]. Interestingly, at least 25 *C. galapagensis*

specimens of this study exhibited mtDNA signatures similar to that found in specimens of *C. obscurus*, while SNP data revealed two highly distinct Galapagos shark samples. The majority of these outlier individuals were located within a proposed contact zone at the Norfolk Islands where both share a sympatric range. The sharing of mtDNA presumably results from ancient hybridization events in the past. Hybridization between distinct shark species is very rare and was recognized only on a few occasions [107,108]. Thus, the genetic similarity of *C. galapagensis* and *C. obscurus* results from relatively recent co-ancestry which makes it difficult to differentiate between them in field investigations without high genetic investigation effort.

In marine and freshwater sciences that focus on producing species inventories, environmental DNA (eDNA) is nowadays commonly used for the detection of fish (and other organisms). Unfortunately, due to their close phylogenetic relatedness, this method is also not successful for the differentiation between *C. galapagensis* and *C. obscurus*. Investigations based on the use of eDNA failed to procure evidence of *C. galapagensis* at Malpelo Island, a location where this species is known to occur, because the required barcode sequence is still unavailable, which makes this method inappropriate for detecting this shark with precision [109]. Thus, the differentiation between *C. galapagensis* and *C. obscurus* and further close relatives (e.g., *C. longimanus*) in studies based on eDNA is impossible because they are indistinguishable using eDNA [110,111]. Further recent studies conducted and based on the use of eDNA also failed to make evidence with certainty for both *C. galapagensis* and *C. obscurus* [112,113]. The strong genetic similarity of both species is also problematic in studies based on DNA barcoding with the use of PCR mini barcodes that target the identification of shark fins sold on fish markets at the species level, which also failed to effectively distinguish these two sibling species among themselves as well as from *C. longimanus* and *C. perezi* [114–116].

The low nucleotide diversity of *C. galapagensis* and the existence of a morphologically and genetically similar species, *C. obscurus*, support the presumption that the Galapagos shark is recently derived [81,90,117]. Additionally, a radiation model developed for carcharhinid sharks also suggests that *C. galapagensis* and *C. obscurus* have been divided just recently [91]. Separate investigations on populations of both species revealed that introgressive hybridization occurred historically as well as recently, raising the hypothesis of ongoing hybridization [33,47,98]. These results may indicate that the Galapagos shark is an evolutionary young taxon and not genetically stabilized yet. Four hybrid specimens (including two backcross hybrids) from Cabo Pulmo National Park, Baja California ( $n = 2$ ), Clipperton Island ( $n = 1$ ), and the Galápagos Archipelago ( $n = 1$ ) were detected in a recent study [98]. As the investigations in this study have shown, *C. galapagensis* and *C. obscurus* are compatible and can function as parental species of hybrids, which in turn can be taken as an indication of their close relationship. Hybrids of *C. galapagensis* and *C. obscurus* were reported recently, in particular from areas where both taxa share sympatric ranges [88,98], although sympatric occurrences are generally uncommon because of the spatial exclusion of both [33]. Due to their close relationship and based on the existence of hybrids, specimens of *C. galapagensis* and *C. obscurus* are apparently compatible [118]. The author of the present study assumes that incidentally, when two mature specimens of both resembling species meet, the lack of distinctive distinguishing features probably could pose a problem for these species themselves when identifying appropriate reproductive partners of the same species. Therefore, it cannot be excluded that hybridization processes between these two species are and were also favoured by confusion between individuals of the species themselves, although these events seem to happen only on rare occasions and are spatially restricted to a few contact zones.

Results based on a single-locus approach have also shown that *C. obscurus* and *C. galapagensis* could not be differentiated by conventional DNA barcoding due to a pervasive mitochondrial admixture [119]. Similar genetic methods previously used also failed to distinguish both species and have led to the conclusion that the defining characteristics for distinguishing these two species are habitat and precaudal vertebral counts [11,69]. It was suggested that these two species may in fact be one and the same, but they exhibit considerable niche separation, with one form (*C. galapagensis*) being found far from landmasses, and the other form (*C. obscurus*) occurring in association with continental shelves and upper slopes [69,120]. Arguably, it is now clear that both are occupying different habitats and are niched into different marine ecosystems, although both species co-occur at a few islands (e.g., Norfolk Island, Revillagigedo Archipelago).

Currently, the taxonomic treatment and validity of *C. galapagensis* as a “true” species are commonly accepted [4,7,121–123], although the taxonomic relationship between *C. galapagensis* and *C. obscurus* possibly has not been finally resolved. In this context, scientists and taxonomists currently are aware that the description of the genome and DNA barcoding methods are not always sufficient to describe a species [124], and that distribution is probably also a parameter that characterizes species. In this context, for *C. galapagensis*, it was stated that it is partly defined by its preferred habitat: clear water over rugged coral or rocky bottoms around offshore islands or seamounts, and occasionally the edge of the continental shelf [7]. This geographic–ecological aspect matters because defining species in terms of distribution and genetic uniqueness is critical for assessing population units and implementing appropriate management actions for sharks [125].

### 3.3. Remarks on the Distribution, the Prevalent Research Need, and the Relationship to Humans

It was recognized that, with a few exceptions, *C. galapagensis* has been taken only off oceanic islands and *C. obscurus* mainly off continental coastlines [11], and further that *C. obscurus* and *C. galapagensis* are spatially segregated, with one (*C. obscurus*) dominating in coastal, warm-temperate to subtropical habitats, and the other (*C. galapagensis*) generally associated with subtropical and tropical oceanic islands [81]. Several other authors have also referred to the apparent spatial exclusion of both *C. galapagensis* and *C. obscurus*. Indeed, sympatric ranges of both species are scarce and restricted to a few localities worldwide (e.g., Norfolk Islands, Revillagigedo Archipelago) that can be considered as contact zones [126,127]. Although sharing sympatric ranges in a few locations, it is apparent that these two species are mainly allopatric, spatially separated, and occupy different habitats (insular = *C. galapagensis* vs. continental = *C. obscurus*) [26,69]. This suggests that some mechanisms of spatial exclusion and niche separation affect both species.

Until recently, the Galapagos shark has received only a little attention in the scientific literature in comparison to other shark species, particularly regarding its unique scattered distribution pattern. Presumably, the occurrences around remote and isolated scattered islands brings this species out of the reach of scientists because they are located at great distances from human settlements. This causes a data gap regarding the knowledge of its exact worldwide distribution. Therefore, *C. galapagensis* belongs as a not deeply investigated shark species, with 193 literature records listed for *C. galapagensis* versus 594 for *C. obscurus* [128]. Additionally, the prevalent data gap may also be the result of identification challenges. Thus, the distribution limits of *C. galapagensis* are not well-defined due to a lack of distributional data and because of permanent confusion with similar species [37,73], especially with the closely related *C. obscurus* and the similar *C. amblyrhynchos*. With both, the Galapagos shark was often confused in the past [11,26,72,75,129–132]. Such confusions have occurred numerous times; for example, with *C. obscurus* at Bermuda and St. Helena Island in the Northwest and Southcentral Atlantic [11] and at oceanic

islands off western Africa in the Northeast Atlantic [133]. Confusion been also occurred with *C. amblyrhynchos* at Lord Howe Island and the Elizabeth and Middleton Reefs in the Southwestern Pacific [72].

*Carcharhinus galapagensis* grows to a large size, with adults occupying large prey items (see Section 7), and can sometimes behave aggressively towards humans, particularly towards divers [134]. Therefore, large specimens of this shark should always be treated with caution. However, reported shark bite incidences involving Galapagos sharks are scarce and only seldom reported [135], likely due to the remote distribution of this shark, which results in only rare encounters with people, but also because of the prevailing difficulties in distinguishing this shark from resembling whaler sharks, which makes it difficult to identify the involved shark species with certainty. For example, only one documented shark bite in the United States between 1982 and 2013, where a Galapagos shark was suspected to be involved, was reported [136]. Further bites of a snorkelling person and on a surfboard for which Galapagos sharks were suspected to be the culprit occurred subsequently in the United States at the Hawaiian Archipelago in 2019 and 2023, respectively, and are included in the “Global Shark Attack File” [137]. Other bites of divers and snorkelers, where Galapagos sharks were suspected to be the species of matter, derive from the Galápagos Archipelago [137]. However, the only way to positively incriminate this species is from a photograph or tooth fragment of the biting shark, which can be DNA tested. Additionally, in a few locations where the Galapagos shark is abundant, this species is competitive with commercial and recreational fishers via the depredation of catches, and shark–human interactions can be an issue here [138–142].

#### 4. Review of Records and Reports—Biogeography and Distribution of *Carcharhinus galapagensis*

This study identified 69 verified and 27 unconfirmed or dubious today-known world-wide records of *Carcharhinus galapagensis* across all three major ocean basins by literature review as well as the investigation of accessible public databases (Supplementary Material S1; Figures 2–6). These 69 verified records comprise 53 records around oceanic islands and only 16 at continental coasts, highlighting oceanic islands as the distributional strongholds of this shark. The Galapagos shark can be considered a cosmopolitan-distributed species [143] as well as a primarily insular species. The northernmost record of *C. galapagensis* in the northern hemisphere was derived from the Azores Archipelago (37.15° N) in the Atlantic Ocean [144], while the southernmost record in the southern hemisphere was derived from the Walters Shoals (−33.20° S) in the Indian Ocean [145].

Until the middle of the 20th century, the Galapagos shark was once thought to be limited to islands off western tropical America in the East Pacific, but already in the second half of this previous century, it was also realized to occur around oceanic islands worldwide, and that its range also spans the Atlantic and Indian Oceans. However, it was long believed that *C. galapagensis* is exclusively a Pacific species [146], but, in the 1960s, it was also discovered in the Indian and Atlantic Oceans as well. This shows that the mapping of shark distribution is considered an ongoing progressive process that must be continued for the most up-to-date state of knowledge. Regarding this, the prevalent difficulties of accurate species identification of requiem sharks of the genus *Carcharhinus* may counteract these efforts. In this context and with special emphasis on *C. galapagensis*, it was remarked that the distribution limits of *C. galapagensis* are not well-defined due to the ongoing confusion with *C. obscurus* [26] (compared in Section 3).

Regarding the distribution of *C. galapagensis*, it has been reported that it is confined to areas surrounding islands and seamounts of volcanic origin [147], and that it is an insular species known from all oceans [148]. Although the Galapagos shark is mainly confined in

its distribution to isolated oceanic islands, its cosmopolitan range character does not make this species a classic subject of island biogeography, as this discipline focuses primarily on phenomena such as endemism, etc., in terrestrial biota. Nevertheless, some biogeographic aspects such as dispersal, which is important for habitat connectivity and gene flow, come to mind when sighting the distribution maps of *C. galapagensis* (see Figures 2–6). Pursuing a global approach such as in this study, it should also be considered that geographic distance promotes genetic separation and diversification in species and their populations, which is of phylogeographic significance. Finally, the worldwide distribution of *C. galapagensis* in the Atlantic, Indian, and Pacific Oceans includes the following countries and overseas territories according to the current state of knowledge [1,7,10,11,14,18,26,31,35] and based on the collated data from this study.

Country occurrences of *C. galapagensis* (ordered alphabetically, only verified records mentioned; stateless localities were also listed):

Angola, Australia (Elizabeth and Middleton Reefs, Lord Howe Island, Norfolk Island), Belize, Brazil (St. Peter and St. Paul Archipelago), Chile (Easter Island, Salas y Gómez Island), Colombia (incl. Malpelo Island, Gorgona Island), Costa Rica (incl. Cocos Island), Cuba, Democratic Republic of São Tomé and Príncipe, El Salvador, Ecuador (incl. Galápagos Archipelago), France (French Polynesia, Clipperton Island, Europa Island, Bassas da India Atoll), Guatemala, Honduras, Independent State of Samoa, Japan (Izu Islands, Mikomoto Island, Zunan Islands, Ogasawara Islands, Amakusa Islands), Mexico (incl. Alijos Rocks, Revillagigedo Archipelago), New Zealand (Kermadec Islands), Nicaragua, Panama, Peru, Portugal (Azores Archipelago, Madeira, Savage Islands), Republic of Cabo Verde, Republic of the Marshall Islands, Spain (Canary Islands), Republic of Suriname, United Kingdom (Bermuda Island, Ascension Island, St. Helena Island, Pitcairn Islands), United States (incl. American Samoa, Hawaiian Archipelago, Johnston Atoll, Mariana Islands, Phoenix Islands, U.S. Virgin Islands), Union of the Comoros, Walters Shoals.

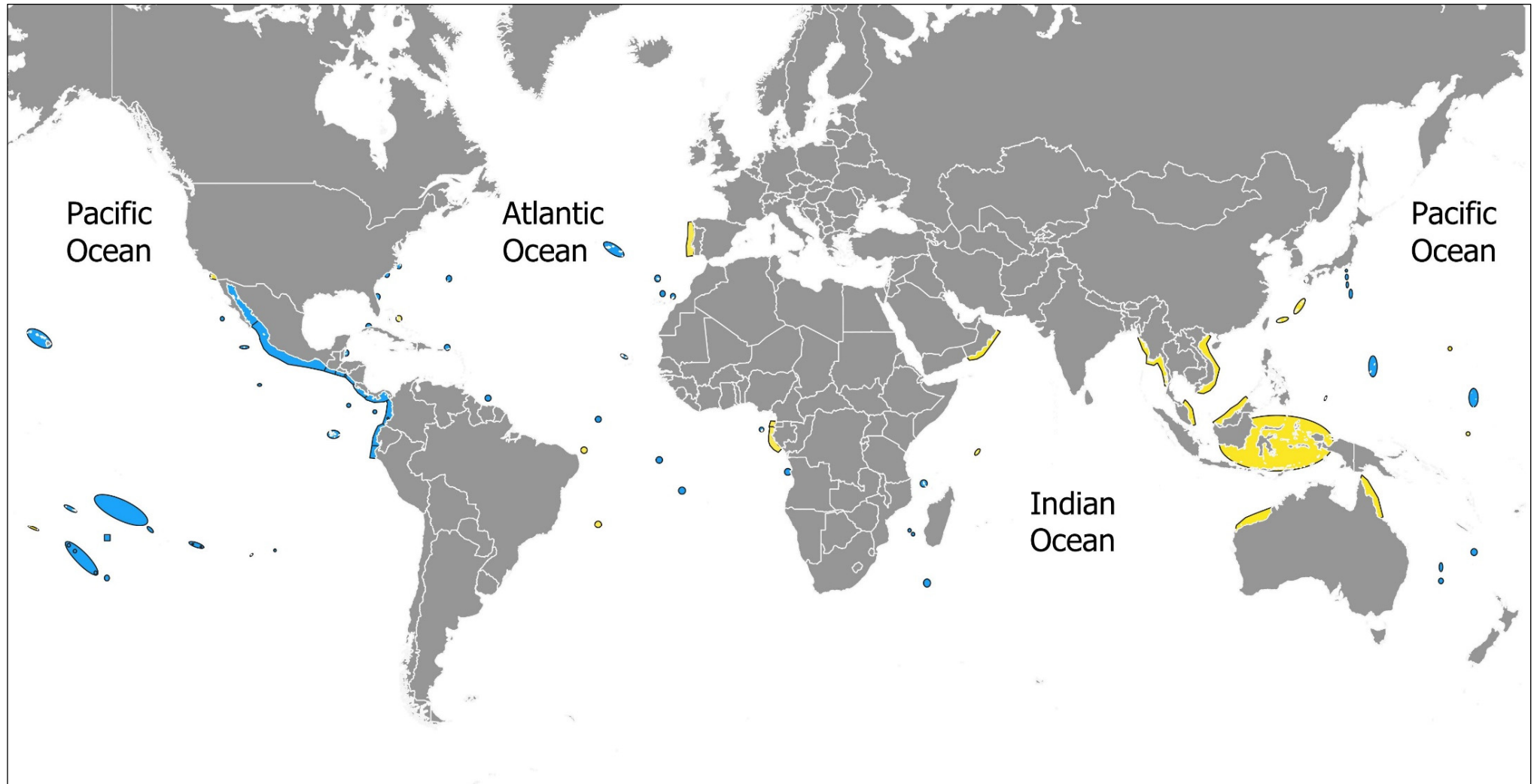


**Figure 2.** Global distribution of *Carcharhinus galapagensis* showing confirmed (blue) and unconfirmed (yellow) records.

#### 4.1. Distribution in the Atlantic Ocean

This section is based on Supplementary Material S1 and summarizes the state of knowledge of the distribution of *C. galapagensis* in this ocean basin. The first record of *C. galapagensis* from the Western Atlantic Ocean derived from an incident that was attributed to this species which occurred in the U.S. Virgin Islands, although this shark was reported much earlier for this ocean basin in the historic literature under erroneous names (see Supplementary Material S1). Nearly at the same time, this shark was also reported for the first time from the Eastern and Central Atlantic Ocean under its valid name [129].

In comparison to the Indo-Pacific, the Atlantic Ocean harbours a lower number of carcharhinid reef sharks. Out of *Carcharhinus*, only two members can be valued as true reef-associated sharks that occur in the Atlantic Ocean: *Carcharhinus galapagensis* and *C. perezi*, whereas the latter is restricted to the Western Atlantic Ocean and occurs in coastal waters from North Carolina to southern Brazil, including a few occurrences around oceanic islands such as the Bermuda Islands and the Fernando de Noronha Archipelago of tropical Brazil [7,71,149].

The Galapagos shark is widespread in the Atlantic Ocean but shows a very scattered distribution here (Figure 3). Records of *C. galapagensis* at the continental coasts of the North and South American continents are scarce (Supplementary Material S1). For the United States, it has been recorded a few times from the coasts of North and South Carolina and Florida [26,150–153]. In a field guide for sharks that occur in the Atlantic Ocean, *C. galapagensis* was also included, but without distributional information [154].

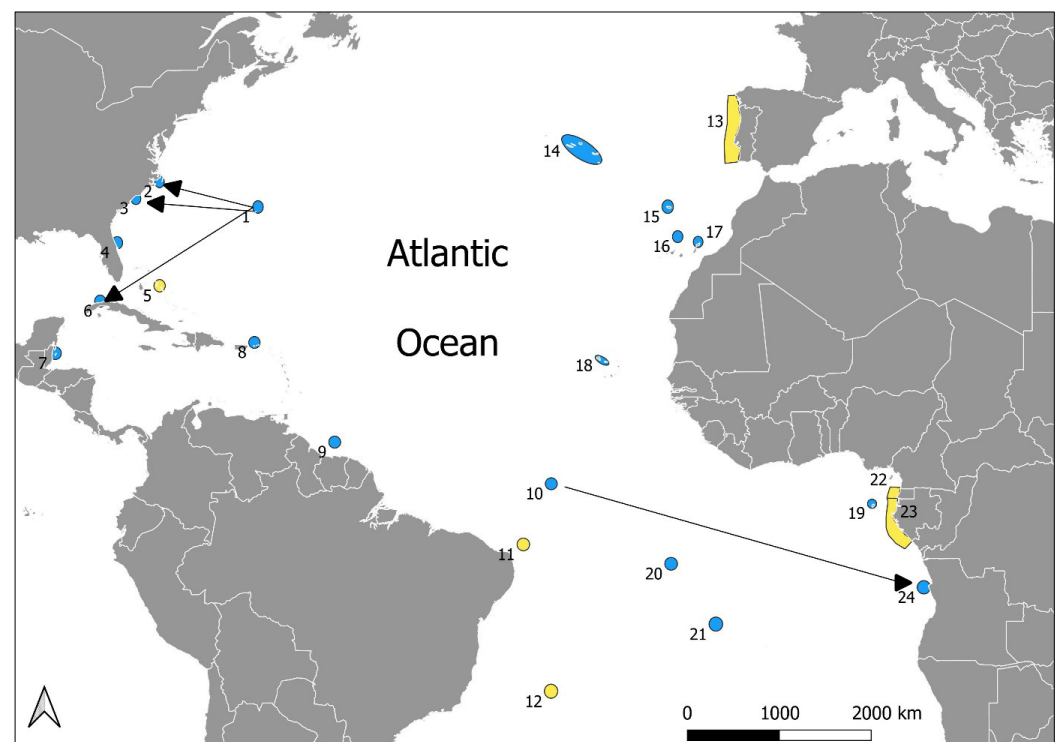


**Figure 3.** Confirmed (blue) and unconfirmed (yellow) records of *Carcharhinus galapagensis* in the Atlantic Ocean inferred from the literature references, including recorded long-distance movements of single specimens (arrows). The numbers in the figure correspond with the numbers of Supplementary Material S1.

##### 4.1.1. Distribution in the Northwest Atlantic Ocean

###### Bermuda Islands

At the Bermuda Islands, *C. galapagensis* was confused with *C. obscurus* (whose occurrence here has never been proven verifiably yet) for more than 100 years and erroneously reported under the latter's scientific name (or one of its early synonyms) by

several authors. However, there exists a detailed compilation of historical and recent Galapagos shark records from this location, including a listing of voucher specimens housed in different museum collections [71]. Requiem sharks that have been collected and reported from here during the late 19th and early 20th centuries were commonly misidentified and named either *Carcharias obscurus* [155–157], *Eulamia obscura* [158,159], *Carcharhinus platyodon* [160], or *Carcharias platyodon* [157], all names that refer to *C. obscurus*. Following investigations of collected material from the Bermuda Islands revealed that these specimens belonged without exception to *C. galapagensis* [11,71]. In an important historical work about sharks from the Western North Atlantic Ocean [161], *C. obscurus* was reported for this location, but newer investigation results suggest that this record was also based on *C. galapagensis* [71]. In 1981, the Galapagos shark was reported under its valid and correct scientific name from the Bermuda Islands [162]. A tagging study on sharks in the Western North Atlantic was conducted by the U.S. National Marine Fisheries Service (NMFS) Cooperative Shark Tagging Program between 1962 and 1993, that aimed to collect data on the migration behaviour of sharks [150], from which new information for *C. galapagensis* was derived. This study included 329 Galapagos shark specimens (146 females, 141 males, and 42 specimens of unknown sex) that were tagged at the Bermuda Islands [150]. The period of this previous study was extended to 2013 [163], with an overall of 422 tagged Galapagos shark specimens between 1962 and 2013. Several of the tagged and recaptured Galapagos sharks showed long-distance movements, and some specimens migrated to the U.S. east coast (Figure 3).

However, fisheries around these islands have affected and altered the population structure of *C. galapagensis* negatively. At the beginning of the 2010s, landing numbers suggested a declining abundance of *C. galapagensis* as well as *C. perezi*, and an increasing exploitation of large specimens of *Galeocerdo cuvier* (Péron & Lesueur, 1822) [164], and it has been reported for this location that *C. galapagensis* is caught intensively in fisheries and, therefore, its populations remain low [165]. However, 95% of the Galapagos sharks that are caught around the Bermuda Islands are newborn [7], suggesting that these islands are an important nursery ground for this shark in the Northwest Atlantic Ocean. Contrary to this, it was reported for the Western Atlantic Ocean that *C. galapagensis* is common off Bermuda [166], presumably information derived from before this shark was heavily fished at this location, and that it also occurs off the U.S. Virgin Islands, but it was suspected that this species is possibly more wide-ranging in the considered area [166].

#### The Bahamas and Adjacent Areas

Some authors gave information that *C. galapagensis* can be occasionally found in the Bahamas [26], but this may be based on confusion with the similar *C. perezi*. In the Bahamas, *C. perezi* was commonly mistaken for *C. galapagensis* [167]. Thus, the occurrence of *C. galapagensis* in the Bahamas is unconfirmed (Supplementary Material S1). Nevertheless, in May of 1966, a research team consisting of D. de Silva, S. Gruber, and W. Richards obtained one specimen of *C. galapagensis* (catalogue no. UF 130195) in open ocean waters of the Atlantic, off Florida, halfway to the Bahamas. Therefore, the Galapagos shark can be expected to occur around the Bahamas, although its presence here requires confirmation. One male Galapagos shark of unknown size, tagged at the Bermuda Islands, was recaptured in waters off northwestern Cuba in the waters of the Gulf of Mexico, at ~2000 km distance from its tagging point [163].

### Mainland United States East Coast

A capture of a shark that could have been *C. galapagensis* was reported off the U.S. east, but information on methods of identification or a specific location where this shark was caught in the Northwest Atlantic Ocean was not provided [168]. However, it was reported that very small numbers of Galapagos sharks are caught each year along the Florida coast [74]. For the northwestern Atlantic Ocean, it was also reported that the Galapagos shark occurs in the Bermuda and Virgin Islands but is rare along the U.S. continental coast [169]. Another study reported that *C. galapagensis* was captured only with two specimens in the bottom longline fisheries of the southeastern U.S. Atlantic during a ten-year period (1994–2003), indicating that this shark is reaching the U.S. east coast only on rare occasions [170]. This is consistent with the information derived from the further literature references which informed that specimens of *C. galapagensis* occasionally stray into the waters of the southeastern United States, but when taken by fishers, they get usually confused with *C. obscurus* [26]. Two specimens of *C. galapagensis*, caught off the continental United States, consisted of a 177.2 cm female caught off Daytona Beach, Florida, in July of 1991, and another was caught in the waters off South Carolina [26]. Due to the rarity of this species along the U.S. east coast, these specimens were apparently strays.

For the continental waters of the Northwest Atlantic Ocean and the southeastern United States, a female Galapagos shark of 168.0 cm weighting 35.6 kg was caught in August of 1990 during the 15th annual Poor Boy Shark Tournament at Shallotte Point, North Carolina [151,152]. This specimen, which was the most unexpected capture of this tournament, was captured on North Carolina's continental shelf [152], and the subsequent examination of this captured specimen, including measuring of the first and second dorsal fins and a tooth account (14-1-14/14-1-13), the resembling *C. obscurus* which was also captured during this tournament could be ruled out. A second single female Galapagos shark of 150 cm was captured off Southport, Brunswick County, in April of 1990, at the continental coast of North Carolina in waters of the Northwest Atlantic Ocean [153]. This location is in approximately 1240 km distance to the nearest known insular occurrence of this species at the oceanic islands of Bermuda. It is quite imaginable that this immature specimen started its journey from this location as the Bermuda Islands are known to house a resident population of Galapagos sharks [71]. However, *C. galapagensis* was evaluated as rare in the waters of North Carolina [171], with only a few occasional records until today, which strengthens the presumption that these specimens were nomads.

Galapagos sharks found in the coastal continental waters of the U.S. east coast (North and South Carolina, Florida) are presumably roaming specimens (strays, vagrants) and probably derive from the Bermuda Islands, their insular stronghold in the Northwest Atlantic Ocean, which is located at approximately 1050 km distance opposite to Cape Hatteras (North Carolina), the nearest point on the North American continent. It can be assumed that these few specimens reported along the U.S. east coast were originated at the Bermuda Islands from where they likely started their journey westwards, heading to the U.S. east coast. Investigation results from tagging studies [150,163] are also supporting this assumption because scientists involved in these studies reported on a single specimen that was tagged at the Bermudas, which was recaptured just south of Cape Hatteras.

### United States Virgin Islands

The first record of this species from the Western Atlantic Ocean derives from the Caribbean Sea. It is believed that a large Galapagos shark was involved in a fatal human–shark incident at Magens Bay, St. Thomas, U.S. Virgin Islands, in April of 1963. The involved shark specimen was caught and, in the following, examined at first by J. E. Randall, a well-renowned ichthyologist, who reported on this case [172–174]. It was reported that a 10-foot

ridge-backed carcharhinid shark had attacked and killed the U.S. Navy Lt. John Gibson who was swimming at the surface in Magens Bay, St. Thomas [172,173]. The shark was caught the following day in the bay with the right hand and other remains of the man in its stomach. Randall flew to St. Thomas from Puerto Rico to examine the shark of which obviously only remains were left. Randall's research revealed that the shark was still in the morgue at the Knud Hansen Memorial Hospital in Charlotte Amalie, but in such poor condition that the hospital authorities had requested its disposal. However, Randall himself examined those shark remains and concluded that it was a *C. galapagensis*, but he sent the remains to the well-known shark expert J. A. F. Garrick for verification of his determination. With the aid of a photograph of this shark specimen, the jaws and the teeth, several of the fins, and numerous measurements, both Randall and Garrick were able to rule out *C. perezi* and determined it in harmony as *C. galapagensis*.

However, investigating this case in retrospective, Randall obviously had doubts regarding his first determination result due to the strong similarity of many *Carcharhinus* species and, therefore, he involved the expert Garrick again, who later revised the whole genus *Carcharhinus* for further examinations and species confirmation. Garrick agreed with Randall's first species diagnosis due to the transmitted information and by an investigation of the remains of this specimen [preserved as: UPRM 1140, 292.0 cm, ♂, jaws only], which he had received from Randall. The features of this male specimen of *C. galapagensis* from St. Thomas agreed widely with the diagnostic features that have been reported for this species [172]. Later, during his extensive revision of *Carcharhinus*, Garrick investigated this catalogued specimen for a second time, and he was not absolutely confident anymore with the previous species diagnosis by Randall as well as from himself. Therefore, in his revision, Garrick stated that the data from this specimen (measurements, vertebral count, and photographs) and fragments, including the jaws he examined, conform closely to *C. galapagensis*, although the teeth differ slightly in shape from material deriving from the Eastern Pacific. Thus, Garrick encouraged the examination of further specimens from the Caribbean region for comparison, particularly of adults, and that these are needed to confirm this previous identification of the St. Thomas specimen. Although the number of precaudal vertebrae in the specimen from St. Thomas (104), already counted by Randall, was in full agreement with *C. galapagensis* and within the range reported for this species (103–109; Table 1), Garrick worded rather vaguely on Randall's record: "Probably in the Caribbean at the Virgin Islands.", which can be understood as an expression of his doubts regarding the species diagnosis. Finally, however, the record of *C. galapagensis* for St. Thomas, U.S. Virgin Islands was assessed as confirmed by the author of this study because there is also no more plausible explanation on species in question (and, conversely, *C. galapagensis* cannot be ruled out with certainty).

From a biogeographical point of view, Randall's record of *C. galapagensis* from the Caribbean Sea is of distributional significance as well as scientific importance because it represents the first record of the Galapagos shark from the Northwest Atlantic Ocean. Even though Galapagos sharks can sometimes behave aggressively toward humans [134], shark–human incidents involving this species were only reported seldomly, although their number might be underrepresented due to confusion with similar members of *Carcharhinus*. However, it is quite imaginable that a roaming adult of *C. galapagensis* has visited the waters of the U.S. Virgin Islands as a nomad. Currently, it is known that the Galapagos shark can be highly mobile under certain circumstances, and large-scale movements have also been reported to occur in the Western Atlantic Ocean [150].

### Western Caribbean Sea

More recently, the first record of the Galapagos shark from the Western Caribbean Sea was reported at Glover's Reef, a partially submerged atoll located off the southern coast of Belize, approximately 45 km from mainland Belize [175–177]. This atoll forms part of the outermost boundary of the 300 km long Belize Barrier Reef, which is part of the 1120 km long Mesoamerican Barrier Reef System that stretches from the northern tip of the Yucatán Peninsula further to the northeast corner of Honduras. A 154 cm female Galapagos shark was caught in May of 2001 at the edge of the reef slope, located at the southern entrance of Glover's Reef [175]. This specimen was positively identified as *C. galapagensis* by appropriate DNA investigation methods and therefore verifiably distinguished from *C. obscurus* [175]. This notable record was not only the first one for Belize [175,178], but it was also just the second record of this shark for the entire Caribbean Sea, together with the previous record by Randall [172]. This record extended the known distribution of the Galapagos shark in the Northwest Atlantic Ocean to the Western Caribbean Sea. It was concluded that the paucity of *C. galapagensis* from offshore coral reefs in the Caribbean Sea is surprising and that this species may be relatively rare in the Caribbean, perhaps due to competitive exclusion with the far more common reef-associated *C. perezi* [175]. However, it may be possible that confusions with similar carcharhinids, particularly *C. obscurus* and *C. perezi*, have masked the distribution of *C. galapagensis* in the Caribbean Sea. *Carcharhinus galapagensis* was often confused with the similar *C. perezi* in the northwestern Atlantic Ocean [167]. The very scarce number of records from this region (Supplementary Material S1) leads to the nearest explanation that the Belize specimen was a vagrant in the Caribbean Sea which originated from residential populations around oceanic islands of the Atlantic Ocean. Following on the unique record of *C. galapagensis* from Glover's Reef in 2001, it was assumed that the Galapagos shark may occur in other areas of the Belize Barrier Reef due to the presence of suitable habitat [179].

Subsequently, based on the records for the U.S. Virgin Islands and Belize, *C. galapagensis* was included in a checklist of fishes occurring in the Caribbean Sea [180] and an identification guide to common sharks and rays of the Caribbean [181], although this shark is scarce rather than common in this region, as indicated by the previous sections. Additionally, *C. galapagensis* was mentioned in a listing of coral reef and coastal pelagic fishes of the Caribbean Sea as a shark that undertakes large-scale movements up to 3000 km [182] (compare to Section 6).

#### 4.1.2. Distribution in the Southwest Atlantic Ocean

Information about the distribution and habitat use of the Galapagos shark around islands and archipelagos of the southern Atlantic Ocean is scarce, as well as in the northern Atlantic Ocean. Therefore, it was emphasized for *C. galapagensis* that further studies on the biology of this species in the Southwest Atlantic Ocean are needed [183].

### Brazilian Oceanic Islands

In the Southwest Atlantic Ocean, *C. galapagensis* was reported from several of Brazil's oceanic islands such as the Fernando de Noronha Archipelago, St. Peter and St. Paul Archipelago, and Trindade Island, which is part of the Vitória-Trindade Seamount Chain [183–190]. However, the reports of *C. galapagensis* for the Fernando de Noronha Archipelago and Trindade Island did not withstand a critical review (Supplementary Material S1) and left the St. Peter and St. Paul Archipelago as the only location with verified records of this shark in Brazilian waters. For the fauna of Brazil, *C. galapagensis* was included in checklists of sharks and chondrichthyan fishes, respectively [183,191]. The Galapagos

shark was also listed in a catalogue of Brazil's marine fishes [192] as well as for Brazil's cartilaginous fishes [193].

#### Fernando de Noronha Archipelago

The reports of this species at the Fernando de Noronha Archipelago [185,186] and at Trindade Island [188,189] are based largely on visual observations and demand confirmation. Possible mistakes with the similar *C. perezii*, which is common at and confirmed for the Fernando de Noronha Archipelago [194–198], are quite imaginable. In this context, records of *C. galapagensis* for the Fernando de Noronha Archipelago were doubted [17]. Although the presence of *C. galapagensis* around the Fernando de Noronha Archipelago could not be confirmed with certainty despite several reports (Supplementary Material S1), this species can also not be ruled out at all at this locality. Scientific research and studies focusing on sharks at the Fernando de Noronha Archipelago are mainly concentrated on a few regions with waters shallower than 60 m in depth and outside of the protection zone that was established around parts of this archipelago (B. Rangel, pers. comment). Therefore, due to the suitable reef habitats provided around this archipelago, the occurrence of the Galapagos shark on the deeper reef slopes in waters more than 60 m in depth cannot be excluded with certainty. Thus, the confirmation of this shark for the Fernando de Noronha Archipelago demands further investigations and research and its presence here remains still to be discovered. However, competitive inter-species exclusion due to the presence of *C. perezii* in this archipelago is also quite imaginable, but this deliberation is only of a speculative nature.

#### St. Peter and St. Paul Archipelago

For the equatorial St. Peter and St. Paul Archipelago of oceanic Brazil, the occurrence of the Galapagos shark is verified by numerous studies (the occurrence of *C. galapagensis* around this archipelago is reported more deeply in Section 8.5). Historic references and early reports remarked on the extraordinary number of sharks surrounding the rocks of this archipelago, but without giving a species determination [199]. The first correct species diagnosis of *C. galapagensis* for the St. Peter and St. Paul Archipelago was made in 1982 [199]. Researchers who went to this remote archipelago noted that the majority of the Galapagos shark specimens around these islands were relatively small (110–140 cm), suggesting that this shark reproduces here [199]. Currently, the records of the Galapagos shark from the St. Peter and St. Paul Archipelago represent the only reliable records of this species for Brazilian waters (Supplementary Material S1) [17].

#### Trindade-Martin Vaz Insular Complex

The occurrence of *C. galapagensis* at the Trindade-Martin Vaz insular complex in the Southwest Atlantic Ocean is unconfirmed and requires confirmation. Despite previous reports of this shark to occur at Trindade Island [188,189], its presence there could neither be recorded in subsequent studies of the elasmobranch fauna of this island group [200] nor in previous studies that had investigated the inshore fish fauna of the Trindade-Martin Vaz insular complex [201]. Instead, scientists reported on occurrences of resembling whaler sharks such as *C. obscurus* and *C. perezii* in this island group [201], both of which *C. galapagensis* was often confused with in the past. Therefore, the record of *C. galapagensis* at the Trindade-Martin Vaz insular complex needs confirmation.

#### 4.1.3. Distribution in the Northeast Atlantic Ocean

At the beginning of the 1980s, *C. galapagensis* was still unknown from the waters of the Northeast Atlantic Ocean. Some researchers stated that they have never observed *C. galapagensis* in the waters of the East Atlantic yet, but they further deliberated that

its presence here is very likely, presumably based on its occurrence already being recognized around islands of the southern Atlantic Ocean such as Ascension and St. Helena Islands [162]. Its presence along the Atlantic Ocean coast of the Iberian Peninsula was supposed [1,39]. However, until today, records of *C. galapagensis* from the continental coast of the Iberian Peninsula are still lacking and the presence of this species here needs further documentation [202].

#### Mediterranean Sea

The identity of a Mediterranean carcharhinid record from Alicante, Costa Brava, Spain, which was described by historic references [203] as *Carcharhinus commersonii* (Blainville, 1816), was critically discussed at the beginning of the Millenium [131]. Later, J. A. F. Garrick investigated this *C. commersonii* specimen from Alicante and suggested that this may have been *C. galapagensis* based on some morphometric features of this specimen, such as the present interdorsal ridge [11]. However, this Alicante specimen was subsequently included under *C. obscurus* [204], but this determination was questioned [131]. Until now, the exact species identification of this specimen from Alicante is still pending and has not yet been satisfactorily clarified. Consequently, the presence of *C. galapagensis* in the Mediterranean Sea cannot be ruled out with certainty as well as its confirmed presence herein. Due to the lack of reliability of the data for this species from the Mediterranean Sea, the Galapagos shark was not included in relevant treatises about the Mediterranean shark fauna [205].

#### Macaronesian Islands

Contrary to its unconfirmed presence off the Iberian Peninsula in the Northeast Atlantic Ocean including the Mediterranean Sea, the Galapagos shark has been recorded from nearly all warm-temperate to tropical Macaronesian individual islands, island groups, and archipelagos. These include the Azores Archipelago, Madeira, the Savage Islands, the Canary Islands, and the Cape Verde Islands [1,11,120,144,202,206–210]. From Madeira and the Canary Islands, this species is only known from sporadic records [206,211], and its rareness here is presumably because these islands are visited irregularly by specimens of this species. Nevertheless, the wide geographic appearance of the Galapagos shark on islands in the Northeast Atlantic Ocean makes it a subject of the biogeography of the Macaronesian ichthyofauna [212]. Until today, verified records of this species exist from all locations mentioned above, although the presence of this shark around some islands of the Macaronesian region may be only of sporadic nature without residential populations [211].

The records of *C. galapagensis* from Portuguese and Spanish islands such as the Azores Archipelago, Madeira, and the Canary Islands (Lanzarote) in the Northeast Atlantic Ocean have led to the inclusion of this species in the following checklists of fishes: checklist of European marine fishes [213], checklist of European cartilaginous fish species [214], checklist of European fishes [215], checklists of marine fishes of Portugal [120,202], and the national checklist of marine fishes of Spain [209]. The references for these Portuguese records of *C. galapagensis* (Azores Archipelago, Madeira) were compiled in detail [202]. Thus, *C. galapagensis* can be considered a native marine fish species of insular Europe.

#### Azores Archipelago

In detail, the first record of *C. galapagensis* from the Portuguese Azores Archipelago was derived from captures of four juvenile specimens reaching from 86.5 to 99 cm near the Formigas islets [144]. These four juvenile specimens of *C. galapagensis* were caught in July of 1988 by recreational anglers [216]. Following this, four juveniles of *C. galapagensis* were photographed in the same area during diving operations at Dollabarat Reef (Formigas Bank) in August 2005 [211]. It was reported that the Galapagos shark was never recorded in the commercial longlining fisheries observer programme of the Azores [211], suggesting

that it is rare in this archipelago. Local experts (M. Machete and M. Santos) reported that the Galapagos shark was recorded only once in the year 2000 in over 340 sets of experimental longlining conducted at the Azores Archipelago, suggesting that specimens of *C. galapagensis* only exceptionally reach the region [211]. A photograph of a small juvenile specimen of *C. galapagensis* (94.0 cm, male) that was captured at Faial Island in the Azores Archipelago in August of 2000 is displayed in the image gallery for the Galapagos shark provided in the public database “FishBase” [217].

Apparently, the Galapagos shark is rare in the Azores Archipelago and has only been recorded seldomly. Therefore, this shark was assessed as a vagrant in the Azores Archipelago [218], although the presence of small juveniles indicates the use of this archipelago by this species for reproduction. However, the occurrence of *C. galapagensis* in the Azores Archipelago was discussed in the context of a putative current tropicalization process in the Azores fish fauna because of the mainly tropical distribution of this shark [211]. *Carcharhinus galapagensis* was considered rare at the Azores Archipelago, and it was occasionally seen associated with seamounts such as the Formigas Islets, Dollabarat Reef, and Princess Alice Bank [68,219]. Despite these numerous verified records of the Galapagos shark at the Azores Archipelago, its occurrence here was still doubted [39], presumably resulting from the ongoing confusion of *C. galapagensis* with *C. obscurus* that also occurs in the Macaronesian region. However, until nowadays, records of *C. galapagensis* from the Azores Archipelago consists exclusively of small juveniles. Despite the repeated reports of juvenile specimens from this location, which could indicate a nursery area at this site, the reports of this species from here are of primarily sporadic nature, and the documented rarity of this species at the Azores Archipelago is leading to the conclusion that the Galapagos shark does not have a residential population here (Supplementary Material S1). In conclusion, the status of this shark in the Azores Archipelago needs deeper investigations.

#### Canary Islands

For the Canary Islands, *C. galapagensis* was reported from the marine reserve La Graciosa, north of Lanzarote Island [206]. In contrast to the presumption by scientists who speculated that the occurrence of the Galapagos shark in the North Atlantic could result from a tropicalization process [211], for the Canary Islands, other scientists resumed that the occurrence of *C. galapagensis* at this location is not correlated with a rise in water temperatures and, moreover, that this species has presumably occurred here long before it was discovered [206].

#### 4.1.4. Distribution in the Southeast Atlantic Ocean

The Galapagos shark was included in a compilation about the marine fishes of Angola in the Southeast Atlantic Ocean (Supplementary Material S1), but details on this occurrence here is lacking [220]. The verification of this largely unsustained report was made more than 30 years later by a tagging study, in which one adult female specimen of *C. galapagensis* that was tagged at St. Peter and St. Paul Archipelago, was found later in waters off the Angolan coast [36]. This tagged specimen had crossed nearly the entire Atlantic Ocean from west to east and could have been attracted by the suitable habitat provided by the Ombaca Canyon and Seamount Complex along the Angolan coast as this shark shows a preference for offshore seamounts. Apparently, the Galapagos shark occasionally moves to the African continental coast from distant islands in the Atlantic Ocean.

*Carcharhinus galapagensis* was included in a compilation of marine fishes from the Gulf of Guinea [221], very likely referring to the occurrence of this shark around São

Tomé because this island is situated in the easternmost part of the tropical Southeast Atlantic Ocean (Supplementary Material S1). For Ascension Island, a mixed demographic population structure of *C. galapagensis* was reported, and that this shark can be encountered here in large groups of dozens of differently sized individuals [94]. Further, a strong site fidelity of *C. galapagensis* around the seamounts adjacent to Ascension Island was also reported, but, additionally, that no Galapagos sharks were observed at the Harris Stewart Seamount located 295 km to the west [222]. This is widely consistent with other reports that informed that the Galapagos shark is the most encountered shark around Ascension's coast and the shallow-water seamounts [25]. At Ascension Island, Galapagos sharks can be found at much higher densities within 5 km of the seamounts than in the surrounding open ocean [25]. This may suggest site-attachment of *C. galapagensis* to these seamount habitats at Ascension Island. A recent study also reported on strong *C. galapagensis* site-attachment to seamounts (Grattan and Young seamounts) some 260–320 km offshore to the south from Ascension Island [223]. By the tagging of 17 specimens ranging between 120 and 245 cm, this study revealed that the Galapagos sharks often resided around these seamounts for months to years [223]. For Ascension Island, recently, a putative increase in the numbers of *C. galapagensis* was reported based on information derived from interviews with residents [224]. Possibly, this increase is caused by shifts in numbers of other marine predatory species, but it may also indicate increased use of inshore habitats by this shark or recovery from previous depletion by fisheries. The Galapagos shark has been reported to be moderately common at St. Helena Island and generally of a small size here (seldom over 150 cm long), which may indicate that this species reproduces here [225,226].

#### 4.2. Distribution in the Indian Ocean

This section is based on Supplementary Material S2 and summarizes the state of knowledge of the distribution of *C. galapagensis* in this ocean basin.

Verified records and reports of the Galapagos shark from nearly the entire Indian Ocean basin are scarce. Currently, verified records of *C. galapagensis* derive only from less than a handful of sites that are exclusively located in the southwestern part of this ocean basin, namely in the Mozambique Channel and south of Madagascar (Figure 4). However, for the Indian Ocean, some reports of *C. galapagensis* are unsustained and presumably based on misidentification with other carcharhinids. *Carcharhinus galapagensis* was reported to occur in India's commercial fishing zone [227], but this is quite imprecise distributional data and probably based on confusion with other members of *Carcharhinus*. The Galapagos shark was also listed in a recent study about the reconstruction of industrial catches for large pelagic species that are harvested in the Indian Ocean and that this species gets harvested by industrial fisheries in this area [228], but this is also quite undetailed spatial information.

##### 4.2.1. Distribution in the Northwest Indian Ocean

A neonate specimen of *C. galapagensis* was reported from the Sea of Oman with the proclamation that it represents a considerable northern range extension in the Indian Ocean [229,230]. Moreover, it was assumed that this record was the first from Omani waters and indication for a possible presence of a breeding population of the Galapagos shark along the coast of Oman in the northern Indian Ocean due to the putatively small size of this specimen (however, no information on the size of this specimen was provided). Later, *C. galapagensis* was listed in a summary of confirmed elasmobranch species from Omani waters based on the belief that this record is valid [231]. Unfortunately, this neonate specimen was neither catalogued nor reliable photographs of this record were made, which

makes a verification of this record impossible. However, this unconfirmed record of this hard-to-determine species persisted in the subsequent literature and was long-lasting in following treatises dealing with the elasmobranch fauna of the Arabian region, and not all scientists doubted the Omani record. For example, it was presumed that this species could also possibly occur and be present in the neighbouring Persian Gulf [232]. However, the Omani record of *C. galapagensis* remained not without doubts, and this species was excluded from a guide to the sharks of the Arabian Seas due to the limited information on this occurrence [233]. In the following, because of a lack of information and missing accuracy in the documentation of this Omani record of *C. galapagensis*, it was stated certainly correct that this record needs confirmation [234].

#### 4.2.2. Distribution in the Southwest Indian Ocean

The Galapagos shark was included in a list of common and scientific names of the fishes of Southern Africa [235], whereby the term “Southern Africa” is to be understood here as broad and presumably also includes the stateless Walters Shoals in the southwestern Indian Ocean. *Carcharhinus galapagensis* was reported from Madagascar [14], arguably in the belief that Walters Shoals belongs to this country. The same mistake occurred repeatedly in further references. The Galapagos shark was reported from “southern Madagascar” and was included in a checklist of the fishes of Madagascar [236], probably due to the belief that Walters Shoals belong to the territorial waters of Madagascar, but it is proven that these shoals are lying outside of national boundaries (Madagascarian Economic Exclusive Zone; hereafter abbreviated with: EEZ). *Carcharhinus galapagensis* appeared also in a list containing the chondrichthyan fishes of Madagascar [237]. Presumably, this report also refers to the occurrence of this species at the Walters Shoals.

Information was reported about an occurrence of *C. galapagensis* in the Seychelles, derived from shark fisheries reports [238] as well as compilations of the species of sharks found in the Seychelles [239,240], but without further information regarding identification or distribution, although it was believed to occur in the Seychelles [240]. Due to this very vague information, all these reports were evaluated as unconfirmed records of the Galapagos shark in the Seychelles in the southwestern Indian Ocean. Possibly, the account of *C. galapagensis* was the result of confusion with the similar *C. amblyrhynchos*, which is verifiably reported to occur in the Seychelles [7]. However, the more than one hundred islands of this archipelago could probably provide suitable habitats for the Galapagos shark, a species that exhibit a preference for remote islands and atolls [48]. Nevertheless, evidence of its occurrence here could not be made yet.

#### Walters Shoals

The first report of *C. galapagensis* from the Indian Ocean was made in 1964 from the Walters Shoals to the south of Madagascar, a remote group of submerged and shallow seamounts of the southern Madagascar Ridge [145,147]. The Walters Shoals are located 845 km south of Cape Sainte Marie (Madagascar) and 1210 km east of Richards Bay (South Africa). The tips of some of these seamounts are only 18 m below the surface [241]. They were discovered relatively late in 1963 and named after Charlie Walters, a South African captain and hydrographer of the 1950s. This Indian Ocean record was made almost at the same time when this species was also reported for the first time under its valid name from the Western, Central, and Eastern Atlantic Ocean [129,172,173]. It was reported that four specimens of *C. galapagensis* were obtained from the Walters Shoals during a fish survey that was conducted by the South African Oceanographic Research Institute in February 1963 [145]. Unfortunately, no information on the size of the caught specimens was provided. When the Walters Shoals were discovered in 1963, they were

inhabited by a huge and pristine population of Galapagos sharks, but the scarce information available indicate that the number of sharks has since decreased largely because of overfishing [242]. *Carcharhinus galapagensis* was not recorded in a survey targeting Walters Shoals anymore in 1988, but instead *C. plumbeus* [241], which may indicate overfishing of the local *C. galapagensis* stock.

#### Bassas da India Atoll

For the Indian Ocean, some authors pointed out for *C. galapagensis*, that the difficulty of its identification makes it probable that this shark occurs at other localities in this ocean basin where it has not been recognized yet, and in hindsight, these authors were right [77]. Following the first record of the Galapagos shark from the Indian Ocean at the Walters Shoals in the 1960s [145,147], the second record from this ocean basin, and simultaneously the first record from the Mozambique Channel, was reported more than 40 years later for the Bassas da India Atoll in 2005 [243]. Large numbers of juvenile Galapagos sharks were reported to occur at this atoll [243], suggesting this reef system could function as a nursery area for this species in the Mozambique Channel (Supplementary Material S2). However, it should be noted that subsequently, the results of an expedition by the Oceanographic Research Institute (South Africa) to Bassas da India Atoll conducted in 1991 were reported, when this species has already been recorded at this atoll at the beginning of the 1990s [244]. Therefore, the verified presence of *C. galapagensis* at Bassas da India can be backdated to the year 1991, which predates the first published record which authors were in the belief that they were the first who recorded the Galapagos shark from the Mozambique Channel [243]. Additionally, a further reference was reporting *C. galapagensis* in the Bassas da India Atoll in high numbers [245].

Due to these reports cited above, the rarity of this species in the entire Indian Ocean, and the assumed function of this site as a place for the reproduction of Galapagos sharks, the Bassas da India Atoll has become an Important Shark and Ray Area (ISRA) because of undefined aggregations (=aggregations or assemblages regularly and/or predictably occur, year-round or seasonally, but the function is currently unknown) of this shark occurring here. Therefore, the delineation of an ISRA for Bassas da India Atoll is based on the consideration of its biogeographic significance and assumed reproductive importance for this species and was initiated by the author of this study [246]. It should be noted that due to its remoteness, the shark population at Bassas da India may be susceptible to high fishing pressure because fishing fleets can operate here out of control by authorities.

#### Europa Island

The third record of *C. galapagensis* for the Southwest Indian Ocean was derived for the French Europa Island, also located in the Mozambique Channel [247–249] (Figure 4). It was reported that *C. galapagensis* is the most abundant species of shark at Europa Island and that this site could be, like the Bassas da India Atoll, a further nursery area for Galapagos sharks in the Southwest Indian Ocean due to the high numbers of observed juveniles here [249]. Other studies did not report *C. galapagensis* for Europa Island but instead the resembling *C. obscurus* [250] with reference to earlier reports [251], possibly based on a mistake with the similar *C. galapagensis*, as this species is known now to occur verifiably at Europa Island.

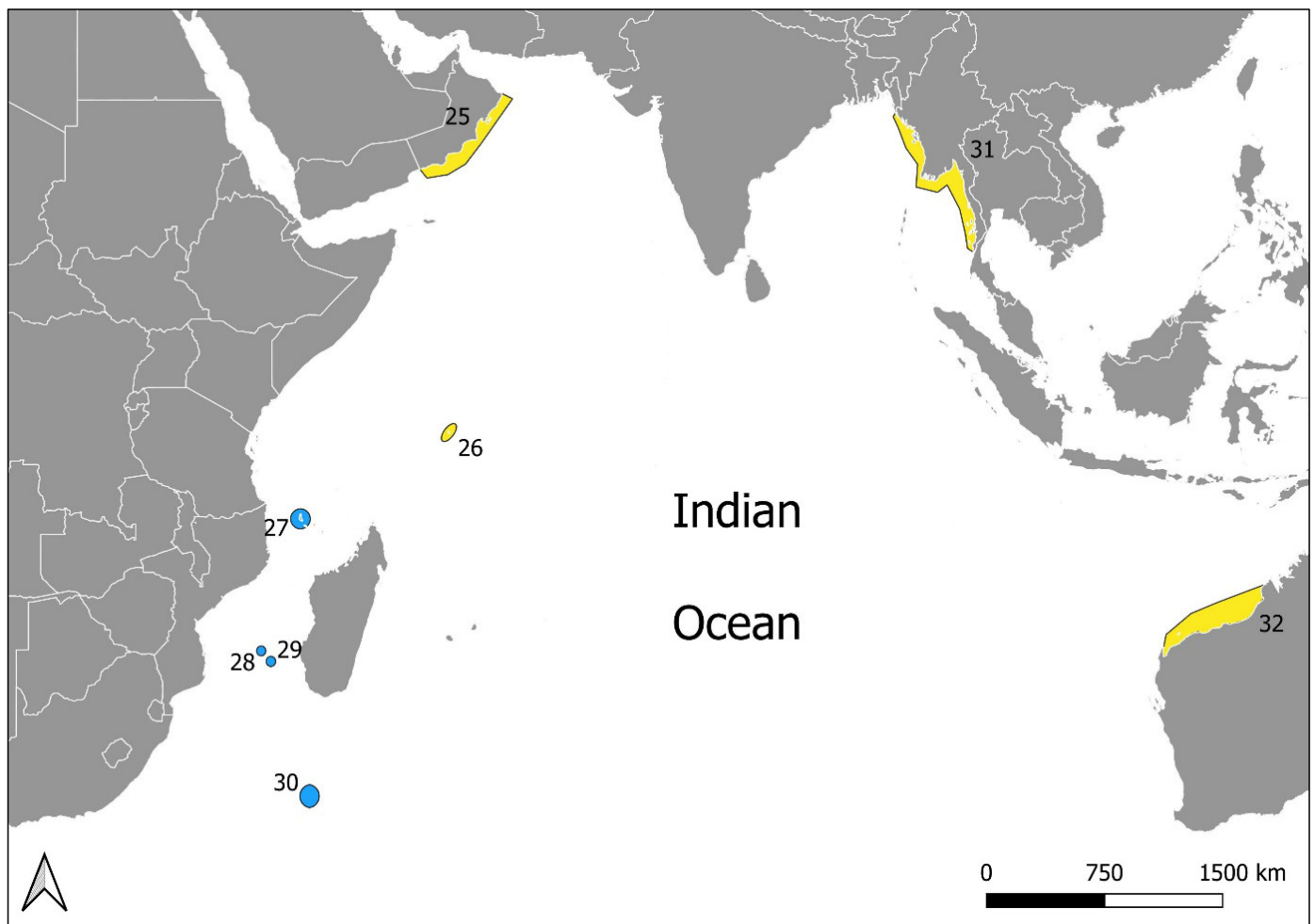


**Figure 4.** Confirmed (blue) and unconfirmed (yellow) records of *Carcharhinus galapagensis* in the Indian Ocean inferred from the literature references. The numbers in the figure correspond with the numbers of Supplementary Material S2.

#### Grande Comore (Comore Islands)

This record of *C. galapagensis* is exclusively based on a work that referred to an examined specimen (jaws preserved only) collected at this locality and currently held in the J. L. B. Smith Institute, South Africa (uncatalogued) [252]. The author of this study had no opportunity of revising this voucher and therefore, he could neither revoke nor confirm this record with certainty. However, the jaws of *C. galapagensis* may be sufficient for a reliable species determination and differentiation from other members of *Carcharhinus* based on the tooth formula (Table 1). As such, with no evidence that this record is erroneous, the author valued this record as confirmed.

#### 4.2.3. Distribution in the Northeast Indian Ocean

For the Northeast Indian Ocean, an unsubstantiated report of a putative occurrence of *C. galapagensis* was derived for Myanmar [253]. Presumably, this report is mainly based on the misidentification of *C. galapagensis* and confusion with other species of *Carcharhinus*.

#### 4.2.4. Distribution in the Southeast Indian Ocean

*Carcharhinus galapagensis* was reported to occur at the Northwest Cape of Australia [33,41]. However, these reports of the Galapagos shark from here were unsustainable due to a lack of verifiable data such as collected specimens, photographs, or DNA analysis of sharks sufficient for a confirmed record. Important works about the fish and shark fauna of

northwestern/western Australia did not mention records of *C. galapagensis* [18,254,255]. Based on this uncertainty, it was emphasized that records of *C. galapagensis* from off the Northwest Cape require confirmation [256]. Thus, the presence of *C. galapagensis* along Australia's coast in the Southeast Indian Ocean remains unconfirmed. It cannot be excluded that the records of *C. galapagensis* from here are derived from mistakes with *C. obscurus*, a species known to occur in this region [257].

#### 4.3. Distribution in the Pacific Ocean

This section is based on the Supplementary Material S3 and summarizes the state of knowledge of the distribution of *C. galapagensis* in this ocean basin.

The Galapagos shark is a transpacific (=amphi-pacific) shark that occurs on both sides of the Pacific Ocean, and around several islands between the margins of this ocean basin in the Central Pacific (Figures 5 and 6). Like in other ocean basins, its distribution here is also highly scattered, with numerous widely separated occurrences around remote and isolated oceanic islands and adjacent continental coasts, the latter primarily diagnosed in the Tropical Eastern Pacific region.

##### 4.3.1. Distribution in the Northwest Pacific Ocean

###### Japanese (Oceanic) Islands

The investigation of the Japanese literature containing information on elasmobranchs by the author of this study brought to light that *C. galapagensis* is more widespread in the archipelagos of Japan and in the northwestern Pacific Ocean than previously believed, and that these Japanese records are commonly underrepresented in most publications and treatments about the fish and sharks of this region (Supplementary Material S3). Therefore, these occurrences were commonly not mentioned in most of the available distribution maps. Apparently, the Galapagos shark occurs around more oceanic islands of subtropical Japan than most people are aware of. Currently, *C. galapagensis* is known from five different locations in subtropical Japan. The Ogasawara, Zunan, and Izu Islands are building an island chain in the Northwest Pacific Ocean and the waters of Japan's EEZ. These subtropical offshore islands provide suitable habitats for *C. galapagensis*, and this species has been reported from here by several authors (Supplementary Material S3). Additionally, *C. galapagensis* also occurs at the Amakusa Islands and Mikomoto Island, the latter representing an isolated seamount just ~8 km off the Japanese mainland (Honshū), from where it has been reported recently [258]. This makes the number of locations with known records of *C. galapagensis* from Japan five. All these locations mentioned before can be assessed as data-poor regions regarding the knowledge of their elasmobranch fauna because studies on elasmobranchs from these localities are scarce. However, all these Japanese offshore islands are suggested to function as stepping stones for the occurring fish fauna [259].

The first record of *C. galapagensis* from Japanese waters was made in the middle of the 1980s from the Ogasawara (=Bonin) Islands, about 1000 km south of Tokyo, and its presence was also suggested in the adjacent Izu Island waters [260]. For the latter, subsequently, the presence of the Galapagos shark at the Izu Islands got verified by reports of catches of this shark at Hachijo Island [261]. Later, catches of *C. galapagensis* were also reported in the waters around Hachijo Island, Izu Islands, between 2005 and 2010 [262]. The first record of *C. galapagensis* from Japan's Zunan Islands, a group of uninhabited volcanoes 360–650 km south of Tokyo, was made by 11 voucher specimens and additional underwater photographs of this shark [263]. Previously, *C. galapagensis* was mentioned in a widely neglected publication from the Amakusa Islands (Kumamoto Prefecture) adjacent to Kyushu, the southernmost of the four Japanese main islands, in which the Galapagos

shark was reported for the first time from this locality [264], whereas this record is mainly based on tooth characteristics. This record from Amakusa Island was confirmed in the following [265]. The presence of *C. galapagensis* at Mikomoto Island, a small oceanic seamount adjacent to the Japanese coast, was described for the first time at the beginning of the 2020s [258]. This study made evidence of the residency of Galapagos sharks at this site by using acoustic and satellite tagging, suggesting that this shark has a residential population at Mikomoto Island, although one tagged specimen conducted a large-scale movement of ~800 km to the east of the Japanese mainland into open Pacific Ocean waters.

For the southernmost Japanese waters, there are two further not well-documented records of *C. galapagensis* from the Ryukyu Islands. The capture of two specimens of *C. galapagensis* with longline fishing gear in reef slopes and offshore habitats in the Ryukyu Islands of subtropical Japan was reported around the Millenium [266]. Additionally, a study informed about the examination of stomach contents of five specimens of *C. galapagensis* caught at the Yaeyama Islands of the southern Ryukyus [267], but no further information was provided. Although these reports of *C. galapagensis* for the Ryukyu Islands [266,267] cannot be assessed as confirmed records due to the lack of important information regarding morphological characteristics and diagnostic features that verifiably allow the identifying of this species, it is quite imaginable that the Ryukyu Islands, comprising more than 100 single islands, provide suitable island habitats for the Galapagos shark. However, there are no further records and reports on the occurrence of the Galapagos shark at the Ryukyu Islands, but perhaps it is worth paying attention to this species there in future studies on elasmobranchs and fish.

However, for Japan, it should be noticed that the report of one museum specimen (ZUMT 64458: 72.7 cm, ♂, immature embryo) that was collected at the Ogasawara Islands in 1913 by S. Fujimori [268] outdates the first record of *C. galapagensis* for Japanese waters, as published earlier in the literature [260]. Based on these verified records mentioned above from at least five different locations across Japan, the presence of *C. galapagensis* in Japanese waters is confirmed. Mainly based on the first scholarly evidence of the Galapagos shark for Japan [260], *C. galapagensis* was listed in an extensive work on the Japanese ichthyofauna [269]. The Galapagos shark was also included in the more recent compilation of the Japanese ichthyofauna [270]. Additionally, the Galapagos shark was mentioned in a list of major shark species that are regularly caught by the Japanese fishing fleet [271].

#### Wake Atoll

The occurrence of *C. galapagensis* at the remote Wake Atoll was reported in an updated table that included fishes of special conservation concern [272], referring to the previously published checklist of fishes of Wake Atoll from four years before, in which the Galapagos shark was not yet mentioned [273]. Wake Atoll is located between the Mariana Islands and the Hawaiian Archipelago in the Western Central Pacific, approximately 2500 km to the northwest of Johnston Atoll and 3700 km to the west of Hawaii and belongs to the most remote and isolated islands in the world. In an updated and more recently published checklist of the fishes of Wake Atoll, including a review of records of requiem sharks (genus *Carcharhinus*) that were reported for this remote atoll, *C. galapagensis* was not mentioned [274]. Instead, in this treatise, it was referred to an old report [275] of *Carcharhinus obscurus* for the Wake Atoll under the name *Eulamia commersonii* (Blainville, 1816), a synonym of *C. obscurus* [276]. For this historic report, the authors of this study collected a specimen of what they named *E. commersonii* at the Wake Atoll and deposited this in the Bishop Museum as a voucher specimen (BPBM 3500). Unfortunately, this specimen has since been lost, and the original identification is in question. A recent

publication provided information that *C. amblyrhynchos* is the only species of *Carcharhinus* that frequently occurs at the Wake Atoll and that this species could foreseeably have been misidentified as *C. obscurus* [274]. However, even when the true identity of the lost voucher specimen of *E. commersonii*, once deposited in the Bishop Museum, will possibly never be uncovered, in the author's opinion, even *C. galapagensis* cannot be ruled out as a mistaken species because it resembles *C. obscurus* in many morphometric features, which has led to many confusions and many misidentifications of both species in the past [72]. Additionally, *C. galapagensis* is well-known today to occur around oceanic islands opposite to *C. obscurus*, which commonly occurs at continental landmasses and shelves. However, because the occurrence of the hard-to-determine *C. galapagensis* at the Wake Atoll derives only from a compilation of fish without providing any further information, the presence of this species at Wake Atoll is assessed as not confirmed and requires verification.

#### Micronesia

For the Western Pacific regions south of Japan, it was reported that *C. galapagensis* is distributed throughout Micronesia [277], but this information is quite imprecise and does not contribute to a detailed listing of records. The first record of *C. galapagensis* from the Mariana Islands derived from reports of captures of this shark from Guam [278,279]. Further, it was also reported that this shark seems to be the most abundant shark around Guam in waters deeper than 70 m depth [279]. For the waters surrounding Palau, one captured specimen of *C. galapagensis* that was caught in the Palau-based pelagic longline fishery during an observation period consisting of 12 years was reported [280], indicating that this species is rare here. Possibly, this was a roaming specimen under the premise that the determination was accurate. Other authors emphasized that the occurrence of *C. galapagensis* at the Palau Islands require verification due to the circumstance that it is reported from here mainly by fishery reports, but they also pointed out that its occurrence is within the expected range and environmental envelope [281]. Considering that all reports of *C. galapagensis* from Palau are not verified by proofed voucher specimens or genetic investigation results that could support reliable evidence, the record of this species from Palau was assessed by the author as unconfirmed. The presence of *C. galapagensis* in Philippine waters was expected [282], although this species was not recorded there yet. Due to its character as an island state comprising more than 7500 islands, the Philippines may provide suitable environments for this shark that are mainly confined to insular habitats.

#### Southeast Asian Pacific (Vietnam, Thailand, Malaysia, Brunei Darussalam)

An unsustained report on a putative occurrence of *C. galapagensis* was derived for the continental waters off Vietnam [283]. Presumably, this report is mainly based on the misidentification of *C. galapagensis* and confusion with other species of *Carcharhinus*. For Southeast Asia, *C. galapagensis* was suspected to occur in the oceanic waters off Thailand [284]. Further, there is also an unsustained report on the first record of *C. galapagensis* from Malaysian waters with no information from which locality this record derives, although a picture of a specimen was provided [285]. The captures of two specimens of *C. galapagensis* were reported from northern Borneo, South China Sea: one juvenile specimen of 84.5 cm caught at Jerudong in Brunei Darussalam waters and one adult specimen of 238 cm caught at Bintulu, Sarawak in Malaysian waters [286]. Additionally, these records were documented by voucher specimens (catalogue nos.: MSR 468, MSR IPP 13; Supplementary Material S3), and in this publication, a picture of one of these putative *C. galapagensis* specimens (catalog no.: MSR 468, 84.5 cm, immature ♂) was provided [286]. According to this reference [286], these specimens are representing the first records of the Galapagos shark from the states of Brunei Darussalam and Malaysia, and it was further stated that

*C. galapagensis* is rarely caught here and is also very rarely found on the fish market in Brunei Darussalam. However, these records from Brunei Darussalam and Malaysia were doubted, and, by referring to this picture of *C. galapagensis* as displayed in the publication about the Brunei Darussalam record, renowned shark scientists and experts remarked that this specimen is most likely a juvenile male of *C. amblyrhynchos* [287], a species of which *C. galapagensis* was often confused with in the past [72]. Unfortunately, the author of the present study could not verify this record based solely on the picture provided in this publication. He therefore strongly recommends a critical review of the collected material to provide clarity on this matter. Thus, the records of *C. galapagensis* from Bornesian waters both of Brunei Darussalam and Malaysia demand confirmation. However, because of the two unverified records for Malaysia [285,286], *C. galapagensis* found entrance in the compilation of Malaysian marine fish names [288].

Other scientists proclaimed that they have made the first record of *C. galapagensis* in Indonesia due to investigated shark fins from all over Indonesia [289], but these researchers used inappropriate investigation methods based on mtDNA (DNA barcoding) that fail to distinguish verifiably between *C. galapagensis* and *C. obscurus* (compare Section 3). Therefore, this record was assessed as doubtful. Another study reported on the verification of both *C. galapagensis* and *C. obscurus* from Banggai Island, Central Sulawesi, Indonesia, by using eDNA [111]. This method can be assessed as totally inappropriate for safely distinguishing two close-related sharks that share mtDNA and can be only verifiably identified by using SNPs. Thus, this report of the Galapagos shark from Indonesia is also assessed as doubtful.

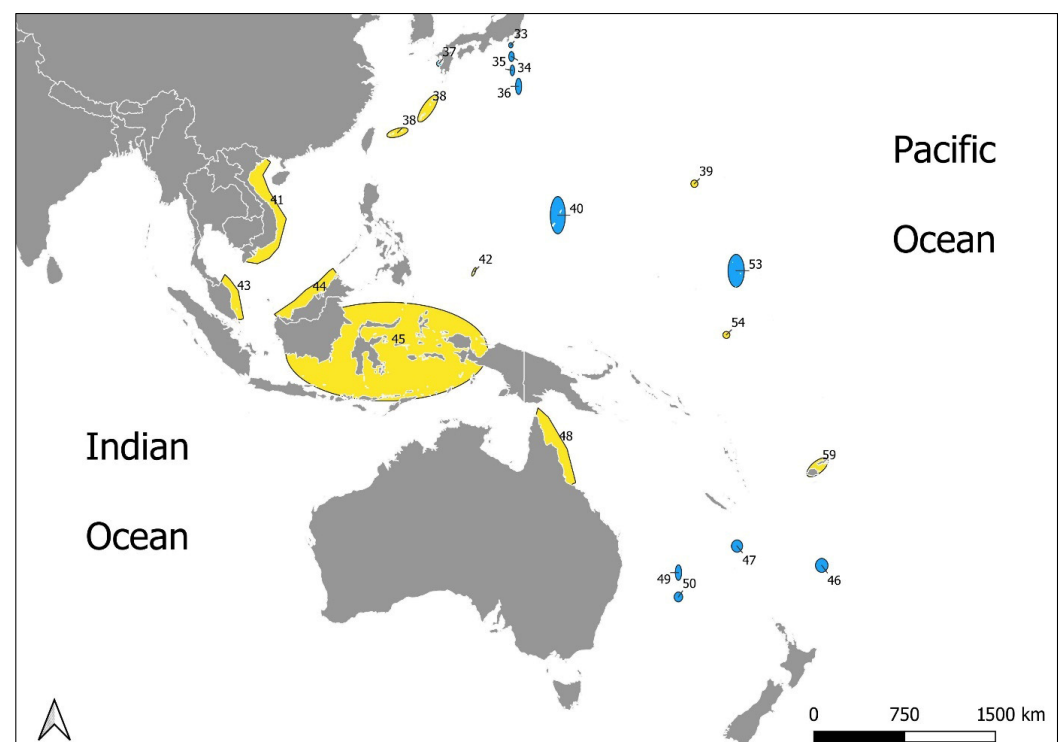


**Figure 5.** Confirmed (blue) and unconfirmed (yellow) records of *Carcharhinus galapagensis* in the Western and West Central Pacific Ocean inferred from the literature references. The numbers in the figure correspond with the numbers of Supplementary Material S3.

Finally, reliable information about the distribution of *C. galapagensis* in the island states and archipelagos of Southeast Asia (e.g., Indonesia, The Philippines) is lacking. The few records from this region are all doubtful or unconfirmed. Thus, the presence and distribution of the Galapagos shark in this region must be investigated in more depth for clarification of its presence here.

#### 4.3.2. Distribution in the Southwest Pacific Ocean Kermadec Islands

The subtropical Kermadec Islands comprise the only known occurrence of *C. galapagensis* in New Zealand's waters. This occurrence of *C. galapagensis* has led to the inclusion of this species in several national checklists, reviews, and essays that provide comprehensive lists about New Zealand's fish fauna [290–295]. This shark was also mentioned in an extensive literature review of the marine fishes of New Zealand that included a short bibliography about the New Zealand records of *C. galapagensis* [296]. For the Kermadec Islands, it was reported that this shark is mainly restricted here to depths less than 50 m [297], which means that it inhabits only a small habitat area and is restricted to shallow coastal waters. Additionally, it was emphasized that the marine reserve status has protected this species in the past and maintained it at natural levels of abundance [297], which is pleasant from a conservation point of view.

Historically, *C. galapagensis* was collected from the Kermadec Islands during the British Challenger Expedition in 1873–1876 and reported as *Carcharias lamia* (Risso) (not Rafinesque, 1810) [298,299]. Recently, this historic report of *C. lamia* was revised as *C. galapagensis* [300]. In a further historic account [301], *C. galapagensis* was reported undetermined as *Carcharias* spec. from the Kermadec Islands [300]. More recently, scientists wrote that *C. galapagensis* is common at this location and attains a length of at least 300 cm [302]. However, for completeness, the Galapagos shark was not mentioned in some previous scientific surveys on the marine fauna of the Kermadec Islands [303,304].

#### Australian Islands

In Australian territorial waters in the Southwest Pacific, the distribution of *C. galapagensis* is restricted to the remote Norfolk Island, Lord Howe Island, and the Elizabeth and Middleton Reefs (Supplementary Material S3). Reports from the Northwest Cape and along the east coast of continental Australia such as the Great Barrier Reef are unconfirmed. For Lord Howe Island, it was reported that *C. galapagensis* is common outside the lagoon and inside at night [148]. Further studies provided information that the Galapagos shark occurs at Lord Howe Island and the Elizabeth and Middleton Reefs off New South Wales [305], while several reports informed that *C. galapagensis* is the most common shark around Lord Howe Island and occurs in high densities [138,140,306,307]. Collected voucher material of *C. amblyrhynchos* from Lord Howe Island, Elizabeth and Middleton Reefs, and Norfolk Island did not withstand a critical check and was revised exceptionless as *C. galapagensis* [72]. Recently, an increase in abundance of *C. galapagensis* in waters surrounding Lord Howe Island was observed [308], presumably due to the effectiveness of protection by the regulations of its marine park.

The presence of *C. galapagensis* at the Elizabeth and Middleton Reefs in the northern Tasman Sea has been reported already in previous studies dating back to the 1920s, where it was reported to be very common in the lagoons [309]. More recent studies provided information that Galapagos sharks are common and occur in relatively high abundances at Australia's Elizabeth and Middleton Reefs [310,311]. A more recent survey also noted that juvenile Galapagos sharks are common at both reefs and that they occurred here in high densities, especially at Middleton Reef [312], and that it is evident that the shallow-water populations of *C. galapagensis* at Elizabeth and Middleton Reefs are comprised of mostly small immature individuals, as well as some very small (newly born) individuals. In this study, the smallest shark recorded was just 70 cm [312], which is within the size range (60–80 cm) given for newly born Galapagos sharks [7]. As such, these reefs may represent nursery habitats [312]. This finding was supported by a further study which also reported for Elizabeth and Middleton Reefs that all observed Galapagos sharks were small immature

individuals, suggesting that shallow habitats here are important nursery areas for this species [313].

However, differences in shark abundancies between both reefs were noticed. It was noted that *C. galapagensis* was significantly more abundant at Middleton Reef compared to Elizabeth Reef [314], which is consistent with previous observations [312]. However, high densities of Galapagos sharks were recorded recently at both Elizabeth and Middleton Reefs in 2018 [315]. It was also recognized that the vast majority of *C. galapagensis* recorded at these reefs were relatively small (<120 cm), with the largest individual recorded being 200 cm [315]. Given that *C. galapagensis* does not mature until 210–250 cm and is born at 60–80 cm in Australian waters [31], these data indicate that the large populations at Elizabeth and Middleton Reefs comprise mostly immature individuals and, moreover, that these reefs are likely important nurseries for this species, which confirms previous assumptions [312,313]. A noticeable high biomass, similar to abundance, of Galapagos sharks at Middleton Reef was also reported by others [316]. Resulting from these findings cited above, the conservation value of Elizabeth and Middleton Reefs as global strongholds for the Galapagos shark was highlighted and it was emphasized that these populations here are particularly notable due to their large population sizes [314]. In the same context, other authors also pointed out that the Elizabeth and Middleton Reefs remain strongholds for the populations of immature Galapagos sharks in the Southwest Pacific Ocean [317].

For Australia, it can be summarized that the Elizabeth and Middleton Reefs presumably harbour the main population of this shark in Australian waters, and together with the population around Lord Howe Island, is one of the southernmost populations in terms of its global distribution (Figure 2). Further, these locations are presenting the southern margin of its range in the southern hemisphere at ~29° S and ~31° S, respectively, in the Southwest Pacific Ocean.

#### 4.3.3. Distribution in the Central Pacific Ocean

*Carcharhinus galapagensis* can be found at scattered locations in the Central Pacific Ocean, including the Phoenix Islands to the west of the Line Islands and farther south to French Polynesia [44]. For the Southcentral Pacific Ocean, many records and reports of *C. galapagensis* derive from the U.S. American ichthyologist J. E. Randall, who focused mainly on the fish fauna of the Pacific region. Thus, species accounts for many of the scattered Pacific islands were produced by this researcher and expert in the field of reef fishes. Comparable with its distributional pattern in other ocean basins, *C. galapagensis* shows widespread but scattered occurrences in the Central Pacific region. This shark is distributed across many of the Polynesian islands and archipelagos. Arguably, there are locations in the Central Pacific Ocean where its presence has yet to be discovered. For example, Randall and others stated for *C. galapagensis* that they expect it to be found in inshore waters in Tonga in the Polynesian region, but its presence there cannot be confirmed [318].

#### Hawaiian Archipelago

*Carcharias nesiotes* (Snyder, 1904) was listed for the Hawaiian Archipelago at the beginning of the 20th century, which is regarded as a synonym of *Carcharhinus amblyrhynchos*, and was documented by two voucher specimens [319]. One of these specimens, formerly housed at Stanford University (SU 12790, 98.2 cm, immature ♀) but now held at the California Academy of Sciences (CAS-SU 12790), was revised and clearly identified as *C. galapagensis* [11]. Thus, the first scientific proof of the existence of *C. galapagensis* in the Hawaiian Archipelago can be backdated to the beginning of the 20th century. Three species of carcharhinid sharks were reported to be the most common shallow-water predators

found in the northwestern Hawaiian Islands' reef habitats in waters <150 m in depth: *C. amblyrhynchos*, *C. galapagensis*, and *Galeocerdo cuvier* [320–322]. Other authors also reported that the Galapagos shark is probably the most abundant nearshore shark in the northwestern Hawaiian Archipelago but was presumably much more common historically around the High Islands 200 years ago [24]. In this context, it was also reported that around the northwestern Hawaiian Islands, sharks were intensively fished both historically (1859–1900) and recently (2000), which could have altered the structure of shark assemblages in these islands substantially [323]. Additionally, it was reported that *C. galapagensis* occurs at the Hawaiian Archipelago from Hawaii Island to Midway Atoll, and at the Hancock Seamounts [45]. A recent report provided information on the recovery of coral reefs at the uninhabited Lalo Atoll, Hawaiian Archipelago, after physical damage and complete destruction of the reefs resulting from Hurricane Walaka in 2018 [324]. In this study, the recruitment of the damaged coral reef by Galapagos sharks in 2021, three years after its destruction, was reported, indicating recovery and healing of the coral reef ecosystem at this remote atoll. In the middle of the Northcentral Pacific Ocean, the catch of a single Galapagos shark specimen in tuna longline fisheries conducted by the Chinese fishery fleet, just north of the Hawaiian Archipelago (30–37° N), was reported [325]. This single Galapagos shark was very likely a roaming specimen that derived from the southern-situated Hawaiian Archipelago.

#### Johnston Atoll

It was reported that a shark of the genus *Carcharhinus*, estimated with 200 cm, which was sighted in 248 m water depth at Johnston Atoll, may have been *C. galapagensis* [326]. For Johnston Atoll, further observations of several very large Galapagos sharks and specimens of *C. amblyrhynchos* at Johnston Atoll exist [327]. However, other and more recent references referred only to *C. amblyrhynchos* from Johnston Atoll and did not mention *C. galapagensis* [328].

#### Fijian Archipelago

Information about the distribution of *C. galapagensis* from Melanesia, Southwest/Southcentral Pacific region, is scarce, and records from here are mainly unconfirmed. *Carcharhinus galapagensis* was included in a list of Fijian fishes and the information was given on this report that it is documented by fisheries photos, yet the photos were not displayed [329]. Rare captures of *C. galapagensis* in the Fijian pelagic longline fishery were reported [330], but this report represents not a reliable record of this shark in Fijian waters because of lacking accompanying information. Both reports cited above are providing only weak evidence of an occurrence of *C. galapagensis* in the Fijian Archipelago. Therefore, the reports of the Galapagos shark from Fiji are assessed as unconfirmed. However, the Melanesian region contains many islands and provides high numbers of putatively suitable insular habitats for *C. galapagensis*, so attention should be paid to occurrences of the Galapagos shark here.

#### French Polynesia, Pitcairn Islands, and Ducie Atoll

The Galapagos shark was reported at first from the Southcentral Pacific region from the Pitcairn Islands [331], followed by reports from Rapa (French Polynesia) [332] and from Ducie Atoll [333]. However, it should not be unspoken here that J. E. Randall, although an expert in coral reef fishes, was not truly a shark expert, and he confused *C. galapagensis* with the similar *C. amblyrhynchos* on a few occasions, e.g., at Easter Island (compare Section 4.3.5). For the highly remote Pitcairn Islands (British Overseas Territory), in the following, the information was provided that *C. galapagensis* is common at Ducie Atoll, infrequent at Pitcairn Island, and rare at Henderson Island [334]. A more recent compilation listed the

occurrences of *C. galapagensis* for the numerous island groups of French Polynesia and gave information on occurrences of this shark at the Society, Tuamotu, Gambier, and Austral Islands, and additionally also for Rapa [335] (Supplementary Material S3). Both Rapa (Iti) and Marotiri of French Polynesia have recently become ISRAs based on their aggregations of Galapagos sharks [336].

Occurrences of *C. falciformis* and *C. amblyrhynchos* in large numbers were reported for Mount MacDonal, southeast of Rapa, a submarine volcano and seamount, respectively, an area with an active underwater life, whereby the authors of this report admitted that their observation of the latter species could have been a confusion with *C. galapagensis* [337]. However, *C. galapagensis* is known to utilize habitats such as undersea volcanoes and seamounts, from where it has been reported on numerous occasions [145,258]. Additionally, for French Polynesia, *C. galapagensis* was reported to abound in Rapa and even more so in Marotiri [338].

#### 4.3.4. Distribution in the Northeast Pacific Ocean

For more than half a century following its original description in 1905, *C. galapagensis* was not known to occur outside the Eastern Pacific [11]. The Galapagos shark is widespread in the tropical to warm-temperate regions of the Eastern Pacific Ocean. This region can be considered the core area of its global distribution based both on number of occurrences (Supplementary Material S3) and the distributional picture (Figures 2 and 6). In opposition to regions of other ocean basins and the western Pacific, this shark has been recorded in the Tropical Eastern Pacific (hereafter abbreviated with: TEP) many times from along vast stretches of the continental coast of North America (Supplementary Material S3). Records of *C. galapagensis* derive from the continental coasts as well as the numerous offshore islands, both from the historic and recent literature for the Eastern Pacific Tropical (Panamanian) Faunal Region, which is extending from Baja California to Peru [339]. In the TEP, this shark shows a continuous distribution along the coastlines of the North, Central, and South American continent, and an accumulation of insular records. The latitudinal range limits of *C. galapagensis* in the TEP were described from 31° N to −7° S, which means a range extending from the northern end of the Gulf of California (Mexican States of Baja California and Sonora) to the Pacific coast of Peru (Lambayeque Province) [340]. Later, an extension of the Galapagos shark distribution in the Eastern Pacific was reported [341] that slightly differs from the previous information [340], with a range from 32° N to −6.28° S, spanning water from the warm-temperate northern Pacific Ocean (Mexico) to the warm-temperate southern Pacific Ocean (Peru). Scientists noted about the Galapagos shark that its distribution pattern in the Eastern Pacific is very similar to that of *Carcharhinus albimarginatus* (Rüppell, 1837) in this region [342], i.e., with a distribution concentrated in the island areas, which was previously also recognized at the end of the 1960s [343].

The Galapagos shark has not yet been verifiably recorded for U.S. Californian waters of the Northeast Pacific Ocean, but one scientist speculated that maybe *C. galapagensis*—among other large warm-water congeneric species such as *Carcharhinus albimarginatus*, *C. falciformis*, and *C. altimus*—could reach U.S. Californian waters during extreme El Niño events, when an influx of unusually warm water attracts these species and may lead to northern-directed range shifts [344].

At least historically, the Galapagos shark has belonged to the most common shark species of several islands in the TEP as historical references indicate. Already, the species authors of *C. galapagensis* stated for the Galapagos Archipelago that this shark is extremely abundant about the Galapagos Islands, especially about Wenman and Culpepper and between Albemarle and Narboro [19]. Other early scientists also recognized specimens of up to ~200 cm of *C. galapagensis* in the TEP and stated that this shark swarms in the waters

of the Galapagos Islands and about Cocos Island in great abundances [20]. Historically, *C. galapagensis* was also reported under its senior synonym *Eulamia galapagensis* from numerous oceanic islands of the TEP, and that it probably occurs also at the coast of Baja California [345]. In 1944, the Galapagos shark was first reported from the Gulf of California (Mexico) [346]. Twenty years later, information was provided that the Galapagos shark occurs occasionally at Mazatlan (Sinaloa, Mexico) and from Guatemala to Ecuador, and further at the Revillagigedo Archipelago and at Cocos Island [347]. One year later, *C. galapagensis* was reported again from Mazatlan [348]. Following this, for the TEP, it was reported that large individuals of *C. galapagensis* not only occur around offshore islands but are also found on the high seas and at the continental coasts of Colombia, Guatemala, and southern Baja California, Mexico [349].

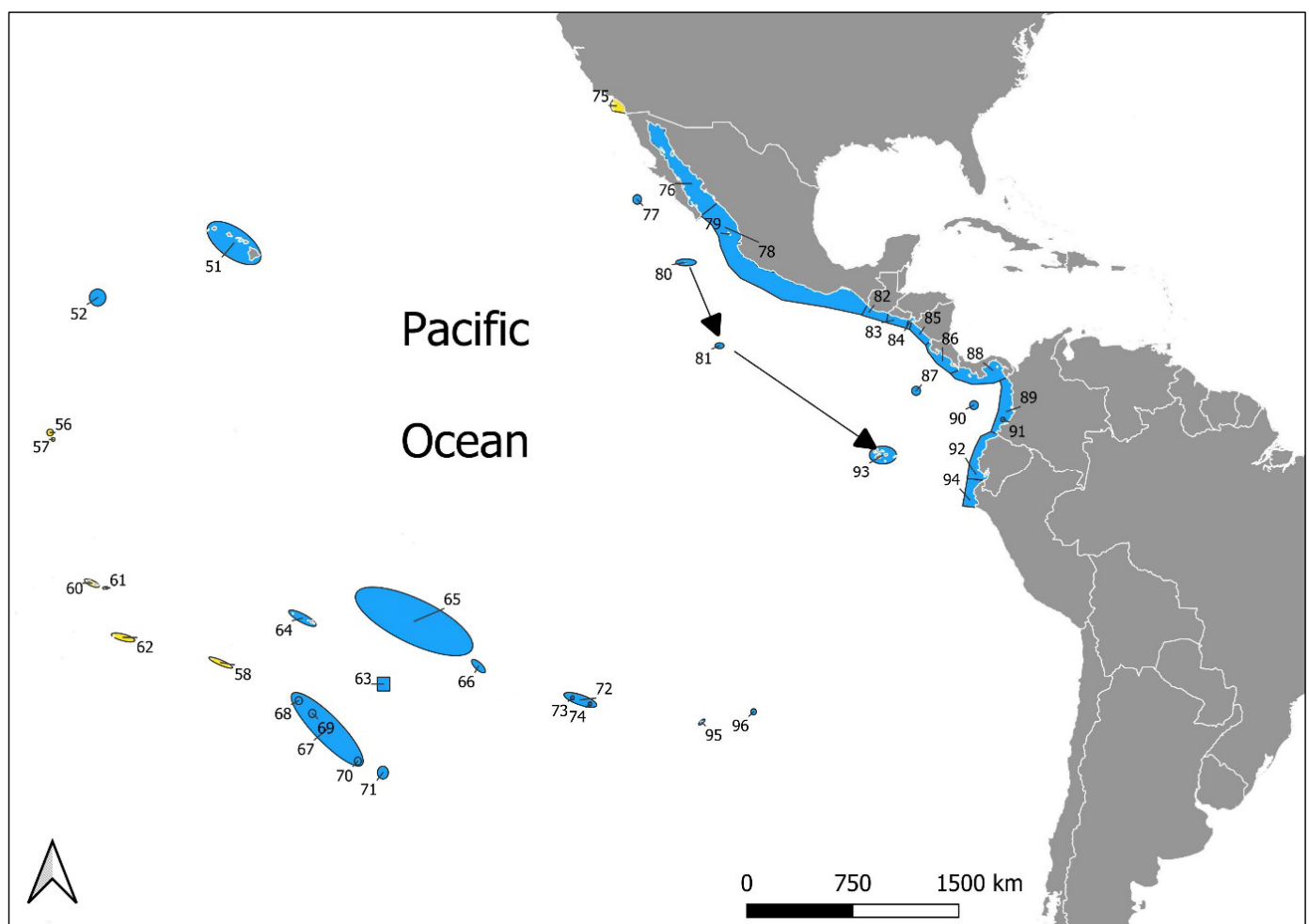


**Figure 6.** Confirmed (blue) and unconfirmed (yellow) records of *Carcharhinus galapagensis* in the Central, Northeast, and Southeast Pacific Ocean inferred from the literature references, including recorded long-distance movements of single specimens (arrows). The numbers in the figure correspond with the numbers of Supplementary Material S3.

However, despite its abundance around several islands and archipelagos in this region, it was remarked for *C. galapagensis* in the TEP that it can be rarely encountered on the continental coasts from Mexico to Ecuador [350]. Moreover, the Galapagos shark has been reported to occur in the TEP sporadically along the continental coasts from the North American to the South American continent from Central Baja California to Peru, including numerous adjacent offshore islands [43,44,58,351–353]. Other authors informed on a distribution of *C. galapagensis* in the Eastern Pacific along the continental

coast from Colombia to northern Peru, and additionally from some offshore islands [354] (Supplementary Material S3).

Mexican, Central American, and Colombian Pacific

An extensive bibliography of Mexican *C. galapagensis* records ranging to the year 2004 was provided [355], that was revised and updated 20 years later [356]. For the continental waters off Mexico, *C. galapagensis* was listed for the Mexican state of Sinaloa [357] and for the state of Chiapas [358]. *Carcharhinus galapagensis* was reported to be a rare component of the longline fishing industry in the Mexican Pacific Ocean [359]. For waters of the Gulf of California (southern Baja California), a low frequency of *C. galapagensis* in landings of artisanal vessels targeting elasmobranchs was reported [360,361]. Additional information was given that *C. galapagensis* occurs in the Gulf of California and the Mexican Central Pacific [362]; for the latter, it most likely referred to the Revillagigedo Archipelago. Catches of *C. galapagensis* were reported from the Mexican Pacific Ocean at Colima State off the Mexican mainland [363]. *Carcharhinus galapagensis* was also listed for the Mexican Pacific Ocean in further studies [89,364–366]. At a time when the composition of the East Pacific fish fauna presumably was not yet heavily altered by intensive industrial fishing, it was noted that *C. galapagensis* was abundant at the French Clipperton Atoll in the 1950s [23], with many juveniles present at this site which is located more than 1000 km off the Mexican mainland.

One remarkable record of a juvenile (105.5 cm) *C. galapagensis* specimen, which is of scientific importance, derives from a museum specimen that was collected in the northern Gulf of California and is today in the collection of the Natural History Museum of Los Angeles County (LACM 51112-1, vertebrate collection) [62]. In January of 1960, L. Pinkas, E. Smith, and D. Miller obtained this juvenile specimen at Bahia Los Animas, Gulf of California, Baja California, Mexico (28.81° N, −113.35° E). This record of *C. galapagensis* is exceptional because this is the only identified record of a small juvenile *C. galapagensis* from a continental coast and not in waters around oceanic islands which the author has found during his investigations. To guarantee the reliability of this record, the author has reviewed photographic material of this specimen provided by the collection managers. The review of this photographic material has led the author to conclude that it truly represents *C. galapagensis*, which confirms this out-of-the-ordinary record. The exceptional nature of this record derives from its unique character, since breeding and small juveniles of the Galapagos shark have been reported exclusively from remote oceanic islands. Interpreting this record of a juvenile *C. galapagensis* at a great distance to its insular stronghold is not as easy. However, the fact that this specimen is of a remarkably small size does not inevitably mean that it was born in adjacent waters near the Mexican coast. Possibly, this specimen was big enough to have reached the continental coast through the crossing of open ocean waters and could have started its journey from an island in the Mexican Pacific.

For Central America, *C. galapagensis* was listed for the Pacific waters of Costa Rica [351,367]. Other references reported on rare catches of *C. galapagensis* in the Panamanian fisheries between 1950 and 2010 [368], while further references listed *C. galapagensis* for the Colombian Pacific Ocean [340,369–373]. Also, for Colombia, it was reported that *C. galapagensis* is distributed in both the coastal and oceanic Pacific [374]. Other studies informed on the abundance of the Galapagos shark at Malpelo Island, and that scientists had observed that *C. galapagensis* did not show significant differences in its abundance between the cold- and warm-water seasons on this island, indicating that it is resident here year-round [22]. All the locations cited above are situated just north of the equator. Presumably, several of the references cited above refer to the presence of *C. galapagensis*

around oceanic islands of the Northeast Pacific Ocean (e.g., Revillagigedo Archipelago, Malpelo Island).

#### Clipperton Atoll

For this remote atoll at ~1080 km distance to mainland Mexico, the capture of one neonate specimen of *C. galapagensis* with visible umbilical scars (85.5 cm) at 15 m water depth and further captures of two juvenile specimens (83.4 cm and 89 cm) at 15–20 m water depth were reported [375]. During a scientific expedition in 2018, among the observation of 147 sharks, 64% of the specimens of *C. albimarginatus* and *C. galapagensis* were <90 cm [376]. These reports suggest that Clipperton Atoll could be a nursery for the Galapagos shark in the TEP.

#### 4.3.5. Distribution in the Southeast Pacific Ocean

For the Pacific Ocean waters south of the equator and for Ecuador, *C. galapagensis* was reported historically [377] and more recently [378–383]. Moreover, *C. galapagensis* was listed in a compilation of Ecuadorian sharks that are commonly fished and utilized [384], and, in addition, further studies also informed that the Galapagos shark gets landed in the Ecuadorian artisanal fisheries [385] as well as in the Ecuadorian longline fleet operating in the Ecuadorian EEZ [386]. For the Southeast Pacific Ocean, it was reported that *C. galapagensis* is distributed across the maritime border between Ecuador and Peru [387]. Further reports referred to the occurrence of the Galapagos shark on the continental coast of northern Peru [388]. Additionally, *C. galapagensis* was reported from Chilean waters [389–391]. *Carcharhinus galapagensis* was mentioned in a compilation of Chile's cartilaginous fishes for the oceanic islands of Chile but without information on a particular locality [391]. For the Southeast Pacific Ocean, the Galapagos shark was mentioned in the further literature references dealing with the Chilean elasmobranch fauna. *Carcharhinus galapagensis* was encoded in a dental identification key for Chilean elasmobranchs [392]. Presumably, all these references cited above referred to occurrences around oceanic islands of the Southeast Pacific Ocean (e.g., Galápagos Archipelago, Easter Island, and Salas y Gómez Island; Supplementary Material S3) that belong to the territorial waters of the respective countries (Ecuador, Chile).

#### Galápagos Archipelago

The high amount of shark biomass at the northern Galápagos Islands of Darwin and Wolf was highlighted [393], and *C. galapagensis*, which can be found around all the islands of this archipelago, contributes in numbers to the diverse elasmobranch fauna of this equatorial Ecuadorian archipelago. Early naturalists had already remarked on the high numbers of *C. galapagensis* at the Galápagos Archipelago [20]. Notably, the local populations of *C. galapagensis* inside this archipelago form genetically unique stocks as investigations unveiled [394], a good example of the hidden, cryptic diversity that can be found in some elasmobranch species. In this review, for the Galápagos Archipelago which represents the type locality of *C. galapagensis* and therefore, the longest period of scientific investigation, the highest number of studies was found that mentioned this species (Supplementary Material S3).

#### Easter Island (=Isla de Pascua, Rapa Nui)

The Galapagos shark was mentioned in a taxonomic identification key for Chilean elasmobranchs [395] with the additional information about an occurrence of this shark at Easter Island (=Isla de Pascua, Rapa Nui) and Salas y Gómez Island. The occurrence of the Galapagos shark at Chile's remote Easter Island was a longtime matter of confusion as it is described in detail in the following.

Two specimens of a carcharhinid shark were collected in 1965 from Chile's Easter Island during the Canadian Medical Expedition (1964–1965) by the marine ecologists Jack A. Mathias and Ian E. Efford [396]. These obtained specimens were later deposited in the fish collection of the Canadian Museum of Nature, Ottawa (catalogue nos.: CMNFI 1968-1860-1, 1968-1863-1; Figure 7) and labelled as "*Carcharhinus menisorrhah*". Following this, the famous American ichthyologist J. E. Randall spent a month diving and intensive fish collecting at Easter Island in 1969. He observed a species of carcharhinid shark at Easter Island but could not identify it clearly. However, Randall stated in the following that he knew that *C. amblyrhynchos* is present at Easter Island and referred to the specimens that were collected during the Canadian Medical Expedition, now housed at the Canadian Museum [396]. He concluded that *C. amblyrhynchos* was already known from Easter Island because these museum specimens were labelled as "*Carcharhinus menisorrhah*", a synonym that was primarily used for *C. falciformis* but also *C. amblyrhynchos* at that time [55,397]. However, Randall, who probably never had investigated these two voucher specimens, admitted his previous misidentification, and commented 35 years later on these specimens that they represent probable misidentifications with *C. galapagensis* [87].

Presumably, based on this early species assessment by Randall in 1970, *C. amblyrhynchos* was subsequently also listed in a compilation of fishes known from Easter Island [398]. Although widespread in the Pacific Ocean, *C. amblyrhynchos* is known to occur in the Eastern Pacific around the Galápagos Archipelago but is rare in the East Pacific and not yet known from Easter Island [1,7]. Additionally, *C. amblyrhynchos* was often confused with *C. galapagensis* in the past [72], and Randall was apparently no exception here regarding his misidentification of both sharks. However, Randall and a further co-author recorded the Rapa Nui names for 115 species of Easter Island fishes and reported *C. galapagensis* for the first time in a scientific paper based on reports by native people and their field observations [399]. At that time, Randall must have already recognized that the whaler shark occurring around Easter Island was not *C. amblyrhynchos* but instead *C. galapagensis*. However, Randall later never confirmed his assessment of the species identification of the two shark specimens collected during the Canadian expedition by an examination in detail.

The indication that these two carcharhinid shark specimens, collected in the middle of the 1960s at Easter Island, were probably misidentified emerged rather randomly by the author's review of a putative record of *Carcharhinus leucas* (Valenciennes, 1839) for Easter Island, from a database entry which turned out to be erroneous after checking. During his research review focusing on *C. leucas* [400], the author of this study investigated an entry in the database "GBIF—Global Biodiversity Information Facility" [401] that provided information about a putative occurrence of *C. leucas* at Chile's Easter Island. Back then, the author had doubts about the validity of this database entry because *C. leucas* is commonly known as a shark with an inshore distribution at continental coasts around the world and moreover, only occurs on rare occasions as a stray around remote and isolated oceanic islands far away from the mainland. This entry in GBIF was linked with two voucher specimens deposited in the fish collection of the Canadian Museum of Nature, and those were labelled with "*Carcharhinus menisorrhah*" [402]. These two specimens were collected in January of 1965 at Easter Island during the Canadian Medical Expedition, as mentioned above [396,401].

Thereupon, for verification of this record provided in the database of GBIF, the author requested photographic material of one of the specimens housed in the Canadian Museum (catalogue no.: CMNFI 1968-1863-1). The examination of this material provided by the curators of the Canadian Museum displayed, without doubt, a shark of the genus *Carcharhinus* with a clearly visible interdorsal ridge and very large eyes (Figure 7), which ruled out the putative *C. leucas* at first, as this species does not exhibit an interdorsal ridge

and has only very small eyes, and secondarily *C. amblyrhynchos*, which also lack an interdorsal ridge [1,11]. The prominent interdorsal ridge, the relatively large eyes, the first dorsal fins origin in front of the inner pectoral fin corner, the shark's slender body with a relatively long and rounded snout (Figure 7), together with the habitat features (remote and isolated oceanic island) left only one candidate species: *C. galapagensis*. In conclusion, the author's examination of one voucher specimen from the Canadian Museum (161 cm, ♀) and his findings are consistent with Randall's last presumptions on these specimens. Out of the investigation results by the author, the first verified record of *C. galapagensis* for Easter Island to science can be backdated now to 1965 (Supplementary Material S3).

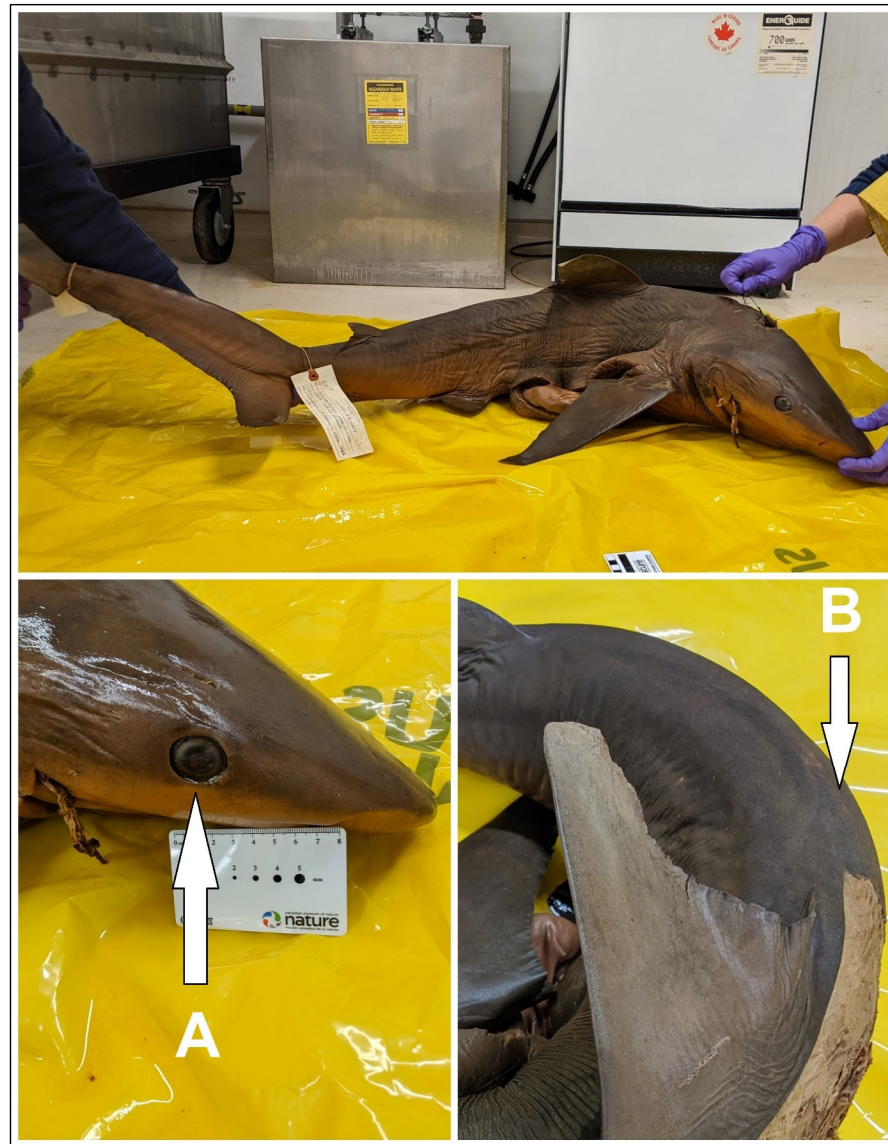


**Figure 7.** Images of the *Carcharhinus galapagensis* voucher specimen housed in the Canadian Museum of Nature (catalogue no.: CMNFI 1968-1863-1, 161 cm, ♀) that was obtained at Chile's Easter Island in 1965 during the Canadian Medical Expedition and erroneously mislabelled as "*Carcharhinus menisorrh*". Note that the colour of this specimen is strongly altered due to the storage in the preservation fluid (ethanol). This specimen was revised by the author under consideration of diagnostic characteristics of *C. galapagensis* such as relatively large eyes in the juvenile age class (A) and the presence of an interdorsal ridge (B). This specimen now represents the first scientific record of *C. galapagensis* for Easter Island, Southeast Pacific Ocean. © Stéphanie Tessier/Canadian Museum of Nature.

### Salas y Gómez Island

The first record of *C. galapagensis* from Chile's remote and uninhabited Salas y Gómez Island, located some 400 km east of Easter Island in the Southeast Pacific, was derived from a study in 1988 that reported that this shark is the most common shark around this island [403]. Later, other authors said that they have photographed *C. galapagensis* at Salas y Gómez Island [352]. In the following, a further study from the first years of the Millennium [404] provided more information on the occurrence of Galapagos sharks around this island and confirmed the previous report [403] and the photographic documentation [352] through the captures of two female juvenile specimens of *C. galapagensis* (79 cm and 120 cm). Subsequently, other scientists reported on the high amount of shark biomass, primarily of *C. galapagensis*, at Salas y Gómez Island [405]. This remote island with its pristine marine waters even nowadays is home to large numbers of Galapagos sharks, and this may have been a good argument for its designation as an Important Shark and Ray Area (ISRA), in fact, by the Motu Motiro Hiva ISRA [406]. A recent study found that Salas y Gómez Island represents a remote nursery area for *C. galapagensis* [9], and, simultaneously, this study outlined the importance of oceanic islands in the distribution of this species in the South Pacific and the need for specific conservation actions.

There appear to be differences regarding the frequency of *C. galapagensis* at Easter Island and the adjacent Salas y Gómez Island, which are separated by a 400 km distance of open ocean waters. Scientists reported at the end of the 1980s that, during 140 h of underwater diving at Easter Island between 1985 and 1986, no sharks were observed anymore despite the fact that *C. galapagensis* was once the most common shark around Easter Island according to the memory of Easter Islanders [403]. These scientists speculated that the paucity of sharks at Easter Island was related to the prevalent fishing pressure on sharks. Deviating from this consternating observation at Easter Island, these scientists also reported on an abundance of *C. galapagensis* from the adjacent Salas y Gómez Island [403]. It was deliberated that the abundance of *C. galapagensis* at the uninhabited Salas y Gómez Island suggests indirectly that Easter Island may have supported a larger population of this shark in the past before they were fished out from here [407]. Other scientists stated around the beginning of the new Millennium that they have not seen Galapagos sharks at Easter Island in March of 1999 and 2000 [408], consistent with the previous observations of the research team in the 1980s [403], indicating that the shark population here has not been recovered yet. According to reports from fishers that are operating in the waters around Easter Island, *C. galapagensis* is only abundant at Salas y Gómez Island [404]. Later, further scientists also remarked that *C. galapagensis* is much more common at Salas y Gómez Island in comparison to Easter Island [87]. Recent studies confirmed this observation that *C. galapagensis* is abundant at Salas y Gómez Island and less common at Easter Island [409]. Two surveys reported consistently on the former population of *C. galapagensis* around Easter Island, and that this species is now virtually absent there [8,405]. The failure in recording any Galapagos sharks at Easter Island in contrast to large numbers of these sharks at Salas y Gómez Island was presumably resulting from intensive fishing activities around Easter Island but no activities around Salas y Gómez Island [405,410]. However, nearly 20 years later, studies reported that *C. galapagensis*, despite its low numbers, was still the most common shark during surveys conducted at Easter Island [409]. The scientists who made this study could positively identify 112 specimens of this shark at Easter Island by using Baited Remote Underwater Video Stations (BRUVS). Despite their current low numbers at Easter Island, the results of this study [409] suggest that the southeast coast of this island could still be serving as a nursery area for juvenile Galapagos sharks. Moreover, studies also reported that this shark is a year-round resident in the waters around Easter Island [409,411].

Due to its remoteness, small size, inaccessibility, and uninhabitability, the isolated Salas y Gómez Island has been largely untouched by humans throughout its history. Therefore, its habitats have remained largely pristine until now. It forms a Marine Protected Area (formerly Parque Marino Salas y Gómez, currently Motu Motiro Hiva Marine Park and Motu Motiro Hiva ISRA, respectively), but, in the meantime, fishing operations have reached its surrounding waters, and illegal fishing activities even in the Motu Motiro Hiva Marine Park around the Salas y Gómez Island were reported to occur [405]. These prohibited activities counteract and undermine the effectiveness of MPAs and conservation efforts for sharks and other marine fauna in designated conservation areas.

## 5. Habitat Use by *Carcharhinus galapagensis*

The information that derived from the examined literature shows age class-dependent habitat preferences of the Galapagos shark and size-dependent spatial segregation: in the subadult and adult age class, this species prefers the steep offshore reef slopes and drop-offs of coral and rocky reefs, often in combination with strong currents, while the juvenile age class occur mainly in sheltered shallow lagoon systems. Additionally, submerged seamounts and pinnacles seem to provide another suitable habitat for larger specimens of *Carcharhinus galapagensis*. More detailed information about the habitat preferences of the Galapagos shark is summarized in the following.

### 5.1. Attachment to Reef Habitats

The Galapagos shark was reported to display high site-attachment to deep reefs, oceanic islands, and, to a lesser extent, also continental shelf environments [105]. *Carcharhinus galapagensis* was also assessed as a coral reef-associated shark by further authors [334,412–415], and this shark commonly occurs in reef habitats around oceanic islands among other species of sharks. Typically, large subadult and adult Galapagos sharks are found along the outer reef drop-off zones, associated with rocky and reef habitats [63,84]. Moreover, the Galapagos shark often occurs in areas with rock and coral bottoms [169], and it was also reported that this shark occurs at rocky and coral reefs and is often common around drop-offs and steep reef slopes [416]. *Carcharhinus galapagensis* was assessed as a reef-associated mesopredator [417]. It has been reported that the Galapagos shark prefers rugged terrain, i.e., rugged coral reef and rocky bottoms [1,23].

The term “reef sharks” was defined as those species of sharks that spend much of their life history in or around reef habitats or species that regularly visit reefs [418]. This definition seems to be suitable and applicable for *C. galapagensis* as this species was commonly reported from coral and rocky reef habitats at oceanic islands, although the environmental spectrum that is utilized by this species also includes pelagic offshore habitats as well as shallow lagoons with sandy bottoms during early life stages. However, habitat use in this species may be dependent on age classes, with juveniles and immature specimens reported to be more resident at shallow reef habitats in comparison to adults, which have been reported from offshore habitats and to undertake large-scale movements across open ocean waters. This behaviour of crossing open ocean waters is not uncommon in reef sharks, although it has been only seldomly observed. Despite being mostly highly residential, some individuals of species such as *C. amblyrhynchos*, *C. galapagensis*, *C. perezi*, *Triaenodon obesus* (Rüppell, 1837), *Stegostoma tigrinum* (Forster, 1781), and *Ginglymostoma cirratum* (Bonnaterre, 1788) make occasionally longer movements from tens up to thousands of kilometres throughout and between widely separated reef systems [419].

In contrast to other reef shark species that mainly use shallow lagoon systems during all stages of their lifetimes such as *Carcharhinus melanopterus* (Quoy & Gaimard, 1824), *C. galapagensis* seems to prefer deeper sites with strong currents on exposed forereef slopes,

crests, and channels when maturing [419]. Apparently, the habitats of *C. galapagensis* and *C. amblyrhynchos* overlap to a large amount as the latter can be found on coral reefs, often in deeper water near drop-offs, in atoll passes, and in shallow lagoons adjacent to strong currents [7]. Only young Galapagos sharks were reported from lagoons at various sites, e.g., at the Elizabeth and Middleton Reefs [316], suggesting that lagoon habitats function as safe places for juveniles. Shallow lagoon habitats may provide sheltered nursery areas for juvenile *C. galapagensis* and can be considered protected waters, where they reside to avoid predation by other large marine predators. However, it was also reported for Australia's Middleton Reef that Galapagos sharks did not show affinities with habitat characteristics and occurred in a broad spectrum of habitats (soft and hard bottom, e.g., rubble, sand, and gravel bottoms, seagrass beds, hard and soft coral), which means that they are apparently not confined to reef habitats at this site [316].

Several reports and studies informed that Galapagos sharks often occur in aggregations consisting of >20 specimens [58,246,248], but some authors emphasized that these aggregations do not present coordinated schools [420]. For the northwestern Pacific Ocean, it was reported that Galapagos sharks commonly aggregate at isolated oceanic seamounts [258], a further habitat besides coral or rocky reefs, where Galapagos sharks occur. For Cocos Island in the TEP, it was reported that *C. galapagensis* was mainly recorded in rocky reef habitats at depths less than 100 m [421], most likely because they tend to aggregate in shallow habitats near oceanic islands or at seamounts. However, for several reef-associated sharks, and also for the Galapagos shark, an agonistic behaviour was reported, both towards divers and other sharks [422,423]. When threatened, surprised, or disturbed, the Galapagos shark performs an apparent threat display, which consists of head swinging, exaggerated swimming, strong bilateral pectoral fin depression, and exaggerated jaw gaping [422–424]. This can be well-interpreted as an agonistic behaviour, which is common in residential and site-attached reef sharks and well-known from *C. amblyrhynchos*, which is the only species known to perform the full display [425]. The early stages of this display were also observed in *C. galapagensis* [422,426]. This behaviour is attributed to defence, both for the defence of the individual itself by maintaining a certain safety distance, as well as for defending a certain claimed space or territory. In this context, it was reported that *C. galapagensis* performs a “hunch” display containing an arched back, raised head, and lowered pectoral fins while twisting and rolling [420]. This behaviour may indicate intra-species dominance, i.e., domination of large specimens over smaller ones out of the same species, and perhaps even territorial behaviour in this shark. Territorial behaviour means that this species will not only defend itself against aggressors but, moreover, that it is occupying a certain terrain and will defend this against invading sharks and other large predatory species to avoid competition on available resources (e.g., prey). Thus, this may also display the residential behaviour and site-attachment of Galapagos sharks to a particular site, with affiliation to a certain territory. Such territorial behaviour has been observed preliminarily in residential reef sharks and, to a lesser extent, also in (semi)pelagic sharks [423].

Little is known about the defined ecological niche of *C. galapagensis*. While some dietary overlap with other carcharhinids was observed, e.g., between *Galeocerdo cuvier* and large specimens of *C. galapagensis* [427], some scientists emphasized that further work is required to understand the Galapagos sharks' ecological niche in South Atlantic waters [428], and that applies to many other regions (e.g., Southwest Indian and North Atlantic Oceans). A study that has been conducted on the movement of sharks by using acoustic telemetry at the small islet of Roca Partida, Revillagigedo Archipelago, Mexico, found evidence for vertical habitat partitioning between the observed species, with *C. galapagensis* generally using shallower depths than *Triaenodon obesus* or *C. albimarginatus*, which may be due to feeding on different prey items [429]. Horizontal habitat partitioning was also detected,

with some shark specimens staying on only one side of the islet, suggesting mechanisms of spatial exclusion [429].

However, beside biological factors, abiotic conditions must also be considered in our understanding of the distribution of reef sharks. A recent study [430] highlighted that environmental factors must be incorporated into studies targeting the abundances of reef sharks because it was found, for 35 reefs across the broad geographic range of French Polynesia, that the relative abundance of sharks varied significantly with the island geomorphology. This study showed that, overall, the relative shark abundances at high islands were nearly three times lower than on atolls, and among atoll geomorphology types, open atolls had abundances nearly 20% higher than closed atolls. However, water temperature and net primary productivity had more limited effects on shark abundances than atoll geomorphology types [430].

## 5.2. Water Depth Range

Regarding the bathymetric distribution of *C. galapagensis*, this shark was assessed as a species with a littoral and semipelagic distribution because it inhabits both inshore coastal and offshore waters, but larger specimens are found, although less common, in open ocean waters at great distance to the coast in deep water [12,431]. On rare occasions and mostly with single individuals, the Galapagos shark can be found at the high sea far off continental coasts and far off oceanic islands. For the Eastern Pacific Ocean, one female Galapagos shark was reported at sea 75 miles (=139 km) northeast of Malpelo Island in deep open ocean waters [432]. For *C. galapagensis*, the information on a depth range of 0–528 m was provided [433], which represents the maximum depth that has ever been reported for this species yet (Table 2), although the authors of this study additionally reported that Galapagos sharks spent most of their lifetime in depths from 0 to 100 m.

**Table 2.** Overview of worldwide recorded maximum water depths for *Carcharhinus galapagensis*.

| No. | Locality                           | Recorded Depth (in m) | Reported Size of <i>C. galapagensis</i> Specimens (in cm) | Reference                  |
|-----|------------------------------------|-----------------------|-----------------------------------------------------------|----------------------------|
| 1   | No information available           | 528                   | No information                                            | Andrzejaczek et al. (2022) |
| 2   | Hawaiian Archipelago               | 371                   | No information                                            | Weijerman et al. (2019)    |
| 3   | St. Peter and St. Paul Archipelago | 304                   | ~220                                                      | de Queiroz (2020)          |
| 4   | Hawaiian Archipelago               | 286                   | No information                                            | Wetherbee et al. (1994)    |
| 5   | Ascension Island                   | 258                   | 123–240                                                   | Madigan et al. (2021)      |
| 6   | Salas y Gómez Island               | 195.5                 | 160                                                       | Morales et al. (2021)      |
| 7   | Hawaiian Archipelago               | 150                   | 133.8–223.9                                               | Asher et al. (2017)        |
| 8   | Kermadec Islands                   | 112–120               | 150                                                       | Clark et al. (2017)        |
| 9   | Elizabeth and Middleton Reefs      | 100                   | No information                                            | Carroll et al. (2021)      |
| 10  | Lord Howe Island                   | 30–100                | >100                                                      | Mitchell et al. (2021)     |

Spatial segregation of age classes and an ontogenetic shift in habitat preference, respectively, were reported as common in carcharhinid sharks [434]. Like most of the requiem sharks, *C. galapagensis* has been reported to exhibit an ontogenetic shift regarding its preferred water depth, with juveniles found mostly in shallow inshore waters and adults in deeper offshore waters and at greater distance to the coast [21,63]. For the Revillagigedo Archipelago, Mexico, it was reported that juveniles of *C. galapagensis* were limited to shallow water (<20 m) and that adults seldom occur together with juveniles [343]. This

spatial exclusion of age classes in one and the same shark species by using different habitats is commonly reported to serve for preventing cannibalism and to reduce predation risk [435]. The juveniles of *C. galapagensis* seem to be restricted to shallower water, in 25 m or less, which they apparently use as nursery grounds, while the adults emancipate themselves from shallow inshore waters and range well offshore [436]. In this context, for the Hawaiian Archipelago, it was reported that Galapagos sharks between 106 and 123 cm in size mainly occurred in shallow waters of 0–30 m depth, and sharks between 133.8 and 223.9 cm were commonly recorded in deeper waters of 30–150 m depth [437]. However, it was also reported from Lord Howe Island that juveniles and neonates of *C. galapagensis* with umbilical scars are found in deeper shelf waters up to 100 m depth [140,141].

This spatial separation by age classes was also observed at Clipperton Island, where juvenile *C. galapagensis* were caught over a depth range of 2–25 m but were most common in the shallower parts of this depth range [23]. Other studies have also found that juveniles of *C. galapagensis* are restricted to coastal or relatively shallow areas [63]. Presumably, this spatial separation of different age classes has been developed in *C. galapagensis* to reduce predation risk. However, there seem to be regional differences in the habitat use of juvenile Galapagos sharks because, for Hawaii, it was reported that juveniles do not use shallow nursery areas but instead occur at greater depths than subadult and adult female individuals [63,438].

Besides ontogenetic differences in the preference of water depths, scientists found out for Hawaiian atolls that Galapagos sharks performed reverse diel vertical movements, diving deeper during the night than during the day, indicating that they probably hunt on eyesight during the daytime when more sunlight is provided in the upper water column [414]. However, the opposite depth pattern was observed at Lord Howe Island, where sharks were shallower at night [140]. For Ascension Island and its surrounding seamounts, it was found that both juvenile and adult Galapagos sharks (123–240 cm) spent their time in a mean depth of 53 m, but the observed sharks conducted dives into deeper water during the night-time [428], which is consistent with the observations for the Hawaiian Archipelago [414].

### 5.3. Water Temperature

The tolerance of cold water must be regarded as a range-limiting factor that influences the distribution of sharks. In both the northern and southern hemisphere, the temperature of sea water is latitude-dependent. In this context, it was reported that the distribution of *C. galapagensis* ranges approximately as far as 36° N to the north [439]. Regarding the preferred water temperature of *C. galapagensis*, it was reported that this is a warm-water species [13]. For Lord Howe Island, it has been reported that *C. galapagensis* occurs in water temperatures of 17 °C to 26 °C [140]. According to a study that determined the preferred water temperatures for marine fishes based on statistical models [440], the Galapagos shark occurs in a temperature range from 15 °C to 28.2 °C, with a mean water temperature of 23.8 °C.

### 5.4. Water Visibility, Flow Regime, and Dissolved Oxygen

It was reported that *C. galapagensis* prefers clear waters [352]. However, it should be noted that offshore island waters are typically clear anyway because of the lack of large estuaries and river mouths on smaller islands, and, as such, this applies to many localities where *C. galapagensis* occurs.

For Cocos Island, it has been reported that the abundance of Galapagos sharks increased with increasing current strength, water visibility, and during the wet season [415]. The apparent preference of the Galapagos shark for clear waters was also reported in fur-

ther works [18], and, for the Hawaiian Archipelago, it was recognized that *C. galapagensis* prefers areas where currents are strong [441]. In contrast to these statements from the cited studies above, researchers measured at Australia's Lord Howe Island that juvenile and subadult specimens (~120 to ~200 cm) of *C. galapagensis* were mainly associated with low-flow environments that exhibit only low current speeds [442]. From this diverging information, it can be concluded that *C. galapagensis* tolerates a wide range of current speeds, and that strong currents may favour its occurrence, but are by no means to be understood as a mandatory prerequisite for it.

For seascapes around Ascension Island, it was found that specimens of *C. galapagensis* spent most of their time in waters between 4.5 and 5 mL/L<sup>-1</sup> dissolved oxygen and were rare or completely absent in waters below this range [428]. However, information on a preferred oxygen range or an avoidance of certain oxygen values is scarce.

## 6. Site Fidelity and Movements of *Carcharhinus galapagensis*

Data deriving from the literature on the occurrence and habitat use of the Galapagos shark indicate that this is a primarily coastal shark around remote oceanic islands and archipelagos, but that this species occasionally ventures into the pelagic realm. *Carcharhinus galapagensis* can exhibit both site fidelity and large-scale movements. Large-scale movements apparently occur only on rare occasions, and the ability to conduct large-scale movements changes through ontogenesis and differ greatly in age classes, with recorded shifts from site-attached juveniles to more mobile subadults and adults. For the Mexican Revillagigedo Archipelago, it was shown that juvenile Galapagos sharks had stronger site fidelity to their tagging site than the more mobile adults [443]. Although for *C. galapagensis* a few recorded cases of large-scale movements with distances of travels over 2000 km are documented [36,150] (Table 3), the Galapagos shark can be considered mainly as a shark with a strong site fidelity. This shark shows a high degree of site fidelity to specific oceanic islands, with most specimens observed to remain within a 30–50 km radius of their home range [98,150,413,414,443–445].

A rare case of extreme site fidelity was derived from the results of a tagging study conducted on Galapagos sharks at the Walters Shoals (Southwest Indian Ocean), with two recaptured specimens [446]. No information on the size of these two tagged specimens was provided, but they were tagged on the same day in September of 1968 and recovered together in the same area, more than five years later, also on the same day in October of 1973. This result impressively demonstrates the strong site fidelity that was observed in this species. In this context, for the Hawaiian Archipelago, it was reported that Galapagos sharks are often highly site-attached to well-defined home ranges [412].

Tracking studies conducted at the southern seamounts in the vicinity of Ascension Island showed that many tagged *C. galapagensis* individuals stayed close to the summits for the entire 235 days of the study period, suggesting they may be part of a resident population here [25]. For the remote Chilean Salas y Gómez Island (Southeast Pacific Ocean), it was found, by using satellite tagging of Galapagos sharks, that the daily individual maximum movements ranged from 17 to 58 km, and the overall maximum distance from Salas y Gómez Island ranged from 31 to 139 km [8]. A further finding of this study at Salas y Gómez Island was that the maximum linear distance travelled for an immature female Galapagos shark of 152 cm was 236 km. These tagging data indicate that *C. galapagensis* remained largely in the waters around Salas y Gómez Island, and that this shark shows fidelity to this site [8]. This is widely consistent with the results of previous studies [446,447] which also found that Galapagos sharks are commonly site-attached to certain oceanic islands, atolls, and seamounts.

Diverging from the information summarized in the paragraphs above, a study informed on two roaming Galapagos shark specimens that were tagged at the Bermuda Islands in the northwestern Atlantic Ocean [150]. One of these specimens travelled straight west to the continental coast of the U.S. Carolinas to continental waters south of Cape Hatteras, North Carolina, at approximately 1050 km distance to its tagging point (Table 3). One further specimen of *C. galapagensis* travelled straight southeast to the waters off Suriname (South America), 2859 km away from its tagging point [150]. Both travels are evidence for observed large-scale movements conducted by Galapagos sharks in the Atlantic Ocean. The authors of this study reported further on a shark tagging programme that was conducted in the Atlantic Ocean from 1962 to 1993, which included 339 Galapagos sharks that were tagged around the Bermuda Islands, and the two specimens with observed large-scale movements were part of this study [150]. Later, this Northwest Atlantic shark tagging program was extended to 2013, with additional results of interest. One male Galapagos shark of unknown size, tagged at the Bermuda Islands, was recaptured in waters off northwestern Cuba in the Gulf of Mexico, at ~2000 km distance from its tagging point [163] (Table 3). These results suggest that the few specimens that have been caught along the U.S. east coast (Supplementary Material S1) very likely derive from their insular stronghold of origin in the northwestern Atlantic Ocean, namely the Bermuda Islands.

One further large-scale movement in the Atlantic Ocean by a female Galapagos shark of 220 cm was reported [36]. By using satellite tracking of a female specimen of *C. galapagensis* to document its wandering behaviour, it was found that this observed specimen conducted a travel of 4354 km distance through the equatorial Atlantic, starting its movement at Brazil's St. Peter and St. Paul Archipelago, and was recorded 168 days later at a point near the continental coast off Angola, Southwest Africa [36]. This record of a Galapagos shark that has crossed nearly the entire Atlantic Ocean represents the longest movement that has ever been recorded for this species yet. These results cited above reveal that the Galapagos shark can be highly mobile on occasion. Therefore, its assessment as a migratory shark species [448,449] may be justified.

**Table 3.** Summarized large-scale movements observed in *Carcharhinus galapagensis* and provision of recorded travelling distances.

| No. | Starting Point of Tagging/Tracking        | Point of Recapture/ Last Tracking    | Duration Between Tagging and Recapture (in Days) | Recorded Travelling Distance (in km) | Ocean Basin    | Sex of Specimen | Reference/Source       |
|-----|-------------------------------------------|--------------------------------------|--------------------------------------------------|--------------------------------------|----------------|-----------------|------------------------|
| 1   | St. Peter and St. Paul Archipelago        | Waters off Angola                    | 168                                              | 4354                                 | Atlantic Ocean | ♀               | de Queiroz (2020)      |
| 2   | Socorro Island, Revillagigedo Archipelago | Darwin Island, Galápagos Archipelago | 395                                              | 3245                                 | Pacific Ocean  | ♀               | Lara-Lizardi (2018)    |
| 3   | Bermuda Islands                           | Waters off Suriname                  | No data                                          | 2859                                 | Atlantic Ocean | Unspecified     | Kohler et al. (1998)   |
| 4   | Bermuda Islands                           | Waters off northwest Cuba            | No data                                          | ~2000                                | Atlantic Ocean | ♂               | Kohler & Turner (2018) |
| 5   | Bermuda Islands                           | Cape Hatteras, North Carolina        | No data                                          | ~1050                                | Atlantic Ocean | Unspecified     | Kohler et al. (1998)   |
| 6   | Mikomoto Island                           | Offshore waters of the high sea      | 218                                              | 800                                  | Pacific Ocean  | Unspecified     | Jacoby et al. (2022)   |

It has been reported that adults of *C. galapagensis* can be occasionally found in the high seas or straying onto continental shores [73], indicating that the adults will leave sometimes their insular habitat and become nomadic. The crossing of open ocean waters seems to be restricted to the larger, strong-swimming specimens and may support gene flow between widely separated subpopulations. For the Mexican Revillagigedo Archipelago, inter-

island movements of *C. galapagensis* from Benedicto Island farther to Socorro Island, some 51.5 km over deep water, were reported [343]. A study on Galapagos sharks conducted around the islands of the Galápagos Archipelago revealed three types of movements with different spatial scales conducted by this shark: insular (>50 km), inter-island (50–400 km), and oceanic (>500 km) movements [450]. Insular movements were generally associated with aggregation sites around islands, inter-island movements were both directional and non-directional within the archipelago, whereas oceanic movements were more directional to other offshore regions. The second type of movement was implying connectivity within the archipelago, and the latter type the likelihood of migratory corridors between the Galápagos Archipelago and other islands or seamounts in the TEP [450].

A further shark tagging study suggested for the first time the probable existence of a migratory corridor for sharks between the oceanic islands in the TEP [451]. In this study, the travel of one 187 cm Galapagos shark (sex undefined) that was tagged in September of 2009 at Costa Rica's Isla del Coco National Park was reported [451]. This specimen moved 255 km within 20 days southeast halfway towards Malpelo Island in Colombia. This result contributes to the evidence that Galapagos sharks occasionally conduct large-scale movements between Marine Protected Areas (abbreviated hereafter with: MPAs) such as the Cocos and Malpelo Islands in the TEP and the probable existence of a migration corridor for sharks here. This result also emphasizes the need for the multinational-scale management of protected areas in this region. It also demonstrates that these islands in the TEP are probably used as stepping stones for migratory species such as sharks, and that they contribute to population connectivity and gene flow. Galapagos sharks that spend a considerable part of their lives at Cocos Island are probably most vulnerable to fishing activities when they migrate through the vast unprotected areas between conservation areas such as the marine parks of Cocos Island, Malpelo Island, and the Galápagos Archipelago.

Several studies consecutively reported on the movement of one subadult female Galapagos shark specimen of 181 cm that was tagged in January of 2016 at Socorro Island, Revillagigedo Archipelago, Mexico [376,443,452–454]. This specimen was detected later 945 km to the south at Clipperton Atoll (France) in October of the same year, and then moved 2300 km farther south to the Galápagos Archipelago (Ecuador), where it was detected more than one year after its tagging in February of 2017 at Darwin Island. This subadult female Galapagos shark was covering a total distance of 3245 km from the site where it was tagged. This documented movement was in fact the second-longest movement that ever has been recorded for this species. It surpasses the previous recorded large-scale movements of this species in the Western Atlantic Ocean [150,163], but it does not surpass the recorded large-scale movement recorded for the central and Eastern Atlantic Ocean [36]. This result maybe makes proof of the function of the islands in the TEP as stepping stones for the marine megafauna in general and for Galapagos sharks in particular and, moreover, it stresses the need for multinational and international conservation plans for migratory sharks with observed large-scale movements. The connectivity of islands in the TEP such as the Revillagigedo Archipelago, Clipperton Island, and the Galápagos Archipelago, and their function as swim ways for Galapagos sharks was also reported by others [455]. However, this movement event may be exceptional as scientists resumed that Galapagos sharks, in general, have a very high degree of site fidelity at Clipperton Atoll since they remained where they were tagged for several months [452]. Nevertheless, such large-scale movements of Galapagos sharks support the evidence of gene dispersal and population connectivity in the TEP.

Additionally, for the Northeast Pacific Ocean, medium-scaled inter-island movements of Galapagos sharks between islands of the Revillagigedo Archipelago were also reported [343,443,456], whereas one study [443] provided information on the results of a

tagging study where most of the sharks were detected on a single island, although some individuals moved over 40 times between the islands of this archipelago.

A long-distance movement by *C. galapagensis* was also observed in the Northwest Pacific Ocean. In a study on the movements of sharks in the waters surrounding Japan that was based on satellite tagging, for a single Galapagos shark (sex undefined), an 800 km movement offshore into the high seas was revealed, starting from Japan's Mikomoto Island, a small seamount located adjacent to Honshu, the Japanese main island [258].

Recently, for the first time, scientists reported on the movements of both female and male subadults of *C. galapagensis* ranging from 183 cm to 213 cm along the continental coast of Central and South America between Panama and Colombia in the TEP [457], in distance from its insular core centre of its distribution in this region around Malpelo Island and other archipelagos. This study, a novelty by representing the first recorded information on movements of this species along a continental coastline anywhere in the world, revealed that four tagged specimens remained commonly within 20 km of the shore and in relatively shallow waters of less than 100 m in depth, although detections were also recorded hundreds of kilometres from the shore in water thousands of metres deep [457]. Despite the limited number of tracked sharks ( $n = 4$ ), this study provided insights into the extensive movements of the Galapagos shark at the continental coast of Central and South America in the TEP, which was previously unknown.

## 7. Trophic Position of *Carcharhinus galapagensis*

The investigation of the trophic role of a shark species can provide insights into its position in the marine food web. As in many large predatory sharks, *Carcharhinus galapagensis* undergoes an ontogenetic dietary shift, with small individuals of the young age class occupying small prey items and large individuals of the adult age class also occupying larger prey items [63]. For *C. galapagensis*, it has been reported to feed primarily on bottom fishes (eels, sea bass, flatfish, flatheads, and triggerfish), but also flyingfish, squid, octopi, and occasional garbage [1]. Further, for this species, it was remarked that it prefers fish to crab, mollusc, and bird meat [1]. *Carcharhinus galapagensis* was assessed primarily as a piscivorous shark [458]. The investigation of 178 stomachs of Galapagos sharks from the Hawaiian Archipelago revealed that 96 (53.9%) contained food, with teleosts and cephalopods occurring most frequently, but elasmobranchs and crustaceans becoming more important as the sharks increased in size [63].

Stomach contents of 18 *C. galapagensis* specimens caught at the Walters Shoals revealed that their diet consisted mainly of teleosts, squid, octopuses, and molluscs [77]. The stomach contents of Galapagos sharks from the northwestern Hawaiian Islands suggest they consume a wide range of reef fishes here [427]. Teleosts occurred most frequently in the stomachs of Hawaiian Galapagos sharks, but they also consumed cephalopods, elasmobranchs, crustaceans, and mammals [427]. Also, for the Hawaiian Archipelago, stable isotope analysis revealed that Galapagos sharks obtain most of their food from shallow reef habitats. Moreover, an analysis of their movements showed that they may function as significant transporters of nutrients, particularly from shallow to mesophotic reefs [414]. *Carcharhinus galapagensis* was assessed as a mesopredator in reef habitats [417].

Although the diet of *C. galapagensis* predominantly consists of small (reef) fish, larger specimens (>180 cm) may occupy bigger prey items. Thus, this species is also known to be an elasmobranch consumer and, as such, this species controls the populations of smaller reef sharks of lower trophic positions like *Triaenodon obesus* [459]. An investigation of the competition within carcharhinid sharks at the Hawaiian Archipelago found that *C. galapagensis* is competitive with both *C. amblyrhynchos* and *C. plumbeus*, and that all these species share a dietary overlap [427]. Moreover, this study revealed that to a lesser extent,

adult *C. galapagensis* also showed dietary overlap with the larger *Galeocerdo cuvier* because both included large food items such as sea mammals in their diet [427]. The inclusion of large prey items such as sea mammals in the diet of *C. galapagensis* has also been reported by other scientists. Although the Galapagos shark's diet primarily consists of teleosts and elasmobranchs, on the islands of the Pacific Ocean, large adult specimens of *C. galapagensis* are known to prey upon several species of pinnipeds. At the Galápagos Archipelago, the attack of a large (~250–300 cm) Galapagos shark on the endemic *Zalophus wolfebaeki* (Sivertsen, 1953) was reported [460]. Further, there are several reports on attacks of large Galapagos sharks on the endemic *Monachus schauinslandi* (Matschie, 1905) at the French Frigate Shoals in the northwest of the Hawaiian Archipelago [461–464] (compare with Section 8.4).

On the other hand, the Galapagos shark itself can be a target of large predatory marine species. There is a verified report from the Galápagos Archipelago of one feeding event by *Orcinus orca* (Linnaeus, 1758) on a Galapagos shark [465]. Although it has not yet been discovered, the Galapagos shark is likely preyed upon by large sharks that occupy a higher trophic position and are known to be apex predators and intensive elasmobranch consumers, such as *Carcharhinus leucas*, *G. cuvier*, *Sphyrna mokarran* (Rüppell, 1837), and *Carcharodon carcharias* (Linnaeus, 1758), particularly in areas where they share overlapping ranges, although the remote distribution of *C. galapagensis* certainly provides some shelter due to allopatric ranges of these species.

## 8. Discussion

This study revealed 69 confirmed records of *Carcharhinus galapagensis* worldwide (of which 53 account for oceanic islands and 16 for continental coasts), which is not much considering the large circumglobally range of this species. This result is highlighting that the core area of its distribution is around oceanic islands, as recognized in other studies [63]. Historically, the Galapagos shark was reported to be the most common inshore species that can be encountered at several remote oceanic islands [23,199,345], although recently, the intensive fishing pressure has decreased their number significantly at many locations worldwide, particularly outside of MPAs.

*Carcharhinus galapagensis* is both an amphi-Atlantic (=transatlantic) and an amphi-Pacific (=transpacific) species [58,374,466], which means that it occurs on both sides of these ocean basins. However, it is apparently not a transindian species as evidence was provided in the Indian Ocean only from its western part, and has not yet been proven for its eastern part [1,7,31,35] (see Figures 2 and 4). A strikingly large gap in distribution can be observed for the area between the Western and Eastern Indian Ocean. This seems surprising because, in the region of the Eastern and Central Indian Ocean, there are many remote islands and island groups with reef habitats (e.g., Christmas Island, Cocos (Keeling) Island, Chagos Archipelago, Maldives) that appear suitable for colonization by *C. galapagensis*.

In particular, the few occurrences of the Galapagos shark around oceanic islands, atolls, and shoals in the Western Indian Ocean raise questions about its unusual distribution in this ocean basin. In the first place, it is difficult to determine how this shark got there, from where these populations initially derived, and in which direction the immigration to these remote oceanic locations took place. Secondly, it is difficult to find logical and plausible reasons why this species is noticeably restricted to the western part of the Indian Ocean and has not been recorded yet from elsewhere in this ocean basin. In this context, a lack of suitable habitats for this species can be largely excluded, particularly for the Eastern Indian Ocean, as there are many oceanic islands exhibiting remote, pristine, and healthy reef ecosystems, such as Australia's Cocos (Keeling) and Christmas Islands. Perhaps, the reefs

of these islands were occupied earlier by other species of reef sharks, and the ecological niche of a reef-inhabiting predator has already been taken up by another species here.

The reports about the Galapagos shark from the Atlantic Ocean indicate that there appears to be a gradient in the abundance of *C. galapagensis* in this ocean basin that is apparently latitude-dependent. At the warm-temperate and subtropical outer range limits of its distribution in the northern Atlantic Ocean, the Galapagos shark is rarely found, e.g., in the Azores Archipelago and at Madeira, the northernmost distributional borders in the Atlantic Ocean. In contrast, in tropical strongholds like São Tomé Island, Ascension Island, and historically also in St. Peter and St. Paul Archipelago, it is one of the most common shark species (for the latter at least in the past, before depletion by fishing activities occurred). These latitude-dependent differences in abundance suggest that the core area of the Galapagos sharks' distribution is inside the tropical latitudes. Therefore, *C. galapagensis* can be assessed as a shark with a primarily tropical distribution, presumably based on its preference for warm water (see Section 5).

The Galapagos shark shows a high fidelity around oceanic islands during periods of reproduction, and it stays in the vicinity of offshore islands when it bears its young. Galapagos sharks only occasionally move to continental coasts as subadults or adults, nomadic rather than migratory, which implies a directed movement that is usually triggered by returning to places of parturition or wandering prey species. Juveniles of *C. galapagensis* have been reported (with one exception) exclusively from remote oceanic island habitats, and not from continental coasts. This reproductive strategy may be effective to reduce and avoid predation on the offspring by primarily continental-distributed intensive elasmobranch feeders such as *Carcharhinus leucas*, *Galeocerdo cuvier*, and *Sphyrna mokarran*. The reproductive behaviour of *C. galapagensis* is completely opposite to what has been observed in other shark species. For the TEP, shore-directed movements to coastal nursery areas along the Pacific coast of Mexico and regional philopatry of primarily pelagic distributed shark species have been reported both for *Rhincodon typus* (Smith, 1828) and *Sphyrna lewini* (Griffith & Smith, 1834), which move to sheltered inshore locations of the mainland [467,468].

### 8.1. Distribution-Limiting and Range-Building Factors

The distribution of the various shark species mainly reflects their phylogeography as well as environmental conditions. Their distribution was largely influenced by the history of the Earth and the geological development, resulting in the genesis of land barriers, which are of biogeographical importance. Oceanographic connectivity driven by ocean currents is also important for the distribution of marine biodiversity because it mediates the genetic and individual exchange between separated populations [469]. Both intra- and interspecific competition are also considered as range-building factors for sharks, as well as abiotic parameters. It can be assumed that carcharhinid sharks compete under a variety of environmental conditions, with resulting phenomena such as niche separation, spatial separation, and competitive exclusion. Some sharks are highly migratory and vagile marine species, with a migration behaviour that is mainly induced by seasonal changes in water temperature, foraging, or reproduction behaviour.

Focusing on *C. galapagensis*, scientists recognized in the 1950s and 1960s that this shark shows an apparent preference for the sea around oceanic islands [76,470]. For the understanding of the unique distribution pattern of the Galapagos shark, several factors must be considered that have most likely shaped its current geographic range: Historical demography, dispersal ability, competition, niche separation, and the evolutionary potential for adaptation to reef habitats around isolated oceanic islands. Until nowadays, data from reef shark science is not sufficient to identify and describe regularities regarding the

distribution of reef sharks in ocean basins [471]. For example, the composition of reef shark assemblages and irregularities in the abundances of certain reef shark species at specific localities have not been identified satisfyingly yet, with many unresolved questions remaining. The ecological niche of *C. galapagensis* does not seem to be completely clear and definable yet. This species occurs in the Indo-Pacific along with typical reef sharks such as *C. albimarginatus* and *C. amblyrhynchos* on the outer reef slope, although a distinct geographical distribution of these three species from different locations has been described, e.g., in the Mozambique Channel by the presence of a particular reef shark species at one location and the absence of others [248]. According to shark scientists, *C. albimarginatus* may be in direct competition with *C. limbatus* (Valenciennes, 1839) and *C. galapagensis*, which may explain why the latter two species increased in numbers at Costa Rica's Cocos Island simultaneously when severe declines in *C. albimarginatus* at this location occurred [415].

Therefore, intra- and interspecific competition can be assessed as a range-building factor that affects the distribution of sharks such as the Galapagos shark. Studies on the behaviour of congeneric sharks revealed that among sharks of nearly the same length occurring at the same location, *C. albimarginatus* very clearly dominated *C. galapagensis*, while both dominated *C. limbatus* [23,472]. For the St. Peter and St. Paul Archipelago in the Atlantic Ocean, a survey based on acoustic telemetry data revealed for *C. galapagensis* and *C. falciformis* that both species showed spatial segregation at this site, with the latter occupying the pelagic zone and the first instead occurring in inshore waters [473], possibly due to competition. Other studies provided information that, in sharks, inter-species competition can be an excluding parameter already in the juvenile age class, which moreover can also be assessed as a driving force of spatial and trophic niche patterns in sympatric species [474].

In the tropical and subtropical Pacific Ocean and at a few locations in the Western Indian Ocean, reef shark assemblages found at the outer reef slopes mainly consist of three co-occurring species of sharks: *Carcharhinus amblyrhynchos*, *C. albimarginatus*, and *C. galapagensis* [475]. These three reef sharks share sympatric ranges in the Indo-Pacific region, but the information is scarce on competitive behaviour, dietary overlaps, and niche separation. However, top-down control in these three species of reef sharks and predation of large sharks such as *C. galapagensis* on juvenile *C. amblyrhynchos* was suspected [475]. Today, *C. galapagensis* is known to feed significantly on other reef sharks, including the smaller *C. amblyrhynchos* and *Triaenodon obesus* [441,459,476,477] because this shark is considerably larger when adult. It is not known how far this top-down control influences the distribution of these reef sharks, although it probably plays a major role in limiting population sizes. Studies on shark distribution around the Hawaiian Archipelago revealed that *C. galapagensis* was more common in the northwestern islands and was replaced by *C. amblyrhynchos* in the southern islands of the northwestern Hawaiian Island Chain [478]. Interspecific competition due to dietary overlap may influence and regulate the distribution of these sharks throughout the Hawaiian Islands [427].

A study conducted on reef sharks in the Western Indian Ocean showed that *C. melanopterus* was the most abundant shark at Aldabra Atoll, and *C. galapagensis* was the most abundant shark at the Bassas da India Atoll [248]. Moreover, the Bassas da India Atoll lacked *C. amblyrhynchos*, *C. melanopterus*, and *T. obesus*, but was therefore characterized by aggregations of juvenile *C. galapagensis*, suggesting a kind of competitive exclusion [248]. Contrarily, for the Chagos Archipelago in the Central Indian Ocean from where *C. galapagensis* has been not reported yet, another study found that the dominant reef shark species were *C. amblyrhynchos* and *C. albimarginatus* [479]. It is very likely that these reef sharks compete with *C. galapagensis*, and competitive exclusion may be one explanation for the apparent absence of the latter from the Chagos Archipelago.

Answering a key question could go a long way toward clarifying the phenomenon of why *C. galapagensis* shows such a strong attachment to remote oceanic island habitats: How do oceanic island coastal habitats differ from those of continental coasts? In this context, a further fundamental question in assessing interspecific competition between species of the genus *Carcharhinus* is whether it may be coincidental that the abundance of *C. leucas* decreases with increasing distance from continental landmasses and, diametrically, the abundance of *C. galapagensis* increases with increasing distance from the mainland? Although it may be unlikely that one single species could have such a strong excluding influence on the distribution of another, it reflects the complexity of tropical marine food webs. Abiotic parameters, such as salinity, and the adaptation to different environments, could also be regulatory drivers for the distribution of these two carcharhinids, because one (*C. galapagensis*) is assessed stenohaline and the other (*C. leucas*) euryhaline.

In nearshore ecosystems at continental coasts of the tropics and subtropics, large-bodied carcharhiniform sharks such as *Sphyrna mokarran*, *Galeocerdo cuvier*, and *C. leucas* occupy top-predatory niches and control the abundance of lower trophic species, including meso-predatory sharks. This predatory pressure can result in types of avoidance behaviour, which means that several shark species such as *C. galapagensis* may escape predation by inhabiting open oceanic waters and remote habitats far from continental coasts. However, this spatial exclusion of predatory sharks seems to be not limited to continental coasts and can also be recognized at several islands in the Western Indian Ocean such as Reunion and Mauritius as well as the Seychelles, where these three apex predators are known to occur at all three locations and *C. galapagensis* is missing. The same applies to some islands of the Pacific Ocean such as the Fijian Archipelago, where *C. leucas* and *G. cuvier* occur but *C. galapagensis* has not been recorded. However, there are a few locations where both *G. cuvier* and *C. galapagensis* co-occur, such as the Hawaiian Archipelago and Norfolk Island [126].

In this context, a tagging study conducted in waters off Florida found that the three large predatory shark species cited above are favouring the productive coastal regions of the Northwest Atlantic Ocean and the Gulf of Mexico along Florida's continental shelf [480]. These competitive species may force the inferior *C. galapagensis* to remote oceanic islands in the Atlantic Ocean such as the Bermuda Islands by competitive pressure, although this assumption is of a mainly speculative nature. With a few exceptions (e.g., Fiji, Reunion Island, The Seychelles), the large elasmobranch consumer *C. leucas* is found only occasionally around most subtropical and tropical oceanic islands, presumably due to the paucity of critical habitats such as low-salinity environments on which this species essentially relies for reproduction [400]. *Carcharhinus leucas* preys heavily on juvenile sharks, including its own offspring [1,481].

Elasmobranchs have developed different evolutionary strategies to protect their offspring and reduce predation risk; for example, leaving the marine environment and moving into low-salinity habitats as observed in *C. leucas* [281,482]. The nursery areas of *C. galapagensis* were identified by this study in waters of remote oceanic islands at a considerable distance to continental coasts, where strong elasmobranch consumers such as *C. leucas* do not occur, and specimens of *G. cuvier* are mainly rare or solely vagrants. No sightings or records of small juvenile *C. galapagensis* up to 150 cm in continental waters may indicate that Galapagos sharks move only to coastal waters of adjacent continental landmasses when they have grown, at least as far as to the large juvenile and subadult age classes. Presumably, then, they have reached sizes that allow them to escape predation by large predators, especially continental-distributed elasmobranch consumers.

Although both *C. galapagensis* and *C. leucas* are mainly tropical to subtropical distributed warm-water species of *Carcharhinus*, it is striking that they share only a few

sympatric ranges that represent exceptions, such as Colombia's Malpelo and Gorgona Islands in the TEP, which are in less distance to the continental coast of the South American continent. This avoidance may be an effective protection for juvenile *C. galapagensis* against predation by other predatory shark species and may guarantee a high survival rate for the offspring. However, it should be noted that several other similar-sized or smaller carcharhinids such as *C. obscurus*, *C. limbatus*, and *C. amblyrhynchos* co-occur with *C. leucas* in the same areas. If predator avoidance would be a strong driving factor, it should be expected that it would also affect the distribution of these species significantly. In this context, it should be mentioned that *C. leucas* can be a very dominant species that does not tolerate any other sharks in the territory it occupies, for example, at Costa Rica's Islas Murciélagos (A. López-Garro, pers. comment).

Regarding the spatial distribution of reef sharks, competition can be assessed as important but not the only regulating factor, and geographic latitude is also of importance. In this context, a large-scale survey based on BRUVS deployments across 18 nations from the Western and Central Pacific Ocean unveiled that *C. amblyrhynchos* was not recorded on Lord Howe Island (Australia) or on the Kermadec Islands (New Zealand), but, therefore in these areas, *C. galapagensis* was recorded, suggesting a spatial exclusion of both [483]. The researcher who conducted this study concluded that there may be latitudinal separations in the species' presence, with *C. galapagensis* present only at higher-latitude reefs (Lord Howe Island, Kermadec Islands) where *C. amblyrhynchos* does not occur. A scheme of the main factors that could be affecting the geographic distribution of *C. galapagensis* is given in Figure 8.

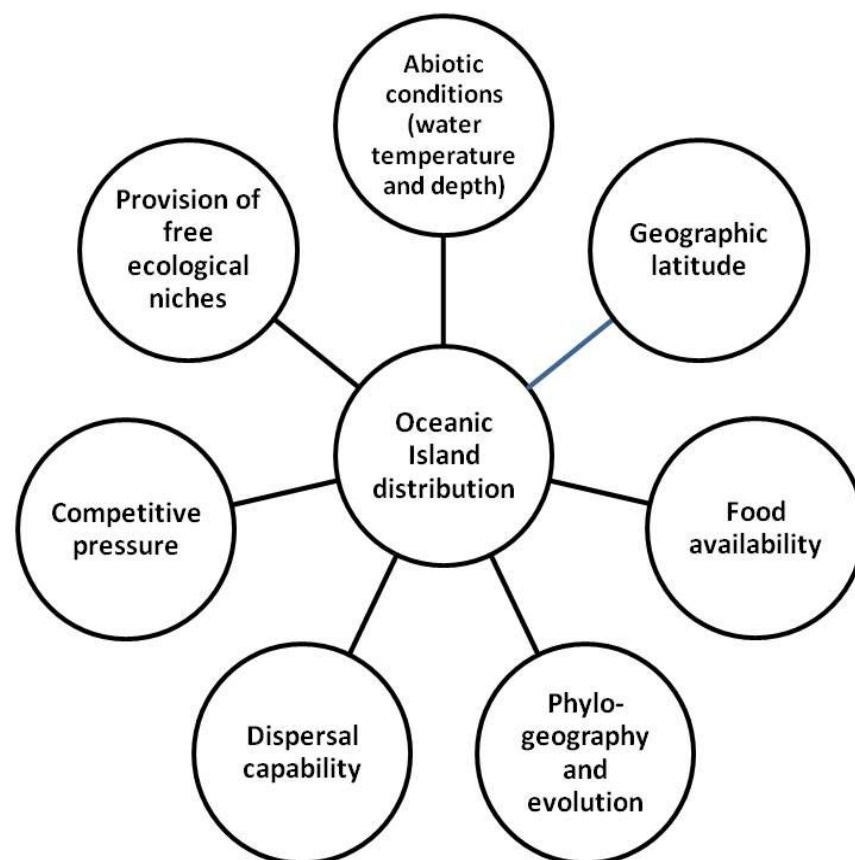


**Figure 8.** Scheme of identified factors possibly affecting the global distribution of *Carcharhinus galapagensis*.

Focusing on the competitive situation of reef sharks in the Atlantic Ocean, here, the situation is different from the Indo-Pacific because of diverging prevalent species compositions. Indo-Pacific reef sharks such as *C. amblyrhynchos* and *C. albimarginatus* do not occur in the Atlantic Ocean but, instead, here, they get replaced by *C. perezi* that has occupied reef habitats in the Western Atlantic, from North Carolina to Brazil [7]. This reef shark is restricted to the Western part of the Atlantic and has not colonized the entire tropical to subtropical Atlantic Ocean. Hence, it is lacking from the Central and Eastern Atlantic. This means that oceanic islands inside the Central and Eastern Atlantic regions may have provided ecological niches in reef habitats and on rocky slopes around oceanic islands that are left to get occupied by predatory fish such as reef-inhabiting sharks. For the Western Atlantic-distributed *C. perezi*, an ecological role similar to the carcharhinid sharks of the Indo-Pacific region was suspected [484]. Possibly, competition between *C. perezi* and *C. galapagensis* is the case for the Caribbean Sea, and this may explain why the Galapagos shark is scarce at reefs habitats here, where only a few reports and records exist (Supplementary Material S1). Probably, around oceanic islands, *C. galapagensis* does not only compete with other reef shark species but also with pelagic sharks. For the equatorial Atlantic Ocean, it was assumed that an increase of *C. galapagensis*, after its near extinction around St. Peter and St. Paul Archipelago (compare Section 8.5), resulted in a decrease in *C. falciformis*, likely a consequence of the dominance and more territorial behaviour of *C. galapagensis* which tend to drive *C. falciformis* away from the archipelago [485].

Regarding abiotic conditions and other environmental factors than competition, the temperature of sea water is important for the spatial distribution of elasmobranchs. Although considered a warm-water species, the Galapagos shark apparently tolerates slightly cooler waters than *C. amblyrhynchos* and *C. leucas*, two sharks assessed as mainly tropical species. However, *C. galapagensis* is not as tolerant to cool waters in comparison to the sibling *C. obscurus*, whose distribution spans even the temperate regions of the world [486]. In contrast to *C. galapagensis*, the distribution of its progenitor *C. obscurus* includes also the cooler temperate waters in the higher latitudes, e.g., the Cape Region of South Africa and the Great Australian Bight of South Australia [1,7,10].

Focusing on oceanography and marine life, climate change may lead primarily to warming effects of water masses in all three ocean basins and therefore, it can be assessed as a driving factor for altering the distribution of fish such as sharks, resulting in habitat loss for cold-temperate species as well as range extensions for tropical species. Ocean warming may result in poleward-directed range shifts of warm-water shark species [487]. Possibly, future ocean warming may promote the dispersal of tropical and subtropical sharks, including *C. galapagensis*, to areas of the higher latitudes. In this context, a study modelled the ranges of carcharhinid sharks and predicted shifts in the distribution by the year 2050, including *C. galapagensis*, with possible range extensions at the distributional margins of this species in the Northeast and Southeast Atlantic Ocean [488]. Probably, this shark will expand its distribution if the ongoing warming of oceans continues. The occurrence of the mainly tropical-distributed *C. galapagensis* around the warm-temperate Azores Archipelago was already discussed in a context of a tropicalization process in the Northeast Atlantic Ocean [211]. In this scenario, range extension mediated by dispersal of single specimens could be rapid, but presumably would result in low genetic diversity in the founder population due to the low population size of the starting population, and a prevalent barrier to the sharing of genes across large distances.

The swimming abilities and the spatial behaviour can also be of importance for the dispersal of sharks and therefore, they are of relevance for shaping the range of *C. galapagensis*. The strong site fidelity of *C. galapagensis* to specific island locations seems to be consistent with the results of studies on the spatial behaviour of further reef-inhabiting

sharks of *Carcharhinus*. Several studies revealed that many reef sharks within the genus *Carcharhinus* are highly residential. For example, for *C. perezii*, it was found that this shark moved little between tag and recapture events (0 to 8 km) despite multiple years at liberty for many specimens (up to 7.1 years) [489]. Scientists also found no evidence of seasonal migration behaviour in *C. perezii* [489], unlike other large congeneric members that are not confined to reef habitats or are just occasional visitors there such as *C. leucas*, who often undertakes large-scale seasonal-induced migrations, especially at its northern and southern range limits [490,491].

The crossing of open ocean waters and the migration between widely separated atolls and islands by reef sharks, which mostly exhibit residential behaviour, seem to be exceptional, but not unusual. Scientists reported on the movement of *C. amblyrhynchos* between different atolls of the Hawaiian Archipelago [492]. Similar movements were also observed in *C. galapagensis*, who travels between islands inside archipelagos as well as to adjacent island groups in greater distances. In this context, researchers reported on the ability of *C. galapagensis* of crossing open ocean waters [169]. Further scientists also suspected the Galapagos shark of ocean-crossing because it exhibits a circumglobally, but disjunct distribution, and the colonization of widely separated islands requires the ability to migrate over extended distances of open ocean waters [46]. Particularly, the adults of *C. galapagensis* are regarded to be capable of crossing considerable distances of open ocean between islands [436]. This partial migration from one island to another adjacent island can be a mechanism for driving migration and gene flow in at least in a small proportion of the population.

## 8.2. Biogeography and Phylogeography

As biogeography aims to identify regularities in species distribution, the finding of characteristic spatial patterns in the distribution of taxa is of particular concern. For elasmobranchs, a relationship between body size and range size has been reported [340], in which large-bodied species are mostly occupying large ranges and small-bodied species are showing overwhelmingly small ranges. The latter are often restricted to certain regions or localities where they are sometimes endemic. In this context, studies have found that reef fish assemblages of oceanic islands often contain high abundances of species with wide geographic ranges, such as cosmopolitan-distributed sharks [493,494]. Investigations of remote oceanic islands in the Pacific Ocean have shown that even these isolated habitats can be inhabited by high numbers of reef sharks due to the high productivity of these ecosystems which provide large amounts of food items for sharks [495,496]. Nevertheless, it should be considered that nowadays, the composition of fish assemblages can be strongly altered even at remote islands, due to fishing activities which affect almost all regions of the world today.

For the dispersal of marine life, natural barriers to its distribution such as strong currents, land bridges such as the Isthmus of Panama, and vast and expanded stretches of open oceans such as the Pacific Plate (often referred to as “ocean deserts”) can be regarded as dispersal limiting factors [497]. Vast stretches of open ocean waters are considered barriers for primarily reef-inhabiting sharks such as *C. galapagensis* [471]. Large expanses of open ocean waters can be assessed as barriers to gene flow, primarily for coastal-restricted species, but also to a lesser extent for strong-swimming pelagic species. In large predatory sharks, there are examples of panmictic species such as *Prionace glauca*, *Carcharhinus longimanus*, and *Isurus paucus* (Rafinesque, 1810), which show no clear population structuring due to virtually no visible barriers [498–500]. Contrastingly, there exist also examples of globally distributed sharks that are showing population structuring because of the isolation

effects of vast stretches of open water, which are separating parts of ocean basins, such as *C. galapagensis* [47].

Scientists outlined the insurmountability of the Eastern Pacific Barrier (EPB) as a part of the Pacific Plate that provides approximately 5000 km of deep water, separating the eastern from the Central Pacific, for shallow-water marine species [501]. These scientists further concluded that the EPB represents the world's widest marine biogeographic barrier, which is virtually impassable for coastal-restricted fish, and that provides a barrier to gene flow across the Western, Central, and Eastern parts of the Pacific Ocean [501]. This nearly insurmountable barrier drives differentiation in marine fish through isolation effects, resulting in limitations of specimen dispersal and gene flow between geographically separated populations. The strength of the Pacific Plate Barrier in elasmobranch dispersion has been observed in the species richness of this group of fish in Australasia [502] as well as in the TEP, where even large, highly vagile, and pelagic species such as *Manta birostris* (Walbaum, 1792) show restricted gene flow between these areas [503]. Only very few reef shark species (e.g., *Carcharhinus albimarginatus*, *C. galapagensis*, *Triaenodon obesus*) exhibit an amphi-Pacific distribution [58]. *Carcharhinus amblyrhynchos* also occurs in the East Pacific but is restricted here to one single location, the Galápagos Archipelago, and as such, this species cannot really be assessed as amphi-Pacific.

Biogeographers and ichthyologists highlighted that many marine fishes are relatively unrestricted in distribution and, therefore, cannot be assigned to any zoogeographic area [504]. In a compilation about Pacific-distributed marine shore fishes, five species of sharks were shore fishes that occur on both sides of the Pacific Plate Barrier, but this listing did not include many large members of *Carcharhinus* and not *C. galapagensis* [339]. Other scientists commented on this compilation [476] and stated that *C. galapagensis*, among other large carcharhinids, should be added to his list because they do also occur on both sides of the Pacific Ocean. *Carcharhinus galapagensis* was not mentioned in a monumental work about the Pacific Plate biogeography [505], but the wide absence of other large-bodied members of *Carcharhinus* from the Pacific Plate was recognized with the conclusion that body size alone is insufficient to account for the presence or absence of *Carcharhinus* species from the plate. It should be assumed that especially the large and strong-swimming members of this genus are predestined to colonize the vast Pacific Plate. From the large members of *Carcharhinus*, only two oceanic species with a worldwide distribution are widely distributed on the Pacific Plate and common in all areas: *Carcharhinus falciformis*, and *C. longimanus*. It is astonishing that out of *Carcharhinus*, which comprises large and strong-swimming species such as *C. leucas* and *C. obscurus*, only three small-to-medium-sized species seem to be the most common species around islands of the Indo-Pacific: *C. albimarginatus*, *C. amblyrhynchos*, and *C. melanopterus*. Without exception, all these three species are largely associated with reef habitats.

At the end of the 1960s, it was recognized for the first time that *C. galapagensis* shows a worldwide distribution in the sense of occurring in the Atlantic, Pacific, and Indian Oceans [76]. Twenty years later, nine species of the genus *Carcharhinus* were listed, all large (>250 cm), that are circumtropical- or circumtemperate-tropical-distributed, which means that they occur in all major ocean basins: *C. altimus*, *C. brachyurus* (Günther, 1870), *C. falciformis*, *C. galapagensis*, *C. leucas*, *C. limbatus*, *C. longimanus*, *C. obscurus*, and *C. plumbeus* [506]. Two further congeneric species can be added to this listing: *C. brevipinna* (Valenciennes, 1839) and conditionally also *C. amboinensis* (Müller & Henle, 1839) (the latter has been recorded for the Atlantic and Pacific Oceans but not yet from the American continent). It was suspected that *C. plumbeus* could possibly be absent from the Eastern Pacific as well as *C. brevipinna* [506], an observation that is consistent with the current knowledge and very likely reflects the strong isolation effect of the Pacific Plate Barrier. All these species

of *Carcharhinus* mentioned above have in common that they are cosmopolitan-distributed and occur exceptionless in all three major ocean basins. Although they can be assessed as strong-swimming species due to their large sizes and are able to cross ocean basins or larger parts of open ocean waters, the strong isolation effect of the Pacific Plate Barrier may hinder the colonization of the East Pacific by *C. brevipinna* and *C. plumbeus*. This compilation above of the 11 species of *Carcharhinus* that exhibit a worldwide distribution is consistent with a biogeographical study that also listed 11 species of requiem sharks with circumtropical distributions, including *C. galapagensis* [143].

However, although these 11 *Carcharhinus* species have in common that they are globally distributed, it was pointed out that these large and cosmopolitan members of *Carcharhinus* occupy different habitats [506]. *Carcharhinus falciformis* and *C. longimanus* are epipelagic and inhabit primarily open ocean waters far from landmasses, *C. galapagensis* prefers insular waters, and *C. obscurus*, *C. brachyurus*, and *C. plumbeus* can tolerate cooler waters in comparison to the others. *Carcharhinus leucas* exhibits a preference for continental coasts and is well-known for penetrating low-salinity environments such as rivers and lakes with access to the sea at its early life stages [400]. In this context, scientists reported on a habitat-mediated diversification in the genus *Carcharhinus* [91], and a splitting of *C. galapagensis* from *C. obscurus* that has been presumably occurred just recently (<1 million years ago; hereafter abbreviated with: MYA). The niche separation of the several *Carcharhinus* species can be understood in the context of diversification and radiation from the early ancestors of *Carcharhinus*, as well as with the adaptation of these taxa to different habitat types, together with an evolutionary specialization to different prey items. A diversification burst of carcharhiniform sharks was reported that has occurred over the last 30 MYA [507], likely mediated by environmental changes. In this context, other researchers had elucidated the evolution of modern sharks and informed on a Miocene climatic disruption that may have promoted morphological segregation of carcharhiniform sharks that was mainly driven by a combination of habitat change, prey availability, feeding ecology, and feeding strategies [508]. Adults of *C. galapagensis* show a slender, streamlined body and large first dorsal and pectoral fins. Hence, this requiem shark shows—at least partially—morphometric characteristics of pelagic sharks and large adult specimens are well-designed for movements across open ocean waters, although they occur primarily at the outer reef slope of oceanic islands and around seamounts. Probably, *C. galapagensis* is an intermediate between reef sharks and pelagic sharks and arose because of this free ecological niche which was left for occupying.

One Colombian scientist listed the known insular occurrences of the Galapagos shark for the Colombian Pacific and pointed out that the case of *C. galapagensis* is particularly noteworthy from a zoogeographical point of view [342]. This scientist concluded that the strongly disjunct distribution of this circumtropical species seems paradoxical and that the occurrences of this species in the Indo-Pacific region strongly suggests an origin in the East Pacific due to the numerous occurrences here. However, this scientist also emphasized that even the Atlantic region cannot be completely excluded as a place of its origin either after the discovery of this shark in this ocean basin at the beginning of the 1960s [129,172,173].

For the elasmobranch diversity of Colombia, an apparent difference in species richness and composition between the Pacific and the Caribbean Sea was reported [374], and it was strongly related to the emergence of the Isthmus of Panama. This event has led to diverging species numbers of elasmobranchs on both sides of the isthmus [373,374], and it can be assessed as the driving force for evolutionary processes in fishes on both sides of the American continent, including the genesis of *C. galapagensis*. For example, in the evolutionary old and stabilized taxa of *Carcharhinus* such as *C. leucas*, a species that can be reliably backdated at least to the border Miocene/Pliocene [509], the isthmus can be

regarded as being responsible for the evolution of different genotypes of this shark on both sides of the isthmus.

The appearance of the Isthmus of Panama ~3.5 MYA and the rise of the Mesoamerican Landbridge can be assessed as the main event in the evolutionary history of elasmobranchs in the American region. This geological event divided the current Atlantic and Pacific Oceans and has left the marine biota isolated beyond both sides of the isthmus. This separating of former undivided populations has not only led to the splitting of shark taxa but also to the emergence of new ones. An example of this diversification is the exclusively Pacific-distributed *Carcharhinus cerdale* (Gilbert, 1898), which arose because of isolation-related allopatric speciation during the closure of the isthmus, and which split off from the Atlantic-distributed sibling *C. porosus* (Ranzani, 1839) [510]. In the case of *C. perezi*, it can be assumed that this species likely arose beyond the Isthmus of Panama since its distribution is limited to the Atlantic side of the Mesoamerican Landbridge, and it does not occur in the Pacific. The same period of emerging dated after the closure of the isthmus can be assumed for the exclusively Pacific-distributed *Nasolamia velox* (Gilbert, 1898) which occurs only on the west side of the American continent.

In the case of *C. galapagensis*, for which genetic studies have attested to be presumably younger than 1 MYA old [91] and, thus, evolved well after the Isthmus of Panama was formed, this means for the TEP that there was a barrier both for westward dispersal due to the EPB and eastward to the Atlantic Ocean by the Mesoamerican Landbridge, assuming that this species originated in the Eastern Pacific. The fact that *C. galapagensis* is common and abundant in the TEP and very rare in the Caribbean Sea and the adjacent waters of the Western Atlantic Ocean (Figure 2) may also be a strong biogeographic argument in supporting that the Galapagos shark has emerged after formation of the Isthmus of Panama and the related persistent dividing of both major ocean basins.

Additionally, genetic investigations also support the theory that *C. galapagensis* was derived in the East Pacific region [47]. Further, this theory is also supported by the knowledge that this species is widespread in the TEP, the core area of its distribution, and is scarce in the Central and Western Pacific. Very useful information that supports this theory has been derived by a further study [501]. The authors of this study have described that the traditional approach for inferring the direction of fish dispersal across the EPB has been to consider the region, in which populations of a transpacific species are most abundant and widespread, as the source and the area in which populations have a more tenuous hold as the target. Although the direction of invasion by fish across the EPB presumably has occurred overwhelmingly from the central to the Eastern Pacific, investigations on species distribution in the Pacific [44] have shown that a few fish species have managed successfully to disperse into the opposite direction (east to west).

Based on its young evolutionary age and its core area of distribution in the TEP, the author of this study argues in harmony with the results from genetic investigations [47] that *C. galapagensis* has presumably derived in this region where many coral and rocky reef habitats around its numerous oceanic islands (e.g., Revillagigedo Archipelago, Cocos Island, Malpelo Island, Galápagos Archipelago) were available. The splitting from its progenitor *C. obscurus* may have supported niche separation in this species, and these isolated reef habitats in the TEP presumably got occupied by the young descendant *C. galapagensis*.

A strongly supported phylogenetic link (based on the SNP phylogeny) between the East and West Pacific Ocean lineages via two investigated Mexican specimens suggests that *C. galapagensis* has entered the Central and Western Pacific from the TEP via Mexico [47]. Further, the genetic investigations by population structuring and phylogeny of the Indo-Pacific Galapagos shark population placed Hawaii and Walters Shoals (southern

Africa) within the Western Pacific population but Mexico and Galápagos within the TEP population [47]. Nevertheless, it can be assumed that there is a limited exchange of genes between the Galapagos shark population of the Western and Eastern Pacific due to the barrier effects of the Pacific Plate.

Cold currents such as the Benguela Current that flows along the Southwest coast of the African continent provide a further dispersal barrier for tropical and subtropical fishes such as *C. galapagensis*, although the interoceanic movement of one warm-water species of *Carcharhinus* and the passing of this biogeographic barrier has been recently reported [508]. A study revealed that the Benguela Barrier has limiting effects on the dispersal of small Atlantic reef fishes [493]. However, it is likely that on rare and occasional events, large warm-water species of fish such as primarily tropical carcharhinid sharks can cross this nearly impassable barrier [511]. The Southeast Atlantic and Southwest Indian Ocean populations of *C. galapagensis* are divided today by this cold current, under the assumption that the Benguela Current presents a strong barrier for a shark species linked to warm-water conditions ( $>20^{\circ}\text{C}$ ). However, despite the evidence of occasionally transfer of the Benguela Barrier by warm-water carcharhinids [511], scientists considered the Benguela Current as constraining for temperature-sensitive sharks, as has been the closure of the Isthmus of Panama [512]. Historical studies outlined that the distribution of Indo-Pacific elasmobranchs is restricted by the  $12^{\circ}\text{C}$  isotherm, which borders the Southwest coast of Africa beyond the west of the Cape of Good Hope and extends up to a  $-22^{\circ}\text{S}$  latitude, serving as a physical barrier for the free dispersal of the Indo-Pacific species into the Atlantic [513]. In this context, scientists reasoned felicitously about the waters off Southwest Africa that the blanket of cold water along the west coast is so much a barrier to most warm-water forms, that, to a large extent, it prevents the intermingling of the fishes of the tropical Atlantic with those of the Indian Ocean shores of South Africa [514]. Further, the Benguela current flowing northwards tend to limit the penetration of Cape waters by fishes from even the colder parts of the Atlantic, and in consequence, the Cape represents a well-defined line of division between the Atlantic and the Indo-Pacific fishes [514].

Moreover, scientists speculated that the Indo-Pacific species that are simultaneously distributed in the Atlantic are relics of an earlier intermingling not long ago in geological times, with different environmental conditions, and that there was almost certainly a warm-water connection between the Indian and Atlantic Oceans that once allowed an exchange of individuals of warm-water elasmobranchs [514]. It is quite imaginable that the Walters Shoals, located in the Southwest Indian Ocean, have functioned as a stepping stone and as a starting point for the migration of *C. galapagensis* into the Southeast Atlantic Ocean, although this must be tested. Presumably, *C. galapagensis* has reached the southern Atlantic Ocean via the southwestern Indian Ocean and through passing the Cape of Good Hope, with a following northern-directed spread and dispersal into the equatorial regions and farther into the North Atlantic. Historical changes in sea levels may also have influenced the dispersal of *C. galapagensis* in ancient times, and, therefore, have shaped its current distribution. Considering these biogeographical facts and deliberations, a historical process has presumably shaped the recent range of *C. galapagensis* and of other cosmopolitan carcharhinids, and the result is today's separate populations of *C. galapagensis* in the three major ocean basins of the world.

However, in sharp contrast to the results of genetically based phylogeographic surveys and diverging from the estimated evolutionary age of *C. galapagensis* based on genetic methods, are the data on its evolutionary age derived from several paleontological studies based on findings of fossil shark tooth at sampling sites across Latin America. In general, some scientists outlined that chondrichthyans are relatively poorly represented in phylogeographic studies due to a paucity of early fossils that has restricted the ability

of phylogeographers to make solid inferences regarding the evolutionary history of the various chondrichthyan groups [515]. Based on its assumed relatively young evolutionary age, *C. galapagensis* is scarce in the fossil record. The presence of *C. galapagensis* in deposits of the Tortugas Formation (late Miocene, ~5 MYA) and the San Diego Formation (Pliocene, ~2 to 3 MYA) of the Mexican Baja California Peninsula was reported [516], as well as its presence in the Mexican fossil fish record between the late Miocene and the Pliocene (~11.6 to ~5.33 MYA) [517], indicating a much older evolutionary age than genetic studies suggest. Other scientists also reported on a fossil record of *C. galapagensis* deriving from the late Miocene and Pliocene of Baja California [518]. Tooth findings of *Carcharhinus* cf. *C. galapagensis* from the Western Venezuelan Cantaure Formation (early Miocene, ~20 to ~16 MYA) were reported from the southern Caribbean Sea [519]. Other scientists have chosen a multi-data approach to determine the evolutionary age of carcharhiniform sharks, both for extinct and extant taxa, and combined data from the fossil record as well as from phylogenetic studies [507]. According to these scientists, *C. galapagensis* is known from the fossil record since the Miocene, while phylogenetic data allow the backdating of this shark to the quaternary (max. 2.5 MYA).

As a conclusion, paleontological reports of fossil *C. galapagensis* tooth suggest a much older evolutionary age of the Galapagos shark than the results of genetic studies, under the premise of correct identification and determination of these teeth. Under the assumption that these fossil tooth findings are determined correctly in age and species, this finding would be of enormous consequence regarding the phylogeography of *C. galapagensis* because it would not only mean that this shark may have settled the Atlantic Ocean at times before the closure of the Isthmus of Panama, moreover, it would also question its East Pacific origin. Nevertheless, it was pointed out that the morphological features of the tooth within the genus *Carcharhinus* bear close resemblances between species [520]. This confusion makes the taxonomic classification of the carcharhinids' fossil teeth difficult, especially when they are incomplete and eroded. However, these paleontological findings led to the shining of the evolutionary history of *C. galapagensis* in a different light and make it difficult to determine its true age.

Comparing and balancing these facts presented in the previous paragraphs, the author of this study believes that it is more likely that *C. galapagensis* has a relatively young evolutionary age, and that its region of origin is the TEP because this is consistent with the genetic results on its demographic history as well as its current global distribution pattern. The abundance of *C. galapagensis* in the TEP and its paucity in the Atlantic Ocean may foster the theory of a Pacific origin. Simultaneously, this distribution pattern and the frequency of records with a clear agglomeration of distribution points in the TEP are good arguments for excluding an origin of this species before the emergence of the Isthmus of Panama ~3.5 MYA. The existence of hybrids resulting from crossing events between *C. galapagensis* and *C. obscurus* [98] also suggests a young evolutionary age because hybridization usually occurs between young, not yet stabilized taxa (see Section 3 and the following Section 8.3).

### 8.3. Genetics and Population Connectivity

Geographic distance to and isolation from neighbouring populations promote genetic specification and diversification in species [521]. Due to their remoteness and geographic isolation, it is known that around islands, populations of globally distributed requiem sharks can show a distinct genetic cluster and present unique single stocks [522]. This also applies to *C. galapagensis* because its global range consists of many widely separated populations around islands.

Large-bodied, highly mobile, and pelagic shark species with circumglobally distributions were generally believed to be genetically panmictic over their ranges due to assumed

high dispersal capacities and therefore, a lack of oceanic biogeographic barriers [523]. However, with increasing investigation efforts and by using higher resolution markers, this view has fundamentally changed. Continental landmasses, cold currents, vast stretches of open ocean waters, and philopatric behaviours are considered barriers to gene flow for even some of the most vagile of circumglobally distributed shark species, including large members of the genus *Carcharhinus* [524]. For *C. galapagensis*, limited oceanic connectivity was described, with population structuring detected between ocean basins [47,525]. Meanwhile, although several studies on the population genetics of *C. galapagensis* were conducted in the Indo-Pacific region [33,34,47,98,105,394,525–527], similar studies have not yet been conducted in the Atlantic Ocean [48], from where information on the population structure is lacking. The same applies to the genetic relationships of *C. galapagensis* populations around oceanic islands of the Western Indian Ocean among each other (Walters Shoals, Bassas da India Atoll, Europa Island).

A study targeted the population genetics of the Indo-Pacific Galapagos shark population both on a large and small local scale, focusing on the haplotype network of 229 individuals and their mitochondrial control region sequences [34]. Consistent with the genetic investigations conducted in the Southwest Pacific Ocean region (Australia, New Zealand), population structuring and two well-differentiated stocks in *C. galapagensis* on a relatively small scale within the Galápagos Archipelago were detected, one at Isabela Island (western population), and the other at the San Cristóbal and Santa Cruz Islands (eastern population) [34,394]. For both populations, only low effective population sizes of approximately 200 individuals were estimated, highlighting their vulnerability to overfishing [34,394]. Moreover, low levels of gene flow (<10%) between these stocks were reported. Amongst these stocks within the Galápagos Marine Reserve, it was found that the Isabela Island stock showed a lower haplotype and nucleotide diversity ( $h = 0.585$ ,  $\pi = 0.018$ ) than the San Cristóbal and Santa Cruz Islands' stock ( $h = 0.739$ ,  $\pi = 0.053$ ), suggesting the population around Isabela Island is of particular concern [394]. This finding highlights the genetic diversity comprised in island populations of *C. galapagensis* in general and the diversity of the population inhabiting the Galápagos Archipelago in particular.

As a further result and on a larger geographic scale, genetic investigations [34] revealed different population clusters for the East Pacific (Revillagigedo and Galápagos Archipelagos) and the Central–West Pacific (Hawaiian Archipelago, Kermadec, Norfolk, and Lord Howe Islands, and Elizabeth and Middleton Reefs). Hence, a strong transpacific break in the population structure of *C. galapagensis* in the Pacific Ocean was detected. Moreover, within the Pacific Ocean basin, the results suggest a regional separation in and structuring of *C. galapagensis* populations, with the identification of separate East Pacific (Revillagigedo and Galápagos Archipelagos), Central Pacific (Hawaiian Archipelago), and West Pacific (Kermadec, Norfolk, and Lord Howe Islands, and Elizabeth and Middleton Reefs) populations [34]. However, population connectivity among the islands of the TEP was detected by the long-distance movement of one Galapagos shark specimen that travelled from the Revillagigedo to the Galápagos Archipelago, with a stopover at Clipperton Atoll [443,453]. The behaviour of travelling between islands of the TEP was recorded in several further species of sharks such as *Rhincodon typus*, *Sphyrna lewini*, and *Carcharhinus falciformis* [456,528,529]. This serves as proof of the importance of these islands as stepping stones for the long-distance movements of sharks.

Studies reported on a strong transpacific break in the Pacific population of *C. galapagensis* and the presence of two subpopulations located in the Eastern Central Pacific and the Western Central Pacific/Indian Oceans [47,525]. However, in these studies, samples from the Atlantic Ocean were not included, but it is very likely that the Atlantic Ocean is inhabited by a third distinct subpopulation due to its isolation from the Pacific and Indian

Oceans by currents and landmasses [35]. Moreover, for the region of the TEP, population differentiation within the TEP was detected by separating the population of *C. galapagensis* around the Galápagos Archipelago from the one around the Revillagigedo Archipelago, whereby this pattern was attributed to historical geographic isolation [47]. The strong genetic break in the Pacific Galapagos shark populations that has been reported [47,525] confirms the effectiveness of the Pacific Plate Barrier regarding its limitation to dispersal, as well as the assumption that only a few specimens of *C. galapagensis* are capable of overcoming this barrier. This result also supports the current knowledge that, in sharks, like in many further organism groups, genetic distinctiveness correlates with geographical distance. Moreover, these results cited above lead to the conclusion of limited gene flow between the Eastern and Western Pacific populations of *C. galapagensis*, but also within the Galápagos Archipelago itself [530].

Results of a study have shown that there are a few areas where *C. galapagensis* and *C. obscurus* share sympatric ranges and co-occur across the Pacific Ocean [98]. In this study, nuclear genome-wide markers were used, which allowed for identifying the hybridization between these two sibling species. Four hybrid individuals were detected intermingling between *C. galapagensis* and *C. obscurus* in the Gulf of California and the East Pacific Ocean [98]. The presence of hybrids at both Clipperton Atoll and the Galápagos Archipelago suggests the movement of female Galapagos sharks (potentially hybrid mothers) from the primary area of contact (Gulf of California or Revillagigedo Archipelago) towards the Galápagos Archipelago, using Clipperton Atoll as a stepping stone. However, the fact that *C. galapagensis* and *C. obscurus* can hybridize may be another indication of the relatively young evolutionary age of the Galapagos shark (~1 MYA) (compare Section 8.2), as hybridization occurs overwhelmingly between young, not-yet-stabilized taxa.

The first study using genetic methods to investigate the regional population structure of *C. galapagensis* can be backdated to 2008 [526]. In this study, on a relatively small scale, significant structuring between the Elizabeth and Middleton Reefs on the one hand and the adjacent Lord Howe Island on the other in the Southwest Pacific Ocean was detected. The identification of two genetic stocks highlighted the need for separate assessments, each with their own appropriate conservation and management plans. Similarly, a further study five years later also found population structuring between the same two locations [527]. By contrast, another scientist not only sampled at these two locations but also included Norfolk Island and the Kermadec Islands in the investigations of *C. galapagensis* populations in the Southwest Pacific [105]. This scientist claimed that the populations from all these locations may form a single Evolutionary Significant Unit (ESU), which means that these populations are considered distinct from those found in other areas of the vast Pacific Ocean.

#### 8.4. Conservation Issues

Despite their important role as keystone species in the stability and health of marine ecosystems, sharks have become one of the most imperilled organism groups today due to the increased fishing pressure that has affected ocean life over the last century. Overfishing was identified as the most significant threat facing sharks and rays, in combination with habitat loss, climate change, and pollution [46,531]. It has been estimated that over one-third of all extant sharks and rays are threatened globally by extinction [532]. Many shark species are wide-ranging, and successful fisheries management in one country can be undone by poorly regulated or unregulated fishing elsewhere, emphasizing the urgent need of multinational action plans for sharks [531]. The conservation of wide-ranging sharks with documented continental-scale movements and migrations can provide a challenge to protection efforts [533].

For the region of Latin America, whose Pacific Ocean waters accounts for a significant proportion of the Galapagos sharks' total range, it was outlined that many chondrichthyan species are at high risk of extinction due to numerous threats [534]. Requiem sharks were estimated to comprise one-third of the annual global chondrichthyan catch and two-thirds of the fin trade of coastal sharks [535], and because they are inadequately managed, consequently, 71% of species are threatened globally. Currently, reef sharks are threatened by extinction on a global scale. Severe population declines of reef sharks for more than half a century were recently reported [29], with large-bodied and widely distributed species such as *C. galapagensis* having the highest extinction risk due to their slow recovery rates combined with the prevalent failure of multinational management plans. A recent study on the decline of five reef shark species revealed that their numbers have decreased globally by about 60 to 73% due to overfishing [536]. Thus, there is an urgent need for successful conservation measures for the world's threatened elasmobranchs, as well as ongoing research on their threats. Unfortunately, a further study revealed that the scientific investigation of sharks in the developing world does not contribute much to their conservation due to the disregarding of scientific results by politicians and stakeholders [537]. Thus, fisheries stakeholders and policy makers in both countries of the developing and the industrialized world should consider scientific findings about shark declines for a successful conservation of sharks as well as for the implementation of sustainable shark fisheries. On the other hand, scientists must address the targets and aims of shark conservation to policy in an understandable manner [538].

It is widely recognized that industrial fisheries—and to a lesser extent artisanal fisheries—are putting global marine ecosystems under severe pressure. Focusing on the Galapagos shark, it was reported that populations of *C. galapagensis* may be subjected to high levels of fishing pressure at many of the sites from where this species has been reported, both from incidental captures/bycatch (tuna longline fisheries) and targeted fishing (shark finning industry, recreational/tourism-based angling) [40]. *Carcharhinus galapagensis* is fished as bycatch across all three major ocean basins [539–541], especially by industrial longline fishing fleets targeting tuna or swordfish. Scientists reported for *C. galapagensis* that its inquisitive nature makes it particularly susceptible to capture by longlines [22]. Although *C. galapagensis* is a species for which strong site fidelity was attested, subadult and adult specimens are particularly threatened by fisheries operating outside of conservation areas when the sharks roam from their insular habitats to continental coasts or to other islands during crossings of open ocean waters. Hence, there is considerable potential to cause severe local declines in the number of mature individuals. The example of the near-extirpated population of *C. galapagensis* at St. Peter and St. Paul Archipelago (see the following Section 8.5) has shown the vulnerability of local populations consisting only of a low number of specimens and, moreover, this case is proof that a severe decline in shark numbers can happen rapidly even at remote oceanic islands.

*Carcharhinus galapagensis* has a broad circumglobally distribution but is abundant only in a small number of offshore islands. There is considerable potential to cause severe declines of the local populations of the Galapagos shark that is susceptible against high levels of fishing pressure [40,431], although this species was assessed globally with “Least Concern” on the IUCN Red List [35] and was downgraded from its previous assessment “Near Threatened” [14]. This current assessment may be reasonable on a global scale, as many populations of this shark are currently situated inside MPAs or shark sanctuaries and, therefore, protected by administrations and governments, especially in the Southwest Pacific region. As such, *C. galapagensis* is not considered to be under threat off Lord Howe Island (Australia) and off the Kermadec Islands (New Zealand), where a marine reserve encompasses the species' range [431,542]. In this context, significantly higher abundances

of *C. galapagensis* were observed in sanctuary zones of Australia's Lord Howe Island Marine Park compared to adjacent fished waters, confirming the effectiveness of sanctuaries regarding the protection of residential sharks [442,543]. A current study has also shown that marine reserves can contribute to well-developed reef shark populations [544], and it was pointed out that the implementation of shark sanctuaries may provide a successful approach for the recovery of the declined reef shark populations of the world [545].

Although a recent evaluation of the effectiveness of shark sanctuaries indicates that their contribution to global shark mortality has been historically small [546], they may succeed in having a positive impact by preventing commercial shark fishing at these sites. This particularly applies to MPAs with no-take zones and where fishing activities are prohibited. Results have demonstrated that MPAs have conservation benefits for shark populations by providing protection, especially for the less migratory and mainly site-attached juveniles that spend most of their time in spatial-limited home ranges [547]. This may largely apply also to the offspring of *C. galapagensis* that prefers the shallow coastal waters around remote islands. Nevertheless, from a global point of view, it should be considered that local subpopulations of this species can be under serious threat, especially at locations that are lying outside of MPAs and shark sanctuaries. The population sizes and trends for many of the Galapagos sharks' distribution localities are not well investigated and are data deficient. Therefore, due to the lack of profound information, its current global population trend was assessed as unknown [35].

The management of species with isolated populations such as *C. galapagensis* is of particular concern because they may be in a higher danger of local extirpations in comparison to species that are widely distributed. Researchers outlined that the loss of individual populations of species with disjunct populations results in a loss of genetic diversity [548], which may prove detrimental for this species. Additionally, global extinction of these species may be possible by progressive piecemeal extirpation of regional or local populations. Hence, every single population of the disjunct distributed *C. galapagensis* is of special concern for conservation and shark fisheries management. From a global point of view, it must be considered that the loss of a single *C. galapagensis* population may weaken the entire global population. Moreover, due to the assumed limited gene flow in this species because of geographic isolation, the protection of every single local population is necessary to ensure and strengthen population connectivity.

For *C. galapagensis*, it was stated that it is of no economic importance because of its usually remote habitat [73], but, nevertheless, this shark can be extremely negatively impacted by fisheries. A study identified the global hotspots of shark interactions with industrial longline fisheries [549], showing that the regions with the highest shark catches are concentrated in the equatorial regions of the Atlantic, Indian, and Pacific Oceans. These regions overlap widely with the tropical insular strongholds of *C. galapagensis* around numerous oceanic islands (Figure 2), highlighting the high degree of threat that this shark is exposed to. For example, the depletion of *C. galapagensis* has been reported for the Brazilian St. Peter and St. Paul Archipelago [183,550,551] (compare with the following Section 8.5), and given the species' habitat specificity and limited biological productivity, this has likely occurred elsewhere in places where fisheries are intense and unregulated, e.g., south of Madagascar at Walters Shoals. As an example for the negative impacts of a regional shark fishery, the decline in landings of *C. galapagensis* in fisheries of the Gulf of California was reported [552], although this species has never been an important component of the historical and recent Mexican fishery.

The local threat of *C. galapagensis* can differ enormously in different regions and between sites, depending on the specific conservation and management plans existing and the intensity of fisheries. For Australia, the Galapagos shark was assessed with "Least

Concern” according to the IUCN Red List for this region [41]. This assessment is certainly justified, as the Australian populations of *C. galapagensis* are mainly located in preservation areas (Lord Howe Marine Park, Norfolk Marine Park) with only low fishing pressure due to small recreational fisheries, and no intensive exploitation. However, it should be mentioned that considerable difficulty in differentiating between species complicates the evaluation of fishing reports and catch quotas of requiem sharks [553].

*Carcharhinus galapagensis* is a slow-growing shark for which an average growth of 3.9 cm per year in the region of the TEP was reported [343]. For the viviparous Galapagos shark, a possible biennial or triennial reproductive cycle has also been reported, with litter sizes ranging from 4 to 16 in Hawaiian waters [63]. Information on size at birth in *C. galapagensis* was provided with 57–80 cm [1]. At the Hawaiian Archipelago, age at maturity is estimated at 6–8 years for males and at 6.5–9 years for females [84], and a maximum age for *C. galapagensis* of 24 years was estimated [83]. This species has a limited intrinsic rebound potential of  $r = 0.048$  [554]. Its slow reproductive rate limits the species’ capacity to withstand population depletion. For the Galapagos shark populations resident at the Elizabeth and Middleton Reefs, a minimum population doubling time of more than 14 years was estimated [555]. The scattered distribution pattern of *C. galapagensis* makes it very likely that a transfer of individuals between localities occurs, but there is no data on the recruitment of specimens to isolated sites after exploitation [40], which makes it difficult to evaluate recovery potential in this species. Based on a limited intrinsic rebound potential and no data on recruitment to isolated sites, local depletions of *C. galapagensis* could lead to the loss of populations at specific localities [40]. Continued fishing pressures throughout its range will result in further declines and therefore, the specific populations require monitoring.

The slow growth, its fragmented geographical distribution, and unknown levels of local connectivity of populations are likely to have contributed to declines of *C. galapagensis* in areas of high fishing pressure throughout all ocean basins [35]. However, the site fidelity, as observed in the Galapagos shark, can prove to be its Achilles heel. In this context, scientists reasoned for the St. Peter and St. Paul Archipelago that the residential population of *C. galapagensis* was much more vulnerable to overfishing than the more mobile population of *C. falciformis*, which can better escape stationary fishing activities by leaving the area [473,556]. The reported attachment of *C. galapagensis* to specific sites may enable shark conservationists to hypothesize that because of its overwhelmingly high site fidelity, it would be better protected by spatial conservation approaches such as MPAs in comparison to other pelagic sharks (e.g., *C. falciformis*, *C. longimanus*) that mostly roam in unprotected waters. However, this protection only applies to populations located inside MPAs and provided that no illegal fishing activities take place in the MPAs, e.g., as it has been reported for the Galápagos Marine Reserve [557,558]. Without control of these MPAs by authorities, they remain “paper parks”.

Historically, the Galapagos shark was once widely distributed in the Hawaiian Archipelago and abundant around most of its islands at the beginning of the 1970s [441], but its numbers declined due to a culling programme implemented for the protection of ocean users [63]. More than 30 years later, *C. galapagensis* was only recorded in the remote and pristine northwestern Hawaiian Islands and not in the highly urbanized main islands of Hawaii as a direct result of anthropogenic impacts [559]. Subsequently, the same was reported for Hawaii by further scientists [560] and for the remote Pitcairn Islands [561]. It is apparent that the structure of the food web within these islands was influenced by the degree of their isolation from settlements, with human-impacted islands showing a smaller proportion of top predators such as sharks.

However, its habitat limitation and strong affinity for oceanic islands may in some ways also be a fortune for *C. galapagensis*, at least historically. It has been reported for the remote reefs and seamounts of the Indo-Pacific that they provide the last refuge for marine predators such as sharks, including *C. galapagensis* [562]. Unfortunately, even remoteness does not always protect sharks from the intensive fishing operations that affect marine ecosystems in all the global oceans today. Although the numerous occurrences of *C. galapagensis* at very remote islands, atolls, and seamounts have long been a fortunate circumstance for this species because they were outside the range of fisheries, regrettably, increasing fishing pressure is now reaching these locations as well. In this context, the decline of reef sharks even at remote atoll situations far away from human settlements has been reported because of the ongoing fishing pressure [563], which highlights the urgent need for stronger conservation efforts and fishing regulations. As a logical consequence, a strict fishing ban for shark and tuna fisheries that also include these offshore habitats should be passed. Unfortunately, as it has been reported for *Isurus oxyrinchus*, current legal protections by laws alone are not working and contribute only a small amount to the conservation of pelagic sharks because there is a lack of control by officials [564].

#### 8.4.1. Conservation Situation in Oceania

Currently, the global population trend of *C. galapagensis* is unclear. However, the extent of its threat can vary greatly from region to region. *Carcharhinus galapagensis* was listed as “Data Deficient” on the IUCN Australia and Oceania Red List due to a scarce information situation from this region and lacking continuous monitoring in most parts of its range [15,431].

Due to its only occurrence in New Zealand waters around the subtropical Kermadec Islands some 983 km northeast of the North Island of New Zealand, *C. galapagensis* was formerly assessed as “Range Restricted” on the New Zealand Threat Classification System list [565]. Later, this shark was reassessed as “Not Threatened” [542,566], whereby this reassessment recognizes that all the known New Zealand distributions of this species are protected within the Kermadec Islands Marine Reserve (Kermadec Ocean Sanctuary). Therefore, the risk of this species against the impact of commercial fishing was assessed as low in New Zealand waters [567]. According to a local study targeting the Kermadec Islands, their marine reserve status has protected the Galapagos shark here and maintained it at apparently natural levels of abundance [568]. In a following national assessment of New Zealand’s chondrichthyans [569], in terms of the IUCN Red List of Threatened Species categories, *C. galapagensis* was assessed with “Least Concern”, meaning that it is unlikely to become endangered or extinct here soon. This national assessment is certainly justified since the species is well protected in New Zealand thanks to existing MPAs.

In an assessment of the Indo–West Pacific subpopulation of *C. galapagensis* for Australia, it has been reported that this shark is only occasionally taken in Australian fisheries [570]. Therefore, in Australia, it is subject to low fishing pressure due to relatively low fishing effort in combination with the protection by marine reserves (e.g., Lord Howe Island Marine Park). Hence, the Indo–West Pacific subpopulation was assessed with “Least Concern” [570], just like the assessment of the global population [35]. Recently, the same assessment was made for the Oceania subpopulation of Australia and New Zealand with the same conclusions [571].

#### 8.4.2. Conservation Situation in the TEP

In the TEP, *C. galapagensis* is considered a priority species for conservation at its type locality, the Galápagos Archipelago [394]. This is of particular concern, as investigations have shown that (a) the population of *C. galapagensis* at the Galápagos Archipelago is

forming a unique stock [394]; (b) numerous shark species, including *C. galapagensis*, are still caught as bycatch around the Galápagos Archipelago despite its high protection status as a UNESCO World Heritage site [557,558,572]; and (c) illegal fishing activities and shark finning occur even inside the protected areas of the Galápagos Marine Reserve, threatening its unique marine biodiversity [573]. Despite the banning of shark finning and fin trading by Ecuadorian law, juvenile *C. galapagensis* are regularly caught as bycatch in this archipelago among other shark species, which impacts shark populations at this site [574].

Recent findings revealed a putative open ocean corridor in the TEP between the Revillagigedo Archipelago (Mexico), Clipperton Atoll (France), and the Galápagos Archipelago (Ecuador) that is utilized by several carcharhinid sharks, including *C. galapagensis*, as a migration route [454]. This stresses the urgent need for multinational action plans for sharks that target the protection of marine areas not only in the adjacent surroundings of oceanic islands, commonly used as stepping stones by highly migratory species, but also guarantee the protection of open ocean waters between oceanic islands to ensure the survival of travelling shark specimens. Scientists highlighted that the movement ecology of several migratory shark species justifies the existence as well as the expansion of MPAs in combination with the regulation of fishing activities in the TEP [575]. This regulation is necessary because a recent study revealed that even in fully protected areas, fisheries management was ineffective, which means that in MPAs, sharks are still at risk from fisheries and their administrative regulation, and authoritative enforcement must go hand in hand [576].

Fortunately, several of the East Pacific localities, where *C. galapagensis* occurs and has been reported to reproduce, are currently declared as Important Shark and Ray Areas (ISRAs) targeting the protection of elasmobranchs in a defined area, such as the Malpelo Ridge, Salas y Gómez/Motu Motiro Hiva, Revillagigedo Archipelago, Clipperton, and the Cocos Island and seamount ISRAs [406]. The designation of protected areas for sharks such as these ISRAs provides an effective tool for conservation, especially of residential sharks [577], and *C. galapagensis* could benefit from these conservation areas.

#### 8.4.3. Conservation Situation in the United States

For the United States, since 1997, retention and possession of 19 depleted and/or poorly understood shark species has been prohibited for both commercial and recreational fisheries [40], including *C. galapagensis* (which fulfils the criterium of “poorly understood” due to the limited knowledge about distribution and habitat use). The retention of Galapagos sharks from U.S. Atlantic fisheries was prohibited since 1999 [35]. Data on population sizes of *C. galapagensis* are scarce, e.g., in the Western Central Atlantic Ocean [578], but essential for reliable stock assessments. Because *C. galapagensis* is rare in U.S. Atlantic waters, this shark was listed as a “prohibited species” in the U.S. Shark Management Plan [579]. This measure should deter fisheries from targeting *C. galapagensis*, even though it is not known to be a target species of fisheries in the Western Atlantic Ocean.

In the past, *C. galapagensis* was also included in governmental shark control programmes and activities that target large and potentially dangerous shark species to prevent and minimize the risk of shark attacks on humans, such as in Hawaii from 1959 to 1976 [580,581]. Those activities may have at least historically contributed to minimizing the size of local populations of *C. galapagensis*.

#### 8.4.4. A Conservation Dilemma—Mammals Versus Sharks

*Carcharhinus galapagensis* can grow to a considerable size of at least 300 cm, and large adult specimens also include sea mammals in their diet (see Section 7). During the late 1990s, at French Frigate Shoals in the northwestern Hawaiian Archipelago, pups of the threatened

pinniped *Monachus schauinslandi* were observed to become prey of large Galapagos sharks patrolling along the shores of Trig Island [461–464,582–587]. This pinniped, one of the world's rarest marine mammals and listed under the U.S. Endangered Species Act [588], is a keystone species for conservation because it is assessed as threatened due to its low effective population size [589,590].

The issue of shark predation on *M. schauinslandi* was assessed as problematic and of concern in terms of conservation, resulting in several authority workshops on this topic to find compatible solutions [464,582]. Therefore, a management plan was implemented to protect newborn seals that included the removal of large specimens of *C. galapagensis* occurring around pupping grounds (shark culling). The predation by *C. galapagensis* was considered serious enough to implement lethal measures such as using baited hook and line or handheld harpoons for selectively killing sharks [589]. For the conservation management of *M. schauinslandi*, “problem individuals” of Galapagos sharks who were observed to prey on seals get lethally removed from areas where pups are located to increase their survival. This measure was based on the hypothesis that only a small number of Galapagos sharks exhibited this predatory behaviour, and their removal would have minimal impact on the local shark population [447]. In this context, the killing of sharks to preserve a target species of conservation can be evaluated critically, but it can be assumed that this measure has only a low impact on the Hawaiian population of *C. galapagensis*, as this species shows healthy populations at least around some northwestern islands of the Hawaiian Archipelago.

Following these shark control measures, the removal of sharks from the natural food web produced conflict between those concerned about pup survival of *M. schauinslandi* and those concerned about the local shark population [591]. It is not clear at all how this seal management affects the Galapagos shark population, but the high numbers of *C. galapagensis* in the northwestern Hawaiian Islands suggest that these conservation efforts did not have substantial impacts on the local population of *C. galapagensis*. However, due to the essential role of large sharks of *Carcharhinus* as marine top predators, it can be critically discussed if it is necessary to make interventions in the natural marine food web. Ethical issues of the government-supported culling of *C. galapagensis* at French Frigate Shoals were discussed [591], which presents a conflict of targets in nature conservation. It can be critically discussed if natural processes in wild areas should be prevented [588], and the benefits and disadvantages of such measures for conservation should be weighed well against each other. Paradoxically, in the 19th century, *M. schauinslandi* was so common that it was hunted for its flesh, which was used as bait for shark fisheries [323]. However, the *C. galapagensis* population in the remote northwestern Hawaiian Archipelago is presumably not under serious threat, so it can be assumed that these measures of obtaining a relatively small number of large shark specimens for seal protection had no significant impacts on the size of the local Galapagos shark population, which was estimated to number more than 600 individuals [447].

#### 8.4.5. Threat by Plastic Pollution

Besides fisheries and the depletion by shark control programmes, the plastic pollution of marine environments that has reached even the remotest places on this planet has become a further serious threat to marine life, including sharks. The entanglement of a juvenile *C. galapagensis* in a plastic strip was reported for the waters around Easter Island [592]. In detail, one specimen (~160 cm) of *C. galapagensis* was recorded swimming in June of 2017 with plastic collar-like debris obstructing its gill region, which led to initial tissue damage and presumably affects the further growth of this specimen during ontogenesis [592]. A further report of an entanglement of a single *C. galapagensis* specimen with a strip of plastic tissue around its body was derived from the remote St. Peter and St. Paul Archipelago [593].

The same concerning entanglements have been observed in other shark species such as *C. leucas* [594].

#### 8.4.6. Conservation Efforts by International Governmental Regulations

Additionally, besides the protection of areas and habitats for sharks, at the “Panama Conference” in 2022, the involved parties decided to include the entire family of Carcharhinidae under the regulations of Appendix II of the Convention on International Trade in Endangered Species (CITES), which was a milestone in the worldwide protection of requiem sharks [595]. These regulations in trade also affect *C. galapagensis* as they provide the prohibition of targeting this shark in fisheries, and, hopefully, it will preserve this species and congeneric members for the future, although there is reason to doubt whether these regulations will be applied consistently, particularly in regions that evade control.

#### 8.4.7. Conclusions for Conservation

Finally, one of the main goals and most effective measures for the conservation of *C. galapagensis* is—like for most elasmobranchs—to protect this shark from the intensive fishing pressure that derives from the industrial tuna, swordfish, and shark fisheries. Equally primarily targeted in shark fisheries or secondary non-targeted as bycatch, the main threat for this species comes from fishing activities. This applies to nearly all carcharhinid sharks. Although now protected by the CITES regulations, it is foreseeable and clear that this alone, and without control of operating fishing fleets as well as the international fin trade, will not guarantee effective protection of requiem sharks. Therefore, only MPAs that are regularly controlled by officials and guards will protect sharks inhabiting these areas effectively and contribute to their conservation [596], besides the regulation of fishing quotas for sharks and efforts that target the reduction of bycatch (e.g., shark deterrents). However, it should be noted that *C. galapagensis* occurs in very isolated locations, which are difficult to police because of their remoteness, making their administrative control challenging.

Further, the proclamation of new and additional MPAs, shark sanctuaries, and other spatial conservation areas may also contribute to the conservation of *C. galapagensis*, particularly for islands, atolls, and seamounts with records of this shark that are currently unprotected. One approach may be the ISRA project, which has already included some of the remote areas inhabited by this species in both the Indian and Pacific Oceans, e.g., Lord Howe Island, Elizabeth and Middleton Reefs, Bassas da India Atoll, Marotiri, Rapa Iti, and Salas y Gómez Island [246,336,406,597]. The same would be desirable also for the Atlantic Ocean, e.g., the islands of Macaronesia.

#### 8.4.8. Potential of Shark Ecotourism for Conservation

Shark ecotourism can provide a profitable alternative to shark fishing for local economies [598]. Nowadays, *C. galapagensis* is subject to numerous shark cage diving and ecotourism activities worldwide, such as the Hawaiian and Galápagos Archipelagos [599–603]. For example, it has been reported that *C. galapagensis* is subject to shark diving tourism activities around the Cape Verde Islands [603], highlighting that shark diving bears the potential for and contributes to shark conservation. The benefit for the local economies by shark diving tourism not only gains financial profit for the local people but also simultaneously bears the chance of sustainable protection of *C. galapagensis* and further shark species while promoting environmental education.

### 8.5. The near Extirpation of a Local Population of *Carcharhinus galapagensis* in the Equatorial Atlantic Ocean: The Case of St. Peter and St. Paul Archipelago

The near extirpation of *C. galapagensis* at Brazil's remote St. Peter and St. Paul Archipelago (hereafter abbreviated with: SPSPA) has attained much attention in the scientific world, resulted in numerous reports about this conservation issue, and is relatively well-documented [550,551]. This incident that occurred at SPSPA can be assessed as a good example of the vulnerability of local shark populations with limited population sizes against fishery depletion, and as an example of the negative impact of fishing activities that have reached even the most remote oceanic island ecosystems of the world. Because this case demonstrated and revealed the vulnerability of local populations of *C. galapagensis*, an insular species of worldwide distribution, a detailed chronology of the historic-demographic development of this shark population is provided here.

In the past, *C. galapagensis* was believed to be one of the most abundant sharks in SPSPA [36], a group of Brazilian oceanic islands located between the South American and African continents (~940 km distance to mainland Brazil and ~1800 km to Africa) in the equatorial West Atlantic Ocean. The pioneering naturalist Charles Darwin visited the archipelago on the H.M.S. Beagle in 1832 and remarked on the sharks, as well as the officers and crew of the H.M.S. Challenger following in 1873 [604,605]. These early visitors to the archipelago mentioned the enormous number of sharks around SPSPA but could not determine the sharks present here on species level. The first scientific mention of *C. galapagensis* for this location was not made until nearly 150 years later [184]. Moreover, two treatises were delivering an extensive account of the historical shark observations from SPSPA [550,606], with all the historic references agreeing that the number of sharks was unusually high due to the high productivity of the surrounding marine environments without exception. These high shark abundances were once reported from visitors of SPSPA continuously from the 1830s to the 1980s [199,550]. Scientists recognized at the beginning of the 1980s that the shark population of SPSPA consisted predominantly of two species, *C. galapagensis* and *C. falciformis* [199], and a short time later, other scientists noticed the same: the shark population at SPSPA was comprised almost entirely of *C. galapagensis* and *C. falciformis* [606].

It has been reported that the substantial decrease in the shark population at SPSPA began as early as the mid-1950s with the visit of the research vessel U.S.S. Atka in 1955 and ongoing fishing for sharks at first for scientific purpose until the mid-1980s [606,607]. Regardless, even after these intensive but sporadic fishing events, the shark population around SPSPA was apparently still high as reports from the 1970s to 1980s indicated [184,199,606,607]. For example, for the 1970s, researchers reported on the difficulties of obtaining fish specimens during an expedition to this archipelago in 1971 as these were frequently taken by marauding sharks before they could be brought on board [608]. With the first species identification of *C. galapagensis* for the remote SPSPA, scientists stated, consistent with the report for the beginning of the 1970s, that at the beginning of the 1980s, large pelagic and semipelagic predators, especially *C. galapagensis*, were unusually common [184]. These scientists also reported that divers were immediately surrounded on occasions by more than 15–20 individuals of these sharks [184]. Nevertheless, hints of a decline in shark numbers derive already from previous reports.

Already, in the middle of the 1960s, scientists suggested that the shark population may have declined in SPSPA due to occasional visits by Brazilian fishing boats [609,610]. Later, following on these reports, further scientists agreed with these observations despite their own reports of high numbers of sharks still present around SPSPA during the 1980s [199,607]. It has been reported that following on the research conducted from the beginning to the middle of the 1980s at this archipelago that, since 1988, a commercial fishing fleet from Brazil operated

continuously in SPSPA [611–613]. Although SPSPA belongs to one of the smallest and most isolated oceanic reef ecosystems of the world, it had suffered from intensive overfishing with dramatic effects on the local shark populations.

A Brazilian scientists noted that *C. galapagensis* was already rare in the years 1989 and 1990 at SPSPA after strong fishing pressure around these islands had heavily altered the composition of fish [614]. The strong influence of the Brazilian fishing fleet quickly made itself visible in the number of sharks around SPSPA. In 1993, the last remaining two specimens of *C. galapagensis* were spotted and documented by underwater video recordings, representing the preliminary last confirmed sightings of this shark at SPSPA in the last decade of the 20th century [550,615]. Further scientists reported that they did not observe *C. galapagensis* during four expeditions to this archipelago between May 1999 and August 2001 [616] and concluded that this absence of *C. galapagensis* was the result of the strong fishing pressure that had lasted for the past two decades at this locality. The scientists estimated that the Galapagos shark has been locally extinct since 1998 at SPSPA and reported that scuba diving expeditions conducted at SPSPA during the first decade of the Millenium (2000–2010) failed to find evidence of carcharhinid sharks, despite much underwater fieldwork [550]. This has led these scientists to the conclusion that *C. galapagensis* was locally extirpated in SPSPA. They resumed that the extirpation of *C. galapagensis* and the accompanying sharp decrease in numbers of *C. falciformis* was the result of the strong fishing pressure of commercial fisheries around this archipelago, which agrees with statements of other researchers before. As a result of the fishing-down of requiem sharks at SPSPA, including the collapse of Galapagos shark numbers around the turn of the Millennium, this species was not considered to be of economic value to fisheries operating in the Brazilian oceanic islands anymore. Therefore, it was not mentioned in a survey on the commercial pelagic fishes of SPSPA [612]. Apparently, *C. galapagensis* was virtually absent from SPSPA, and it was not recorded anymore in a fisheries survey conducted between 1998 and 2010 in waters surrounding this archipelago [617,618].

Due to the alarming decrease in sharks and unsuccessful verification attempts over many years, *C. galapagensis* was considered locally extinct in SPSPA since around the end of the first decade of this Millenium by numerous experts [17,68,550,551,613,619–627]. *Carcharhinus galapagensis* was not recorded for nearly 15 years around SPSPA, which has resulted in uncertainties regarding the status of this species at this locality. These uncertainties resulted in deliberations if it was either still present here or extinct [17,628,629]. However, the belief that *C. galapagensis* was extinct in SPSPA dominated in the scientific discussion, and it persisted for nearly one-and-a-half decades.

Resulting from intensive, unregulated, and unsustainable fishing, the local population of *C. galapagensis* was suggested to be extinct at this location and, moreover, because of its uniqueness for this country, in the entirety of Brazil [550,630]. Apparently, *C. galapagensis* vanished at SPSPA and had been missing there continuously for almost 15 years. This long-lasting absence made some scientists question the occurrence of *C. galapagensis* in this Brazilian oceanic archipelago [628], and, despite previous records of this shark from this location, these scientists had doubts about the validity of the species record due to the lack of contemporary records from there. However, at the beginning of the 2010s, researchers reported on occasional individuals of the once common *C. falciformis* in the vicinity of SPSPA again because of constant immigration of this pelagic species from outside the area, suggesting a recovery of shark populations at this archipelago when the fishing pressure was removed [550]. These researchers were not wrong with their presumption, as the following paragraphs will show.

A few years after the diagnosis of its putative extinction at SPSPA, *C. galapagensis* was detected at this locality again by numerous independent studies on sharks that were

conducted at this site [36,190,197,473,485,551,556,631–634]. Due to repeated reports by independent researchers, the renewed evidence of *C. galapagensis* for this location can be regarded as certain. Following the alarming decrease in sharks, with the ban on longline fishing in the proximity of SPSPA imposed by SECIRM (=Secretaria da Comissão Interministerial para os Recursos do Mar) in 2012, fortunately, an increase in the presence of pelagic sharks around this archipelago has been observed, both for *C. galapagensis* and *C. falciformis* [556,632,635]. Apparently, the recruitment of SPSPA by *C. galapagensis* took place shortly after the implementation of the fishing ban around this archipelago [36].

The investigation of the literature cited above pinpoints the earliest rediscovery of *C. galapagensis* at the SPSPA in the year 2010. Since 2010, there were several subsequent records of *C. galapagensis* from SPSPA, suggesting that this species has been returning to the area. *Carcharhinus galapagensis* was rediscovered at SPSPA in 2010 due to a tagging study conducted on sharks which results were reported simultaneously by different authors [485,556,631]. In this tagging study, three *C. galapagensis* were tagged in 2012, with a further 20 specimens captured two years earlier in 2010, indicating that the numbers of this species around this archipelago were still low and population recovery was at its beginning. As an example, for the prevalent low numbers of sharks at this time, *C. galapagensis* was not recorded during five other field expeditions to SPSPA conducted between 2005 and 2015, which focused on all observed marine fish in its surroundings [636]. This indicates that *C. galapagensis* was rare and a cryptic species in the SPSPA during this period. However, scientists concluded that *C. galapagensis* probably never was completely extinct or absent from SPSPA, and that the lack of reports during the one-and-a-half decades, in which this shark was not reported from here, was based mainly on the persistent difficulties in its identification and distinguishing from other members of this genus [556].

Capture numbers of *C. galapagensis* around SPSPA reported in one study [473] made evidence not only of its presence at this archipelago and its renewed confirmation, but the data also showed its increase in numbers since shark fishery was banned around this area. During this study, *C. galapagensis* was not only observed at this location again but, moreover, this scientist also reported specimens of all age classes occurring here, with immatures dominating the catches. This observation indicated a probable reproduction of *C. galapagensis* at SPSPA again [473]. A following survey based on information provided by fishers, catch data, and additional video images made it also possible to confirm the presence of *C. galapagensis* at SPSPA, and data also indicated that its population has been recovering astonishingly quickly [551]. It has been reported that between 2010 and 2019, 37 Galapagos sharks were caught and released after being tagged and measured [36]. Based on a study conducted in September of 2018 using BRUVS, researchers revealed the presence of one *C. galapagensis* specimen at SPSPA [632], as a further researcher has done a short time later by also using BRUVS [637].

Meanwhile, the recovery of the local population of *C. galapagensis* at SPSPA was reported, and the immediate success following the implementation of a strong fishing ban on sharks [190]. Scientists consistently speculated that *C. galapagensis* never really vanished from this archipelago despite that it had not been recorded here for a long time (~15 years) [190,556]. However, almost ten years after the implementation of the fishing ban for sharks around SPSPA, the number of sharks increased [197], and it even has been reported that their number has not only increased but, instead, that *C. galapagensis* was the second-most abundant shark caught in this archipelago again, recorded in catches from 2010 to 2019, showing that this species is not only present but is also becoming common again [551]. Catch data of *C. galapagensis* showed that its relative abundance was increasing over time [548]. This supports predictions that the local population may totally recover again. However, other scientists reported that they have recorded only one Galapagos

shark specimen at SPSPA in September of 2018 by using BRUVS [633], and despite signs of its recovery, this observation suggest that it was still extremely rare at the beginning of a putative recovery. Eleven specimens of *C. galapagensis* collected at this site between 2012 and 2013 were positively identified and differentiated from the sympatric *C. obscurus* by using SNP's [88].

These findings mentioned above all confirmed the current presence of *C. galapagensis* at SPSPA (Figure 9) and, moreover, indicate that the prohibition of fishing on sharks in the area in 2012 had a positive effect on its local population recovery. However, it remains unclear if after a period of stock regeneration and restriction of fisheries, the *C. galapagensis* population at SPSPA will recover again completely. As a shark with a low reproduction rate characterized by relatively late maturity and small litter sizes of 4–16 pups [1,63], the population recovery will take many years. Another theory of the rediscovery of *C. galapagensis* at SPSPA, beside the population recovering from remaining specimens, may be the resettlement and the recruitment of SPSPA from Galapagos shark populations derived from distant island groups (e.g., Ascension Island, St. Helena Island, and Cape Verde Islands) because of large-scale movements by specimens. However, it is very likely that the ban on longline fishing in the proximity of SPSPA imposed in 2012 has led to an increase in the presence of sharks around this archipelago, as it has been noticed from the beginning of the 2010 decade [556,632,634]. Finally, *C. galapagensis* is still present in SPSPA [551], either because it was never completely extinct here, or has resettled and repopulated this archipelago by roaming specimens derived from other remote islands of the Atlantic Ocean. One conclusion deriving from this example of fishing down a local population of *C. galapagensis* may be that it was well-recognized by several scientists. Possibly, their publications have informed and raised alarms in fishing authorities who fortunately implemented thereafter restrictions that have the potential for a recovery of Brazil's only Galapagos shark population. Time will show if this unique population of *C. galapagensis* in the equatorial Atlantic of Brazil will totally recover again, although data on historical population size are lacking. The responsibility of the Brazilian state for the conservation of this one and only national Galapagos shark population must be regarded as high.



**Figure 9.** Two females of *Carcharhinus galapagensis* patrolling the waters near the surface at St. Peter and St. Paul Archipelago, an equatorial Brazil oceanic island group that harbours the only Brazilian population of this shark in the tropical Western Atlantic Ocean. This local population was once considered to be extirpated but has recovered again recently. © Camila Brasilino Botêlho de Araújo.

## 9. Conclusions

1. Despite the current abundance of *Carcharhinus galapagensis* around some oceanic islands throughout the world (e.g., Galápagos Archipelago, Ascension Island), the Galapagos shark can be considered a rare species from a global perspective due to its spatial restriction to a few isolated and remote island habitats in the tropical, subtropical, and warm-temperate regions of the world. This review identified an overall of 53 verified occurrences of Galapagos sharks at oceanic islands, atolls, and seamounts worldwide, which is very few when considering the total number of tropical to warm-temperate islands and atolls in the world. Nevertheless, even rare species can have important functions for ecosystems and contribute to the biological diversity on Earth. Moreover, due to their rarity, these species are often targets of conservation policy, and, focusing on the Galapagos shark, the preservation of every single subpopulation contributes to the protection of its entire global population. It should be noted that the extinction of local and regional populations of sharks can cause a permanent loss of biodiversity by weakening the global population. Therefore, each subpopulation of the Galapagos shark deserves increased attention and separate efforts to ensure its protection.

2. The present study shows that neonates and small juveniles of *C. galapagensis* have been reported almost exclusively from oceanic island habitats worldwide, with only one documented extraordinary record of a juvenile specimen from the continental waters of the Gulf of California (compare Section 4.3.4). This supports the presumption that remote oceanic islands, atolls, and seamounts function as critical habitat and nursery areas for this species, with juveniles confined to remote island habitats. Although large individuals of *C. galapagensis* have been reported on the high seas and close to continental shelves as well as to continental coasts, neonates and small juveniles are essentially limited in distribution to their insular strongholds. Hence, remote oceanic islands are not only the distributional strongholds of this shark but, moreover, important for parturition of this species. Apparently, subadults and adults of this shark occasionally leave their insular habitat and stray to continental shores, presumably when they are large enough to escape predatory fish such as other large-bodied sharks. The reports on sizes from Galapagos sharks occurring at continental coasts worldwide support this presumption (compare Supplementary Materials S1–S3), although one specimen of 105.5 cm size reported from the Gulf of California at the Mexican coast may be exceptional. Most of the Galapagos sharks reported from continental coasts were at least 150 cm in size.

Thus, oceanic islands, atolls, and seamounts serve as nurseries for juveniles of *C. galapagensis*. Therefore, these remote locations support Galapagos sharks at a vulnerable and critical stage of their life cycle by providing shelter deriving from remoteness and the lack of predators occurring at continental coasts, and this may be a spatial benefit for the offspring of *C. galapagensis*. The low inter-species competition and the wide absence of large predatory sharks around remote oceanic islands may be an advantage in the use of these islands as nursery areas for *C. galapagensis*. This finding gets supported by investigation results of museum collections which almost exclusively contain small juvenile voucher specimens of *C. galapagensis* that have been collected from numerous oceanic islands worldwide. Although it cannot be ruled out that the domination of juveniles present in the collections is due to the simple fact that small specimens are easier to preserve than large ones, it seems to be no coincidence that juveniles dominated the collections because they are more common around islands than in offshore habitats, and virtually non-existent from continental coast. This observation is consistent with the data deriving from the literature, as for most of the oceanic islands where *C. galapagensis* occurs, small juveniles (70–90 cm) have been reported, mostly in large numbers.

In conclusion, oceanic islands presumably provide low-mortality habitats for young *C. galapagensis*. Shark species known to be large elasmobranch consumers, especially *Carcharhinus leucas*, *Galeocerdo cuvier*, and *Sphyrna mokarran*, are either completely absent or mostly rare visitors around remote oceanic islands and exhibit a distribution primarily at continental coasts. Although both congeneric members are considered as tropical warm-water species, *C. galapagensis* and *C. leucas* share only seldom sympatric ranges, which are restricted to only a few localities closer to the continental coast (e.g., Malpelo and Gorgona Islands). It is very likely that a species-excluding mechanism based on competition and niche separation has evolved throughout the carcharhinids that has led to spatial segregation at least during the early stages of their lifetimes. However, it is unclear if all of those identified 53 remote oceanic island locations fulfil the Heupel criteria of shark nurseries for *C. galapagensis* [638].

3. Apparently, in *C. galapagensis*, the dispersal of genes is mediated by both sexes. Long-distance movements have been observed both in males and females (compare Table 3). This finding is contrary to the results of other studies and different from other members of *Carcharhinus* such as *C. leucas*, in which gene dispersal is maintained primarily by roaming males. Because neonates and small juveniles of *C. galapagensis* are largely restricted in their distribution to the shallow-water habitats around oceanic islands, the population connectivity in *C. galapagensis* is maintained primarily by roaming subadult and adult specimens contributing to gene dispersal. The observed behaviour of long-distance movements by single *C. galapagensis* specimens may represent a successful distributional strategy for occupying not only new suitable nursery grounds around oceanic islands but also habitats that were previously uncolonized by this species. However, it can be assumed that the exchange of genes between ocean basins is minimal due to biogeographic barriers and the vast stretches of open ocean waters, which present enormous and often nearly insurmountable distances even for strong-swimming shark species. Nevertheless, a small exchange of genes may be sufficient for maintaining population stability and prevents ongoing inbreeding.

4. *Carcharhinus galapagensis* is a large insular requiem shark of worldwide distribution. The disjunct distribution of *C. galapagensis* around widely separated oceanic islands can be understood as the expression of its attachment to remote islands that provide suitable nursery habitats for this species. The TEP can be assessed as the core area of the worldwide distribution of *C. galapagensis* as it can be found here occasionally along the continental coasts from Baja California Sur to Peru, including numerous offshore islands where it is more abundant. In this region, it appears frequently but only in low numbers in continental waters outside its insular strongholds. Although much of its range has been discovered yet, there are several ambiguities and conundrums remaining, such as the vast distribution gap in the Indian Ocean between the Western Pacific and the Western Indian Oceans, and the apparent absence of this species from islands of the eastern part of the Indian Ocean basin. Presumably, the noticeable distribution pattern of *C. galapagensis*, which comprises numerous scattered and isolated subpopulations at oceanic islands worldwide, is a complex trade-off resulting from multiple factors that have shaped its current range, e.g., abiotic conditions, evolutionary history, interspecific competition, niche separation, and phylogeography. Therefore, *C. galapagensis* can be assessed as an insular elasmobranch that occurs around several oceanic islands in the tropical to warm-temperate regions of the world but shows only low dispersal across known biogeographic barriers, e.g., vast stretches of open ocean waters and cold currents.

5. From a global perspective, the occurrence of *C. galapagensis* was documented most extensively in the Galápagos and Hawaiian Archipelagos. As the numerous references summarized for both archipelagos suggest, distribution, population structure, and biology

of this shark are investigated best at these two locations in the Pacific Ocean. This high number of references for both the Galápagos and Hawaiian Archipelago reflects the intensity of fish surveys and the numerous studies on the ichthyofauna in general and on sharks in special that were conducted in these archipelagos, primarily over the last five decades. In particular, the Galápagos Archipelago shows a long-lasting history regarding the study of its fauna, including its ichthyofauna, and was particularly the focus of biogeographers.

6. A comprehensive survey based on the review of records is essential for the creation of a reliable distribution map that can be considered the base for understanding spatial relationships between subpopulations, including population connectivity and gene flow. Moreover, a reliable distribution map is helpful for future global conservation assessments. After the intensive study of the global distribution of *C. galapagensis* by the author, it is very likely that this shark is more widespread than currently known, and that it has not been discovered yet at all localities where it occurs. Therefore, new records from additional localities should be expected in the future. Thus, mapping of these records is an ongoing process, and this study provides only the present state of knowledge.

7. The permanent taxonomic issue of separating *C. galapagensis* and *C. obscurus* makes it difficult to define their precise distribution. Thus, the global distribution of *C. galapagensis* is difficult to determine, partly due to the confusion with other similar congeneric members, particularly *C. amblyrhynchos* and *C. perezi*. This difficulty in identifying *C. galapagensis* suggests that it may be underrepresented in studies on elasmobranchs of certain regions resulting from confusions with resembling carcharhinids.

8. The results of this study stress the need for critical proof of whaler shark voucher specimens collected at remote islands around the world. In many cases, the critical review of material collected at tropical, subtropical, and warm-temperate islands determined and labelled with *C. obscurus* or *C. amblyrhynchos* (or one of their synonyms) unveiled that these specimens were truly *C. galapagensis*. Therefore, information derived from this material, especially that provided by the numerous online information systems and databases, must be treated with caution and checked regarding reliability. On the other hand, because *C. galapagensis* is hard to determine, it can be extremely helpful and necessary to collect material and deposit this in ichthyological collections in cases of new records of this species. This is regarded as important both for the validation and the subsequent verification of records of this species.

9. Future scientific investigations that are likely to include *C. galapagensis* should consider that there is a serious problem with reliably identifying this species with certain approaches. Due to their genetic similarity and homogeneity in DNA, *C. galapagensis* and *C. obscurus* (and further close relatives, e.g., *C. longimanus*) are indistinguishable in investigations based on mtDNA and eDNA. Recent studies conducted based on the use of eDNA failed to find evidence with certainty for each *C. galapagensis* and *C. obscurus*. Thus, records for *C. obscurus* that derive from eDNA may mask true records of *C. galapagensis*, and be contrary. Currently, this genetic similarity of the sibling *C. galapagensis* and *C. obscurus* among themselves and their similarity with other species of *Carcharhinus* (e.g., *C. longimanus*, *C. perezi*) is also problematic in studies based on DNA barcoding and the use of PCR mini barcodes that target species identification of shark fins sold on fish markets. As such, *C. galapagensis* may remain a cryptic species in many genetic-based investigations on sharks.

## 10. Future Research Aims

Currently, information on the movements of *Carcharhinus galapagensis* is scarce for many regions across its range. Large-scale movements of *C. galapagensis* were discovered and reported yet only for the Pacific and Atlantic Oceans. Hence, the connectivity of *C. galapagensis* populations in the Atlantic, Indian, and Pacific Oceans must be investigated,

especially regarding the identification of islands that possibly function as stepping stones as well as stretches of oceans that can function as migratory corridors of sharks. Such basic information is needed for the successful conservation management of this partly mobile shark that exhibits a global distribution containing many widely separated populations, and whose population stability depends on the exchange of individuals between distant populations. Because *C. galapagensis* can be considered a rare species from a global perspective due to the limited number of occurrences worldwide, it is especially susceptible to the loss of populations and resulting shrinking of its distribution. Thus, its populations around oceanic islands should be monitored for documentation purposes, with the aim of early recognizing population declines and the quick development of suitable countermeasures.

From viewpoints of phylogeography, biogeography, and evolution, it would be of special interest to know the exact historical distribution paths of *C. galapagensis* and its dispersal across ocean basins over space and time. For elucidating these questions, only genetic investigations based on material collected from all ocean basins and across the Galapagos sharks' circumglobally range are suitable for reconstructing historical dispersal events. In this context, multiple dispersal waves were discovered recently for the reef-associated Indo-Pacific *Carcharhinus amblyrhynchos* based on results of molecular studies of 173 individuals deriving from across the species' range [639], which supported greatly elucidating its evolutionary history. Previously, the demographic history of the cosmopolitan-distributed *Galeocerdo cuvier* based on genetic samples across all three major ocean basins was unveiled [640]. Similar studies conducted on *C. galapagensis* are desirable for a complete understanding of the evolutionary history of this shark and its unique current distributional pattern. Genetic investigations of *C. galapagensis* populations should focus especially on the Atlantic Ocean region because of the prevalent gap of data from here.

The example of St. Peter and St. Paul Archipelago has shown the extreme vulnerability of local Galapagos shark populations that are characterized by limited population sizes to overfishing. Therefore, the monitoring of *C. galapagensis* populations can be considered an ongoing task for conservationists, scientists, and associated fishing authorities. Although several of these populations around oceanic islands are in protected areas nowadays [641]; contrarily, there is still an overlap of these remote islands and archipelagos with hotspots of activities of industrial longline fleets across all ocean basins [549]. Thus, the expansion and declaration of new and additional no-take zones, MPAs, and ISRAs are desirable for the effective protection of sharks, including *C. galapagensis*. As such, the remaining islands and island groups that harbour this species but are currently unprotected must be considered in marine spatial planning and become MPAs, at best with no-take zones and the prohibition of shark fishing, e.g., at the Bermuda Islands.

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## References

- Compagno, L.J.V. FAO Species Catalogue: Vol. 4—Part 2. Sharks of the World. An annotated and illustrated catalogue of shark species known to date. *FAO Fish. Synop.* **1984**, *4*, 251–655.
- Compagno, L.J.V.; Niem, V.H. Carcharhinidae. Requiem sharks. In *The Living Marine Resources of the Western Central Pacific. Vol. 2: Cephalopods, Crustaceans, Holothurians and Sharks*; Carpenter, K.E., Niem, V.H., Eds.; FAO: Rome, Italy, 1998; pp. 1312–1360.
- Nelson, J.S.; Grande, T.C.; Wilson, M.V.H. *Fishes of the World*, 5th ed.; John Wiley & Sons: Hoboken, NJ, USA, 2016.
- Weigmann, S. Annotated checklist of the living sharks, batoids and chimaeras (Chondrichthyes) of the world, with a focus on biogeographical diversity. *J. Fish Biol.* **2016**, *88*, 837–1037. [[CrossRef](#)] [[PubMed](#)]
- White, W.T.; Kyne, P.M.; Harris, M. Lost before found: A new species of whaler shark *Carcharhinus obsolerus* from the Western Central Pacific known only from historic records. *PLoS ONE* **2019**, *14*, e0209387. [[CrossRef](#)] [[PubMed](#)]

6. de Oliveira, C.D.L.; Ladle, R.J.; da Silva Batista, V. Patterns and trends in scientific production on marine elasmobranchs: Research hotspots and emerging themes for conservation. *J. Coast. Conserv.* **2023**, *27*, 6. [CrossRef]
7. Ebert, D.A.; Dando, M.; Fowler, S.L. *Sharks of the World. A Complete Guide*; Princeton University Press: Princeton, NJ, USA, 2021.
8. Morales, N.A.; Heidemeyer, M.; Bauer, R.; Hernández, S.; Acuña, E.; van Gennip, S.J.; Friedlander, A.M.; Gaymer, C.F. Residential movements of top predators in Chile's most isolated marine protected area: Implications for the conservation of the Galapagos shark, *Carcharhinus galapagensis*, and the yellowtail amberjack, *Seriola lalandi*. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **2021**, *31*, 340–355. [CrossRef]
9. Morales-Serrano, N.; Gonzalez-Pestana, A. Identification of the first nursery area of the Galapagos shark (*Carcharhinus galapagensis*) in the south-east Pacific Ocean. *J. Fish Biol.* **2024**, *105*, 1008–1013. [CrossRef] [PubMed]
10. Compagno, L.J.V.; Dando, M.; Fowler, S.L. *Sharks of the World*; Princeton University Press: Princeton, NJ, USA, 2005.
11. Garrick, J.A.F. *Sharks of the Genus Carcharhinus*; US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service: Silver Spring, MD, USA, 1982; Volume 445, pp. 1–194.
12. Compagno, L.J.V. Chapter 2: Pelagic elasmobranch diversity. In *Sharks of the Open Ocean: Biology, Fisheries and Conservation*; Camhi, M.D., Pikitch, E.K., Babcock, E.A., Eds.; Blackwell Publishing Ltd.: Oxford, UK, 2008; pp. 14–23.
13. Bass, A.J.; Heemstra, P.C.; Compagno, L.J.V. *Carcharhinidae*. In *Smith's Sea Fishes*; Smith, M.M., Heemstra, P.C., Eds.; Macmillan South Africa Publishers: Johannesburg, South Africa, 1986; pp. 67–87.
14. Bennett, M.B.; Gordon, I.; Kyne, P.M. *Carcharhinus galapagensis*. The IUCN Red List of Threatened Species. e.T41736A10550977. 2003. Available online: <https://www.iucnredlist.org/species/41736/10550977> (accessed on 21 January 2023).
15. Bennett, M.B.; Gordon, I.; Kyne, P.M. Galapagos shark—*Carcharhinus galapagensis* Snodgrass & Heller, 1905. In *The Conservation Status of Australian Chondrichthyans: Report of the IUCN Shark Specialist Group Australia and Oceania Regional Red List Workshop*; Cavanagh, R.D., Kyne, P.M., Fowler, S.L., Musick, J.A., Bennett, M.B., Eds.; The University of Queensland, School of Biomedical Sciences: Brisbane, Australia, 2003; p. 112.
16. Ebert, D.A.; Fowler, S.L.; Compagno, L.J.V. *Sharks of the World. A Fully Illustrated Guide*; Wild Nature Press: Plymouth, UK, 2013.
17. Sampaio, C.L.S.; Carvalho-Filho, A.; Ferreira, C.E.L.; Feitoza, B.M.; Floeter, S.R.; Gasparini, J.L.; Luiz, O.J., Jr.; Rocha, L.A. Capítulo 7: Guia de identificação ilustrado das espécies de peixes endêmicas e ameaçadas das ilhas oceânicas brasileiras e do banco dos Abrolhos. In *Ilhas Oceânicas Brasileiras: Da Pesquisa ao Manejo*; Mohr, L.V., Castro, J.W.A., Costa, P.M.S., Alves, R.J.V., Eds.; Ministério do Meio Ambiente: Brasília, DF, Brazil, 2009; Volume 2, pp. 163–198. (In Portuguese)
18. Last, P.R.; Stevens, J.D. *Sharks and Rays of Australia*, 2nd ed.; CSIRO Publishing: Collingwood, ON, Canada, 2009.
19. Snodgrass, R.E.; Heller, E. Papers from the Hopkins-Stanford Galapagos Expedition, 1898–1899. XVII. Shore fishes of the Revillagigedo, Clipperton, Cocos and Galapagos Islands. *Proc. Wash. Acad. Sci.* **1905**, *6*, 333–427. [CrossRef]
20. Herre, A.W. *Fishes of the Crane Pacific Expedition*; Food and Agriculture Organization of the United Nations: Rome, Italy, 1936; Volume 21, pp. 1–472.
21. Acuña-Marrero, D.; Smith, A.N.; Salinas-de-León, P.; Harvey, E.S.; Pawley, M.D.; Anderson, M.J. Spatial patterns of distribution and relative abundance of coastal shark species in the Galapagos Marine Reserve. *Mar. Ecol. Prog. Ser.* **2018**, *593*, 73–95. [CrossRef]
22. Soler, G.A.; Bessudo, S.; Guzmán, A. Long term monitoring of pelagic fishes at Malpelo Island, Colombia. *Lat. Am. J. Conserv.* **2013**, *3*, 28–37.
23. Limbaugh, C. Field notes on sharks. In *Sharks and Survival*; Gilbert, P.W., Ed.; Boston, MA, USA, 1963; pp. 63–94.
24. Taylor, L.R. *Sharks of Hawaii: Their Biology and Cultural Significance*; University of Hawaii Press: Honolulu, HI, USA, 1993.
25. Ascension Island Government. *The Ascension Island Marine Protected Area Management Plan 2021–2026*; Ascension Island Government Conservation and Fisheries Directorate: Georgetown, TX, USA, 2021.
26. Castro, J.I. *The Sharks of North America*; Oxford University Press: Oxford, UK, 2011.
27. Waechter, L.S.; Luiz, O.J.; Leprieur, F.; Bender, M.G. Functional biogeography of marine vertebrates in Atlantic Ocean reefs. *Divers. Distrib.* **2022**, *28*, 1680–1693. [CrossRef]
28. Sandin, S.A.; French, B.J.; Zgliczynski, B.J. Emerging insights on effects of sharks and other top predators on coral reefs. *Emerg. Top. Life Sci.* **2022**, *6*, 57–65. [CrossRef] [PubMed]
29. Sherman, C.S.; Simpfendorfer, C.A.; Pacoureau, N.; Matsushiba, J.H.; Yan, H.F.; Walls, R.H.; Rigby, C.L.; VanderWright, W.J.; Jabado, R.W.; Pollom, R.A.; et al. Half a century of rising extinction risk of coral reef sharks and rays. *Nat. Commun.* **2023**, *14*, 15. [CrossRef] [PubMed]
30. Raoult, V.; Grant, M.I.; Barbosa Martins, A.P.; Feitosa, L.M.; Braccini, M.; Cardeñosa, D.; Carlson, J.; Chin, A.; Curtis, T.; Costa, L.F.C.; et al. Assigning shark fin origin using species distribution models needs a reality check. *Biol. Lett.* **2021**, *17*, 20200907. [CrossRef] [PubMed]
31. Last, P.R.; Stevens, J.D. *Sharks and Rays of Australia*; CSIRO Publishing: Collingwood, ON, Canada, 1994.
32. Voigt, M.; Weber, D. *Field Guide for Sharks of the Genus Carcharhinus*; Dr. Friedrich Pfeil: Munich, Germany, 2011.

33. Corrigan, S.; Maisano Delser, P.; Eddy, C.; Duffy, C.A.J.; Yang, L.; Li, C.; Bazinet, A.L.; Mona, S.; Naylor, G.J.P. Historical introgression drives pervasive mitochondrial admixture between two species of pelagic sharks. *Mol. Phylogenet. Evol.* **2017**, *110*, 122–126. [CrossRef] [PubMed]
34. Pazmiño, D.A. Population Genomics Informs Conservation and Management of the Galapagos Shark (*Carcharhinus galapagensis*) at Local, Regional and Oceanic Scales. Ph.D. Thesis, James Cook University, Townsville, Australia, 2017.
35. Kyne, P.M.; Barreto, R.; Carlson, J.; Fernando, D.; Fordham, S.; Francis, M.P.; Herman, K.; Jabado, R.W.; Liu, K.M.; Pa-coureaux, N.; et al. *Carcharhinus galapagensis*. The IUCN Red. List Threat. Species. e.T41736A2954286. 2019. Available online: <https://www.iucnredlist.org/species/41736/2954286> (accessed on 16 December 2022).
36. de Queiroz, J.D.G.R. Histórico de Recuperação e Padrões de Movimentação do Tubarão de Galápagos *Carcharhinus galapagensis* (Snodgrass & Heller, 1905) no Arquipélago de São Pedro e São Paulo. Master's Thesis, Universidade Federal de Pernambuco, Recife, Brazil, 2020.
37. Florida Museum. Discover fishes: *Carcharhinus galapagensis*. 2020. Available online: <https://www.floridamuseum.ufl.edu/discover-fish/species-profiles/carcharhinus-galapagensis> (accessed on 27 February 2023).
38. Fischer, W.; Bianchi, G. *FAO Species Identification Sheets for Fishery Purposes. Western Indian Ocean (Fishing Area 51)*; FAO: Rome, Italy, 1984.
39. Compagno, L.J.V. Sharks. In *The Living Marine Resources of the Eastern Central Atlantic*; Carpenter, K.E., De Angelis, N., Eds.; FAO: Rome, Italy, 2016; Volume 2, pp. 1122–1336.
40. Kyne, P.M.; Carlson, J.K.; Ebert, D.A.; Fordham, S.V.; Bizzarro, J.J.; Graham, R.T.; Kulka, D.W.; Tewes, E.E.; Harrison, L.R.; Dulvy, N.K. *The Conservation Status of North American, Central American, and Caribbean Chondrichthyans*; IUCN SSC Shark Specialist Group: Vancouver, BC, Canada, 2012.
41. Kyne, P.M.; Heupel, M.R.; White, W.T.; Simpfendorfer, C.A. *The Action Plan for Australian Sharks and Rays 2021*; Marine Biodiversity Hub, National Environmental Science Program: Hobart, Australia, 2021.
42. Ebert, D.A.; Dando, M.; Fowler, S.L. *A Pocket Guide to Sharks of the World*, 2nd ed.; Princeton University Press: Princeton, NJ, USA, 2021.
43. Love, M.S.; Bizzarro, J.J.; Cornthwaite, A.M.; Frable, B.W.; Maslenikov, K.P. Checklist of marine and estuarine fishes from the Alaska-Yukon Border, Beaufort Sea, to Cabo San Lucas, Mexico. *Zootaxa* **2021**, *5053*, 1–285. [CrossRef] [PubMed]
44. Robertson, D.R.; Grove, J.S.; McCosker, J.E. Tropical Transpacific Shore Fishes. *Pac. Sci.* **2004**, *58*, 507–565. [CrossRef]
45. Mundy, B.C. Checklist of the fishes of the Hawaiian Archipelago. *Bish. Mus. Bull. Zool.* **2005**, *6*, 1–704.
46. Dulvy, N.K.; Fowler, S.L.; Musick, J.A.; Cavanagh, R.D.; Kyne, P.M.; Harrison, L.R.; Carlson, J.K.; Davidson, L.N.K.; Fordham, S.V.; Francis, M.P.; et al. Extinction risk and conservation of the world's sharks and rays. *eLife* **2014**, *3*, e00590. [CrossRef] [PubMed]
47. Pazmiño, D.A.; Maes, G.E.; Green, M.E.; Simpfendorfer, C.A.; Hoyos-Padilla, E.M.; Duffy, C.A.J.; Meyer, C.G.; Kerwath, S.E.; Salinas-de-León, P.; Van Herwerden, L. Strong trans-Pacific break and local conservation units in the Galapagos shark (*Carcharhinus galapagensis*) revealed by genome-wide cytonuclear markers. *Heredity* **2018**, *120*, 407–421. [CrossRef] [PubMed]
48. Gausmann, P. The preference for remoteness—The distribution and status of the Galapagos shark (*Carcharhinus galapagensis*) in Macaronesia, a rare insular European elasmobranch species. In Proceedings of the Poster Presentation, European Elasmobranch Association Conference, Thessaloniki, Greece, 21–24 October 2024. [CrossRef]
49. Froese, R.; Pauly, D. FishBase. World Wide Web Electronic Publication. Version 08/2022. References Used for *Carcharhinus galapagensis*. 2022. Available online: [https://www.fishbase.org/au/references/SummaryRefList.php?speccode=870&vtable=refrens\\_a&lang=english](https://www.fishbase.org/au/references/SummaryRefList.php?speccode=870&vtable=refrens_a&lang=english) (accessed on 20 January 2023).
50. Froese, R.; Pauly, D. FishBase. World Wide Web Electronic Publication. Version 08/2022. *Carcharhinus galapagensis* (Snodgrass & Heller, 1905): Galapagos Shark. 2022. Available online: <https://www.fishbase.se/summary/Carcharhinus-galapagensis.html> (accessed on 16 December 2022).
51. Pollerspöck, J.; Straube, N. References for *Carcharhinus galapagensis* Snodgrass & Heller, 1905. 2023. Available online: <https://shark-references.com/literature/listBySpecies/Carcharhinus-galapagensis> (accessed on 3 March 2023).
52. Biodiversity Heritage Library. Bibliography for *Carcharhinus galapagensis*. 2023. Available online: <https://www.biodiversitylibrary.org/name/Carcharhinus%20galapagensis> (accessed on 21 February 2023).
53. ALA—Atlas of Living Australia. *Carcharhinus galapagensis* (Snodgrass & Heller, 1905). 2023. Available online: [https://bie.ala.org.au/species/https://biodiversity.org.au/afd/taxa/46a70298-8d94-4948-a151-da951a9330d9#cite\\_note-bester-4](https://bie.ala.org.au/species/https://biodiversity.org.au/afd/taxa/46a70298-8d94-4948-a151-da951a9330d9#cite_note-bester-4) (accessed on 31 January 2023).
54. CONABIO—Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. EncicloVida. Tiburón de Galápagos: *Carcharhinus galapagensis*. 2023. Available online: <https://enciclovida.mx/especies/28600-carcharhinus-galapagensis> (accessed on 28 February 2026).
55. Fricke, R.; Eschmeyer, W.N.; van der Laan, R. Eschmeyer's Catalog of Fishes: Genera, Species, References. 2022. Available online: <http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp> (accessed on 18 December 2022).
56. Field Museum. Field Museum's Online Zoological Collections Database. 2023. Available online: <https://collections-zoology.fieldmuseum.org> (accessed on 7 July 2023).
57. Fricke, R.; Eschmeyer, W.N. A Guide to Fish Collections in Eschmeyer's Catalog of Fishes. Electronic Version. 2022. Available online: <http://researcharchive.calacademy.org/research/ichthyology/catalog/collections.asp> (accessed on 26 March 2023).

58. Robertson, D.R.; Allen, G.R. Shorefishes of the Tropical Eastern Pacific: Online Information System. Version 3.0. Smithsonian Tropical Research Institute, Balboa, Panamá. 2024. Available online: <http://www.stri.org/sftep> (accessed on 2 January 2026).
59. Robertson, D.R.; Van Tassell, J. Shorefishes of the Greater Caribbean: Online Information System. Version 2.0 Smithsonian Tropical Research Institute, Balboa, Panamá. 2019. Available online: <https://biogeodb.stri.si.edu/caribbean/en/pages> (accessed on 27 February 2023).
60. Appeltans, W.; Bouchet, P.; Boxshall, G.A.; Fauchald, K.; Gordon, D.P.; Hoeksema, B.W.; Poore, G.C.B.; van Soest, R.W.M.; Stöhr, S.; Walter, T.C.; et al. World Register of Marine Species (WoRMS). WoRMS Taxon Details: *Carcharhinus galapagensis* (Snodgrass & Heller, 1905). 2023. Available online: <https://www.marinespecies.org/aphia.php?p=taxdetails&id=105790> (accessed on 17 February 2023).
61. Pollerspöck, J. Bibliography Database of Living/Fossil Sharks, Rays and Chimaeras (Chondrichthyes: Elasmobranchii, Holocephali). Species Descriptions. Version 14.10.2011. 2011. Available online: [https://shark-references.com/images/meine\\_bilder/downloads/Species\\_Descriptions\\_14.10.2011.pdf](https://shark-references.com/images/meine_bilder/downloads/Species_Descriptions_14.10.2011.pdf) (accessed on 22 February 2023).
62. NSF—National Science Foundation. VertNet. Version 29.09.2016. 2016. Available online: <http://portal.vertnet.org/search?q=Carcharhinus+galapagensis> (accessed on 1 March 2023).
63. Wetherbee, B.M.; Crow, G.L.; Lowe, C.G. Biology of the Galapagos shark, *Carcharhinus galapagensis*, in Hawai'i. *Environ. Biol. Fishes* **1996**, *45*, 299–310. [CrossRef]
64. Francis, M.P. Morphometric minefields—Towards a measurement standard for chondrichthyan fishes. *Environ. Biol. Fishes* **2006**, *77*, 407–421. [CrossRef]
65. Froese, R.; Pauly, D. FishBase World Wide Web electronic publication. Version 10/2024. Length-length Parameters for *Carcharhinus galapagensis*. 2024. Available online: <https://www.fishbase.de/popdyn/LLRelationshipList.php?ID=870&GenusName=Carcharhinus&SpeciesName=galapagensis&fc=11> (accessed on 2 April 2025).
66. Sabaj, M.H. Codes for Natural History Collections in Ichthyology and Herpetology. *Copeia* **2020**, *108*, 593–669. [CrossRef]
67. Ferretti, F.; Jenrette, J.; Moro, S.; Butner, C.; Fox, E.; Haddock, S.H.D.; Jorgensen, S.J.; Hastie, T.; Micheli, F. From data deficient to big data in shark conservation. *Fish Fish.* **2025**, *26*, 977–990. [CrossRef]
68. Barreiros, J.P.; Gadig, O.B.F. *Catálogo Ilustrado Dos Tubarões e Raias Dos Açores*; Instituto Açoriano de Cultura: Angra do Heroísmo, Portugal, 2011; (In Portuguese and English).
69. Naylor, G.J.P.; Caira, J.N.; Jensen, K.; Rosana, K.A.M.; White, W.T.; Last, P.R. A DNA sequence based approach to the identification of shark and ray species and its implications for global elasmobranch diversity and parasitology. *Bull. Amer. Mus. Nat. Hist.* **2012**, *367*, 1–262. [CrossRef] [PubMed]
70. Naylor, G.J.P.; Caira, J.N.; Jensen, K.; Rosana, K.A.M.; Straube, N.; Lakner, C. Chapter 2: Elasmobranch phylogeny: A mitochondrial estimate based on 595 species. In *Biology of Sharks and Their Relatives*, 2nd ed.; Carrier, J.C., Musick, J.A., Heithaus, M.R., Eds.; CRC Press: Boca Raton, FL, USA, 2012; pp. 31–56.
71. Smith-Vaniz, W.F.; Collette, B.B.; Luckhurst, B.E. Fishes of Bermuda: History, zoogeography, annotated checklist, and identification keys. In *American Society of Ichthyologists and Herpetologists. Special Publication No. 4.*; Allen Press: Lawrence, KS, USA, 1999.
72. Duffy, C.A.J. Misidentification of *Carcharhinus galapagensis* (Snodgrass & Heller, 1905) in the Southwest Pacific Ocean. *Zootaxa* **2016**, *4132*, 97–106. [CrossRef] [PubMed]
73. Castro, J.I. *The Sharks of North American Waters*; Texas A&M University Press: College Station, TX, USA, 1983.
74. Castro, J.I. *A Field Guide to the Sharks Commonly Caught in Commercial Fisheries of the Southeastern United States*; US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center: Miami, FL, USA, 1993; Volume 338, pp. 1–47.
75. Ebert, D.A.; Stehmann, M. Sharks, batoids, and chimaeras of the North Atlantic. *FAO Spec. Cat. Fish. Purp.* **2013**, *7*, 1–523.
76. Garrick, J.A.F. A broad view of *Carcharhinus* species, their systematic and distribution. In *Sharks, Skates, and Rays*; Gilbert, P.W., Mathewson, R.F., Rall, D.P., Eds.; Johns Hopkins University Press: Baltimore, MD, USA, 1967; pp. 85–92.
77. Bass, A.J.; D'Aubrey, J.D.; Kistnasamy, N. *Sharks of the East Coast of Southern Africa. Vol. I. The Genus Carcharhinus (Carcharhinidae)*; SAAMBR Investigational Report; Oceanographic Research Institute: Durban, South Africa, 1973; Volume 33, pp. 1–168.
78. Dudley, S.F.J.; Cliff, G.; Zungu, M.P.; Smale, M.J. Sharks caught in the protective gill nets off KwaZulu-Natal, South Africa. 10. The dusky shark *Carcharhinus obscurus* (Lesueur 1818). *Afr. J. Mar. Sci.* **2005**, *27*, 107–127. [CrossRef]
79. Ebert, D.A. *On Board Guide for the Identification of Pelagic Sharks and Rays. Western Indian Ocean*; FAO: Rome, Italy, 2014.
80. Almeida, A.J.; Biscoito, M. Chaves para a identificação dos peixes de oceano Atlântico oriental, Mar Mediterrâneo e Mar Negro. I—Myxini; Petromyzontida; Chondrichthyes. *Bol. Mus. Munic. Funchal (Hist. Nat.)* **2019**, *15*, 1–195, (In Portuguese, with an English abstract).
81. Musick, J.A.; Harbin, M.M.; Compagno, L.J.V. Chapter 2: Historical zoogeography of the Selachii. In *Biology of Sharks and Their Relatives*; Carrier, J.C., Musick, J.A., Heithaus, M.R., Eds.; CRC Press: Boca Raton, FL, USA, 2004; pp. 33–78.
82. Frisk, M.G.; Miller, T.J.; Dulvy, N.K. Life histories and vulnerability to exploitation of elasmobranchs: Inferences from elasticity, perturbation and phylogenetic analyses. *J. Northw. Atl. Fish. Sci.* **2005**, *35*, 27–45. [CrossRef]

83. Froese, R. Estimating somatic growth of fishes from maximum age or maturity. *Acta Ichthyol. Piscat.* **2022**, *52*, 125–133. [[CrossRef](#)]
84. De Crosta, M.A.; Taylor, L.R.; Parrish, J.D. Age determination, growth and energetics of three species of carcharhinid sharks in Hawaii. In *Proceedings of the 2nd Symposium on Resource Investigations in the Northwestern Hawaiian Islands*; Grigg, R.W., Tanoue, K.Y., Eds.; University of Hawaii Sea Grant College Program: Honolulu, HI, USA, 1984; Volume 2, pp. 75–95.
85. Randall, J.E. Survey of ciguatera at Enewetak and Bikini, Marshall Islands, with notes on the systematics and food habits of ciguatoxic fishes. *Fish. Bull.* **1980**, *78*, 201–249.
86. Myrberg, A.A., Jr. Distinctive markings of sharks: Ethological considerations of visual function. *J. Exp. Zool.* **1990**, *256*, 156–166. [[CrossRef](#)]
87. Randall, J.E.; Cea Egaña, A.; Meléndez, R. Checklist of shore and epipelagic fishes of Easter Island, with twelve new records. *Bol. Mus. Nac. Hist. Nat. Chile* **2005**, *54*, 41–55. [[CrossRef](#)]
88. de Oliveira, J.S.; Domingues, R.R.; de Morais, L.R.; Macena, B.C.L.; Corrigan, S.; Naylor, G.; Hilsdorf, A.W.S. SNP-based species identification of sympatric *Carcharhinus galapagensis* and *C. obscurus* sharks to support conservation monitoring in oceanic habitats. *Environ. Biol. Fish.* **2026**, *109*, 89. [[CrossRef](#)]
89. Ehemann, N.R.; González-González, L.V.; Chollet-Villalpando, J.G.; Cruz-Agüero, J.D.L. Updated checklist of the extant Chondrichthyes within the Exclusive Economic Zone of Mexico. *ZooKeys* **2018**, *774*, 17–39. [[CrossRef](#)] [[PubMed](#)]
90. Naylor, G.J.P. The phylogenetic relationships among requiem and hammerhead sharks: Inferring phylogeny when thousands of equally most parsimonious trees result. *Cladistics* **1992**, *8*, 295–318. [[CrossRef](#)] [[PubMed](#)]
91. Sorenson, L.; Santini, F.; Alfaro, M.E. The effect of habitat on modern shark diversification. *J. Evol. Biol.* **2014**, *27*, 1536–1548. [[CrossRef](#)] [[PubMed](#)]
92. Blower, D.C.; Corley, S.; Hereward, J.P.; Riginos, C.R.; Ovenden, J.R. Characterisation and cross-amplification of 21 novel microsatellite loci for the dusky shark, *Carcharhinus obscurus*. *Conserv. Genet. Res.* **2015**, *7*, 909–912. [[CrossRef](#)]
93. Wong, E.H.K.; Shivji, M.S.; Hanner, R.H. Identifying sharks with DNA barcodes: Assessing the utility of a nucleotide diagnostic approach. *Mol. Ecol. Resour.* **2009**, *9*, 243–256. [[CrossRef](#)] [[PubMed](#)]
94. Wirtz, P.; Bingeman, J.; Bingeman, J.; Fricke, R.; Hook, T.; Young, J. The fishes of Ascension Island, central Atlantic Ocean—New records and an annotated checklist. *J. Mar. Biol. Assoc. UK* **2017**, *97*, 783–798. [[CrossRef](#)]
95. Stafford-Deitsch, J. *Haie*; Tetra Verlag: Melle, Germany, 1991. (In German)
96. Talwar, B.S.; Stein, J.A.; Connett, S.M.; Liss, S.A.; Brooks, E.J. Results of a fishery-independent longline survey targeting coastal sharks in the eastern Bahamas between 1979 and 2013. *Fish. Res.* **2020**, *230*, 105683. [[CrossRef](#)]
97. McCandless, C.T.; Conn, P.; Cooper, P.; Cortés, E.; Laporte, S.W.; Nammack, M. *Status Review Report: Northwest Atlantic Dusky Shark (Carcharhinus Obscurus)*; Report to National Marine Fisheries Service, Office of Protected Resources; NMFS & NOAA: Washington, DC, USA, 2014.
98. Pazmiño, D.A.; van Herderden, L.; Simpfendorfer, C.A.; Junge, C.; Donnellan, S.C.; Hoyos-Padilla, E.M.; Duffy, C.A.J.; Huveneers, C.; Gillanders, B.M.; Butcher, P.A.; et al. Introgressive hybridisation between two widespread sharks in the east Pacific region. *Mol. Phylogenet. Evol.* **2019**, *136*, 119–127. [[CrossRef](#)] [[PubMed](#)]
99. Sendell-Price, A.T.; Tulenko, F.J.; Pettersson, M.; Kang, D.; Montandon, M.; Winkler, S.; Kulb, K.; Naylor, G.J.P.; Phillippy, A.; Fedrigo, O.; et al. Low mutation rate in epaulette sharks is consistent with a slow rate of evolution in sharks. *Nat. Commun.* **2023**, *14*, 6628. [[CrossRef](#)] [[PubMed](#)]
100. Barton, N.H. The role of hybridization in evolution. *Mol. Ecol.* **2001**, *10*, 551–568. [[CrossRef](#)] [[PubMed](#)]
101. Caballero, S.; Cardenosa, D.; Soler, G.; Hyde, J. Application of multiplex PCR approaches for shark molecular identification: Feasibility and applications for fisheries management and conservation in the Eastern Tropical Pacific. *Mol. Ecol. Resour.* **2012**, *12*, 233–237. [[CrossRef](#)] [[PubMed](#)]
102. Fields, A.T.; Fischer, G.A.; Shea, S.K.; Zhang, H.; Abercrombie, D.L.; Feldheim, K.A.; Babcock, E.A.; Chapman, D.D. Species composition of the international shark fin trade assessed through a retail-market survey in Hong Kong. *Conserv. Biol.* **2018**, *32*, 376–389. [[CrossRef](#)] [[PubMed](#)]
103. Schmidt, T.L.; Thia, J.A.; Hoffmann, A.A. How can genomics help or hinder wildlife conservation? *Annu. Rev. Anim. Biosci.* **2024**, *12*, 45–68. [[CrossRef](#)] [[PubMed](#)]
104. Torralba Sáez, M.; Hofreiter, M.; Straube, N. Shark genome size evolution and its relationship with cellular, life-history, ecological, and diversity traits. *Sci. Rep.* **2024**, *14*, 8909. [[CrossRef](#)] [[PubMed](#)]
105. Green, M.E. A Mitochondrial and Genome Wide Genetic Investigation of Galapagos Shark (*Carcharhinus galapagensis*) Populations in the Southwest Pacific Ocean. Bachelor's Thesis, James Cook University, Townsville, Australia, 2014.
106. Green, M.E.; Van Herwerden, L.; Simpfendorfer, C.A.; Maes, G.; Hobbs, J.-P. An investigation into the population structure of Galapagos Sharks, *Carcharhinus galapagensis*, in the West Pacific Ocean using genomic approaches. In *Proceedings of the Sharks International Durban*, Durban, South Africa, 2–6 June 2014.

107. Morgan, J.A.; Harry, A.V.; Welch, D.J.; Street, R.; White, J.; Geraghty, P.T.; Macbeth, W.G.; Tobin, A.; Simpfendorfer, C.A.; Ovenden, J.R. Detection of interspecies hybridisation in Chondrichthyes: Hybrids and hybrid offspring between Australian (*Carcharhinus tilstoni*) and common (*C. limbatus*) blacktip shark found in an Australian fishery. *Conserv. Genet.* **2012**, *13*, 455–463. [\[CrossRef\]](#)
108. Barker, A.M.; Adams, D.H.; Driggers, W.B., III; Frazier, B.S.; Portnoy, D.S. Hybridization between sympatric hammerhead sharks in the western North Atlantic Ocean. *Biol. Lett.* **2019**, *15*, 20190004. [\[CrossRef\]](#) [\[PubMed\]](#)
109. Marques, V.; Castagné, P.; Fernández, A.P.; Borrero-Pérez, G.H.; Hocdé, R.; Guérin, P.-É.; Juhel, J.-B.; Velez, L.; Loiseau, N.; Letessier, T.B.; et al. Use of environmental DNA in assessment of fish functional and phylogenetic diversity. *Conserv. Biol.* **2021**, *35*, 1944–1956. [\[CrossRef\]](#) [\[PubMed\]](#)
110. Bakker, J.; Wangensteen, O.S.; Chapman, D.D.; Boussarie, G.; Buddo, D.; Guttridge, T.L.; Hertler, H.; Mouillot, D.; Vigliola, L.; Mariani, S. Environmental DNA reveals tropical shark diversity in contrasting levels of anthropogenic impact. *Sci. Rep.* **2017**, *7*, 16886. [\[CrossRef\]](#) [\[PubMed\]](#)
111. Moore, A.M.; Jompa, J.; Tassakka, A.C.M.A.; Yasir, I.; Ndobe, S.; Umar, W.; Gold, Z.; Barber, P.H. Sharks and rays (Chondrichthyes) around Banggai Island, Banggai MPA, Indonesia: Biodiversity data from an environmental DNA pilot study. *Aquac. Aquar. Conserv. Legis.* **2021**, *14*, 725–745.
112. De La Hoz Schilling, C.; Jabado, R.W.; Veríssimo, A.; Caminiti, L.; Sidina, E.; Gandega, C.Y.; Serrão, E.A. EDNA metabarcoding reveals a rich but threatened and declining elasmobranch community in West Africa's largest marine protected area, the Banc d'Arguin. *Conserv. Genet.* **2024**, *25*, 805–821. [\[CrossRef\]](#)
113. West, K.M.; Harry, A.V.; Payet, S.; Harvey, E.; Dambimangari Rangers; Bardi-Jawi Rangers; Karajarri Rangers; Yawuru Country Managers; Travers, M.J. Comparative assessment of eDNA metabarcoding and longline deployments for elasmobranch surveying across a large tropical marine park network. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **2024**, *34*, e4144. [\[CrossRef\]](#)
114. Cardeñosa, D.; Fields, A.; Abercrombie, D.; Feldheim, K.; Shea, S.K.H.; Chapman, D.D. A multiplex PCR mini-barcode assay to identify processed shark products in the global trade. *PLoS ONE* **2017**, *12*, e0185368. [\[CrossRef\]](#) [\[PubMed\]](#)
115. Cardeñosa, D.; Quinlan, J.; Shea, S.K.H.; Chapman, D.D. Multiplex real-time PCR assay to detect illegal trade of CITES-listed shark species. *Sci. Rep.* **2018**, *8*, 16313. [\[CrossRef\]](#) [\[PubMed\]](#)
116. Cardeñosa, D.; Fields, A.T.; Babcock, E.A.; Shea, S.K.H.; Feldheim, K.A.; Chapman, D.D. Species composition of the largest shark fin retail-market in mainland China. *Sci. Rep.* **2020**, *10*, 12914. [\[CrossRef\]](#) [\[PubMed\]](#)
117. Benavides, M.T.; Horn, R.L.; Feldheim, K.A.; Shivji, M.S.; Clarke, S.C.; Wintner, S.; Natanson, L.; Braccini, M.; Boomer, J.J.; Gulak, S.J.B.; et al. Global phylogeography of the dusky shark *Carcharhinus obscurus*: Implications for fisheries management and monitoring the shark fin trade. *Endanger. Species Res.* **2011**, *14*, 13–22. [\[CrossRef\]](#)
118. Arriaga-Mayorga, A.; Castelblanco-Martínez, D.N.; Aguilera-Miranda, I.D.; Velarde-Lemus, J.; Niño-Torres, C.A.; Blanco-Parra, M.P.; Charruau, P.; Islas-Villanueva, V. Romeo and Juliet: A forbidden love story? A review of hybridization in keystone, aquatic megafauna. *Anim. Biodivers. Conserv.* **2024**, *47*, 209–225. [\[CrossRef\]](#)
119. da Silva Ferrette, B.L.; Domingues, R.R.; Ussami, L.H.F.; Moraes, L.; de Oliveira Magalhães, C.; de Amorim, A.F.; Hilsdorf, A.W.F.; Oliveira, C.; Foresti, F.; Mendonça, F.F. DNA-based species identification of shark finning seizures in Southwest Atlantic: Implications for wildlife trade surveillance and law enforcement. *Biodivers. Conserv.* **2019**, *28*, 4007–4025. [\[CrossRef\]](#)
120. Carneiro, M.; Martins, R.; Landi, M.; Costa, F.O. Updated checklist of marine fishes (Chordata: Craniata) from Portugal and the proposed extension of the Portuguese continental shelf. *Eur. J. Taxon.* **2014**, *73*, 1–73. [\[CrossRef\]](#)
121. Compagno, L.J.V. Checklist of living elasmobranchs. In *Sharks, Skates, and Rays: The Biology of Elasmobranch Fishes*; Hamlett, W.C., Ed.; Johns Hopkins University Press: Baltimore, MD, USA, 1999; pp. 471–498.
122. Compagno, L.J.V. Appendix 1: Global checklist of living chondrichthyan fishes. In *Sharks, Rays and Chimaeras: The Status of the Chondrichthyan Fishes. Status Survey*; Fowler, S.L., Cavanagh, R.D., Camhi, M., Burgess, G.H., Cailliet, G.M., Fordham, S.V., Simpfendorfer, C.A., Musick, J.A., Eds.; IUCN SSC Shark Specialist Group & IUCN: Gland, Switzerland; Cambridge, UK, 2005; pp. 401–423.
123. Fowler, S.L.; Reed, T.M.; Dipper, F.A. Elasmobranch biodiversity, conservation and management. In *Proceedings of the International Seminar and Workshop, Sabah, Malaysia, 8–10 July 1997*; IUCN SSC Shark Specialist Group & IUCN: Gland, Switzerland; Cambridge, UK, 1997.
124. Zamani, A.; Fric, Z.F.; Gante, H.F.; Hopkins, T.; Orfinger, A.B.; Scherz, M.D.; Sucháčková Bartoňová, A.; Pos, D.D. DNA barcodes on their own are not enough to describe a species. *Syst. Entomol.* **2022**, *47*, 385–389. [\[CrossRef\]](#)
125. Jorgensen, S.J.; Micheli, F.; White, T.D.; Van Houtan, K.S.; Alfaro-Shigueto, J.; Andrzejczek, S.; Arnoldi, N.S.; Baum, J.K.; Block, B.; Britten, G.L.; et al. Emergent research and priorities for shark and ray conservation. *Endanger. Species Res.* **2022**, *47*, 171–203. [\[CrossRef\]](#)
126. Matley, J.K.; Roberts, C.N.; Clarke, T.M.; Meyer, L.; Doane, M.P.; Dinsdale, E.A.; Scott, M.; Barnett, A.; Huveneers, C. Comparative space use of sympatric sharks at a remote island in the South Pacific Ocean. *Ecol. Evol.* **2025**, *15*, e71534. [\[CrossRef\]](#) [\[PubMed\]](#)

127. Matley, J.K.; Meyer, L.; Roberts, C.N.; Clarke, T.M.; Scott, M.; Barnett, A.; Huveneers, C. Resource use of dusky and Galapagos sharks in response to fishing activities at a remote Pacific Island. *Sci. Rep.* **2025**, *15*, 31743. [CrossRef] [PubMed]
128. Pollerspöck, J.; Straube, N. Bibliography Database of Living/Fossil Sharks, Rays and Chimaeras (Chondrichthyes: Elasmobranchii, Holocephali)—Papers of the year 2018. World Wide Web Electronic Publication, Version 01/2018. 2019. Available online: [https://shark-references.com/images/meine\\_bilder/downloads/Papers\\_2018\\_27012\\_vers1.pdf](https://shark-references.com/images/meine_bilder/downloads/Papers_2018_27012_vers1.pdf) (accessed on 27 February 2023).
129. Cadenat, J.; Marchal, E. Resultats des campagnes oceanographiques de la Reine-Pokou aux îles Sainte-Hélène et Ascension. *Poisson. Bull. Inst. Fr. Afr. Noire Sér. A* **1963**, *25*, 1235–1315. (In French)
130. Castro, J.I.; Woodley, C.M.; Brudek, R.L. *A Preliminary Evaluation of the Status of Shark Species*; FAO Fisheries Technical Paper; FAO: Rome, Italy, 1999; Volume 380, pp. 1–72.
131. Fergusson, I.K.; Compagno, L.J.V. Distributional note on the dusky shark, *Carcharhinus obscurus*, from the Mediterranean Sea, with a first record from the Maltese Islands. In *Proceedings of the 3rd Meeting of the European Elasmobranch Association, Boulogne-sur-Mer, France, 27–29 May 1999*; Séret, B., Sire, J.Y., Eds.; Société Française Ichtyologie & IRD: Paris, France, 1999; pp. 57–65.
132. Bodiguel, C.; Clerkin, P.; Ebert, D.A.; Wallemacq, F. *Report of the Workshops on Identification of Pelagic Sharks and Rays in the Western Indian Ocean. Albion, Mauritius 28th–30th October 2014, Victoria, Mahé, Seychelles 4th–6th November 2014, Saint Denis, Reunion 25th–27th January 2016*; SmartFish-FAO Report; FAO: Rome, Italy, 2017; Volume 37, pp. 1–70.
133. Camhi, M.D.; Musick, J.A.; Simpfendorfer, C.A. Species accounts: Dusky shark, *Carcharhinus obscurus* (Lesueur, 1818). In *Sharks, Rays and Chimaeras: The Status of the Chondrichthyan Fishes. Status Survey*; Fowler, S.L., Cavanagh, R.D., Camhi, M.D., Burgess, G.H., Cailliet, G.M., Fordham, S.V., Simpfendorfer, C.A., Musick, J.A., Eds.; IUCN SSC Shark Specialist Group & IUCN: Gland, Switzerland; Cambridge, UK, 2005; pp. 297–300.
134. Randall, J.E.; Earle, J.L.; Pyle, R.L.; Parrish, J.D.; Hayes, T. Annotated checklist of the fishes of Midway Atoll, northwestern Hawaiian Islands. *Pac. Sci.* **1993**, *47*, 356–400.
135. Muter, B.A.; Gore, M.L.; Gledhill, K.S.; Lamont, C.; Huveneers, C. Australian and US news media portrayal of sharks and their conservation. *Conserv. Biol.* **2013**, *27*, 187–196. [CrossRef] [PubMed]
136. Chapman, B.K.; McPhee, D. Global shark attack hotspots: Identifying underlying factors behind increased unprovoked shark bite incidence. *Ocean Coast. Manag.* **2016**, *133*, 72–84. [CrossRef]
137. Shark Research Institute. Global Shark Attack File. Incident Log. 2025. Available online: <https://www.sharkattackfile.net/incidentlog.htm> (accessed on 16 April 2025).
138. Robbins, W.D.; Peddemors, V.M.; Kennelly, S.J. Assessment of permanent magnets and electropositive metals to reduce the line-based capture of Galapagos sharks, *Carcharhinus galapagensis*. *Fish. Res.* **2011**, *109*, 100–106. [CrossRef]
139. Mitchell, J.D.; McLean, D.L.; Collin, S.P.; Langlois, T.J. Shark depredation in commercial and recreational fisheries. *Rev. Fish. Biol. Fish.* **2018**, *28*, 715–748. [CrossRef]
140. Mitchell, J.D.; Camilieri-Asch, V.; Jaine, F.R.; Peddemors, V.M.; Langlois, T.J. *Galapagos Shark Movement Patterns and Interactions with Fishing Vessels in the Marine Parks Surrounding Lord Howe Island*; Report to Parks Australia; Parks Australia, Commonwealth of Australia: Canberra, Australia, 2021.
141. Mitchell, J.D.; Camilieri-Asch, V.; Gudge, S.; Jaine, F.R.; Peddemors, V.M.; Langlois, T.J. Applying acoustic telemetry, vessel tracking and fisher knowledge to investigate and manage fisher-shark conflict at Lord Howe Island, Australia. *Mar. Biol.* **2024**, *171*, 230. [CrossRef]
142. Mitchell, J.D.; Camilieri-Asch, V.; Jaine, F.R.; Huveneers, C.; Peddemors, V.M.; Langlois, T.J. *Lord Howe Island Shark Research Program: Testing Deterrents to Reduce Shark Bycatch and Depredation and Continuation of the Deepwater Acoustic Receiver Array, Final Report for Parks Australia*; Parks Australia, Commonwealth of Australia: Canberra, Australia, 2025.
143. Gaither, M.R.; Bowen, B.W.; Rocha, L.A.; Briggs, J.C. Fishes that rule the world: Circumtropical distributions revisited. *Fish Fish.* **2016**, *17*, 664–679. [CrossRef]
144. Brum, J.M.M.; Azevedo, J.M.N. First record of the Galapagos shark *Carcharhinus galapagensis* (Snodgrass & Heller, 1905) (Carcharhinidae) on the Azores. *Bol. Mus. Munic. Funchal* **1995**, 139–143.
145. D'Aubrey, J.D. *Preliminary Guide to the Sharks Found off the East Coast of Southern Africa*; SAAMBR Investigational Report; Oceanographic Research Institute: Durban, South Africa, 1964; Volume 8, pp. 1–95.
146. Springer, S. A revision of North American sharks allied to the genus *Carcharhinus*. *Am. Mus. Novit.* **1950**, *1451*, 1–13.
147. Davies, D.H. *About Sharks and Shark Attack*; Shuter & Shooter: Pietermaritzburg, South Africa, 1964.
148. Allen, G.R.; Hoese, D.F.; Paxton, J.R.; Randall, J.E.; Russell, C.; Starck, W.A.; Talbot, F.H.; Whitley, G.P. Annotated checklist of the fishes of Lord Howe Island. *Rec. Aust. Mus.* **1977**, *30*, 365–454. [CrossRef]
149. Carlson, J.K.; Charvet, P.; Blanco-Parra, M.P.; Briones, A.; Belloch, C.; Cardenosa, D.; Derrick, D.; Espinoza, E.; Morales-Saldaña, J.M.; Naranjo-Elizondo, B.; et al. *Carcharhinus perezii* The IUCN Red. List Threat. Species. e.T60217A3093780. 2021. Available online: <https://www.iucnredlist.org/species/60217/3093780> (accessed on 14 February 2022).

150. Kohler, N.E.; Casey, J.G.; Turner, P.A. NMFS cooperative shark tagging program, 1962–93: An atlas of shark tag and recapture data. *Mar. Fish. Rev.* **1998**, *60*, 1–87.
151. Schwartz, F.J. History of the Poor Boy Shark Tournament in North Carolina, 1982–1996. *J. Elisha Mitchell Sci. Soc.* **1998**, *114*, 149–158.
152. Schwartz, F.J. Sharks new to the North Carolina elasmobranch fauna: The good, the bad, and the ugly. *J. Elisha Mitchell Sci. Soc.* **2000**, *116*, 292.
153. Schwartz, F.J. *Sharks, Skates, and Rays of the Carolinas*; The University of North Carolina Press: Chapel Hill, NC, USA; London, UK, 2003.
154. Domingo, A.; Cortés, E.; Forselledo, R.; Driggers, R. *Guide D'identification Des Requins de L'Océan Atlantique*; Commission Internationale pour la Conservation des Thonidés de l'Atlantique: Madrid, Spain, 2014. (In French)
155. Goode, G.B. Catalogue of the fishes of the Bermudas. Based chiefly upon the collections of the United States National Museum. *Bull. U. S. Natl. Mus.* **1876**, *1*, 1–82.
156. Günther, A. Report on the shore fishes procured during the voyage of H.M.S. Challenger in the years 1873–1876. *Rep. Voy. Chall. Zool.* **1880**, *1*, 1–82.
157. Beebe, W.; Tee-Van, J. *Field Book of the Shore Fishes of Bermuda*; G. P. Putnam's Sons: New York, NY, USA, 1933.
158. Goode, G.B. A preliminary catalogue of the reptiles, fishes and leptocardians of the Bermudas, with descriptions of four species of fishes believed to be new. *Am. J. Sci.* **1877**, *14*, 289–298. [[CrossRef](#)]
159. Bean, T.H. A catalogue of the fishes of Bermuda, with notes on a collection made in 1905 for the Field Museum. *Publ. Field Columbian Mus. Zool. Ser.* **1906**, *7*, 21–89. [[CrossRef](#)]
160. Barbour, T. Notes on Bermudian fishes. *Bull. Mus. Comp. Zool. Harv. Univ.* **1905**, *46*, 107–134.
161. Bigelow, H.B.; Schroeder, W.C. Sharks. In *Fishes of the Western North Atlantic, Part I: Lancelets, Cyclostomes, Sharks*; Tee-Van, J., Breder, C.M., Hildebrand, S.F., Parr, A.E., Schroeder, W.C., Eds.; Yale University: New Haven, CT, USA, 1948; pp. 59–576. [[CrossRef](#)]
162. Cadenat, J.; Blache, J. *Requins de Méditerranée et d'Atlantique (plus particulièrement de la Côte Occidentale d'Afrique)*; Faune Tropicale; ORSTOM: Paris, France, 1981; Volume 21, pp. 1–330. (In French)
163. Kohler, N.E.; Turner, P.A. Distributions and movements of Atlantic shark species: A 52-year retrospective atlas of mark and recapture data. *Mar. Fish. Rev.* **2018**, *81*, 1–93. [[CrossRef](#)]
164. Ajemian, M.J.; Powers, S.P.; Murdoch, T.J. Estimating the potential impacts of large mesopredators on benthic resources: Integrative assessment of spotted eagle ray foraging ecology in Bermuda. *PLoS ONE* **2012**, *7*, e40227. [[CrossRef](#)] [[PubMed](#)]
165. Smith, S.R.; Sarkis, S.; Murdoch, T.J.; Weil, E.; Croquer, A.; Bates, N.R.; Johnson, R.J.; de Putron, S.; Andersson, A.J. Chapter 13: Threats to coral reefs of Bermuda. In *Coral Reefs of the United Kingdom Overseas Territories*; Sheppard, C.R.C., Ed.; Springer: Dordrecht, The Netherlands, 2013; pp. 173–188. [[CrossRef](#)]
166. Compagno, L.J.V. Sharks. In *The Living Marine Resources of the Western Central Atlantic. In FAO Species Identification Guide for Fisheries Purposes and American Society of Ichthyologists and Herpetologists Special Publication 5*; Carpenter, K.E., Ed.; FAO: Rome, Italy, 2002; Volume 1.
167. Jensen, C.; Schwartz, F.J.; Hopkins, G. Occurrence of an adult male reef shark, *Carcharhinus perezi* (Carcharhinidae) off North Carolina. *J. Elisha Mitchell Sci. Soc.* **1995**, *111*, 121–125.
168. Casey, J. *Cruise Results for Polish R/V Wieczno Survey of Apex Predators, Sharks and Swordfish*; Cruise Report; Narragansett Laboratory: Narragansett, RI, USA, 1985.
169. Grace, M. *Field Guide to Requiem Sharks (Elasmobranchiomorphi: Carcharhinidae) of the Western North Atlantic*; NOAA Technical Report NMFS; US Department of Commerce: Washington, DC, USA, 2001; Volume 153, pp. 1–32.
170. Morgan, A.; Cooper, P.W.; Curtis, T.; Burgess, G.H. Overview of the U.S. East Coast bottom longline shark fishery, 1994–2003. *Mar. Fish. Rev.* **2009**, *71*, 23–38.
171. Schwartz, F.J. Changes in North Carolina's marine fish faunas: Good or bad? *J. N. C. Acad. Sci.* **2012**, *128*, 44–50. [[CrossRef](#)]
172. Randall, J.E. A fatal attack by the shark *Carcharhinus galapagensis* at St. Thomas, Virgin Islands. *Caribb. J. Sci.* **1963**, *3*, 201–205.
173. Randall, J.E. A fatal attack by the shark *Carcharhinus galapagensis* at St. Thomas, Virgin Islands. In *Proceedings of the Fifth Meeting of the Association of Island Marine Laboratories of the Caribbean, Bimini, Bahamas, 6–8 November 1963*.
174. Shark Research Institute. Global Shark Attack File. GSAF 1963.04.20. 2023. Available online: [https://sharkattackfile.net/spreadsheets/pdf\\_directory/1963.04.20-Gibson.pdf](https://sharkattackfile.net/spreadsheets/pdf_directory/1963.04.20-Gibson.pdf) (accessed on 27 February 2023).
175. Pikitch, E.K.; Chapman, D.D.; Babcock, E.A.; Shivji, M.S. Habitat use and demographic population structure of elasmobranchs at a Caribbean atoll (Glover's Reef, Belize). *Mar. Ecol. Prog. Ser.* **2005**, *302*, 187–197. [[CrossRef](#)]
176. Chapman, D.D.; Babcock, E.A.; Abercrombie, D.; Bond, M.E.; Pikitch, E.A. The elasmobranchs of Glover's Reef Marine Reserve and other sites in northern and central Belize. *Fish. Cent. Res. Rep.* **2011**, *19*, 38–42. [[CrossRef](#)]
177. Bond, M.E.; Valentin-Albanese, J.; Babcock, E.A.; Abercrombie, D.; Lamb, N.F.; Miranda, A.; Pikitch, E.K.; Chapman, D.D. Abundance and size structure of a reef shark population within a marine reserve has remained stable for more than a decade. *Mar. Ecol. Prog. Ser.* **2017**, *576*, 1–10. [[CrossRef](#)]

178. Meerman, J.C. *Compilation of Information on Biodiversity in Belize*; Report to INBio and the Chief Forest Officer; Forest Department of the Ministry of Natural Resources and the Environment: Belmopan, Belize, 2005.
179. Graham, R.T.; Burgess, G.H. *Abundance and Diversity of Reef-Associated Sharks at the Gladden Spit Marine Reserve, Belize—Preliminary Results*; Report to the Department of Fisheries and Friends of Nature, Belize; Department of Fisheries and Friends of Nature: Placencia, Belize, 2004.
180. Jennings, G.H. *A Classified Taxonomic Checklist of the Sea Fishes of the Caribbean Sea, Central Western Atlantic, Florida & Bermuda, Gulf of Mexico & Northern Coast of South America*; Calypso Publications: Sechart, BC, Canada, 1999.
181. Bonfil, R. *Identification Guide to Common Sharks and Rays of the Caribbean*; FAO: Rome, Italy, 2016.
182. Green, A.; Chollett, I.; Suárez, A.; Dahlgren, C.; Cruz, S.; Zepeda, C.; Andino, J.; Robinson, J.; McField, M.; Fulton, S.; et al. *Biophysical Principles for Designing a Network of Replenishment Zones for the Mesoamerican Reef System*; The Nature Conservancy, Comunidad y Biodiversidad, A.C., Smithsonian Institution, Perry Institute for Marine Science, Centro de Estudios Marinos, Healthy Reefs Initiative & Universidad Autónoma de Baja California Sur: Mérida, Yucatan, Mexico, 2017.
183. Soto, J.M.R. Annotated systematic checklist and bibliography of the coastal and oceanic fauna of Brazil. I. Sharks. *Mare Magnum* **2001**, *1*, 51–120.
184. Lubbock, H.R.; Edwards, A.J. The fishes of Saint Paul's Rocks. *J. Fish Biol.* **1981**, *18*, 135–157. [[CrossRef](#)]
185. Soto, J.M.R. Tubarões e raias (Chondrichthyes) encontrados no Arquipélago de Fernando de Noronha durante as expedições ARFENOR I e II. *Alcance* **1997**, *4*, 71–80. (In Portuguese)
186. Soto, J.M.R. Peixes do Arquipélago Fernando de Noronha. *Mare Magnum* **2001**, *1*, 147–169, (In Portuguese, with an English abstract).
187. Gadig, O.B.F. Tubarões da Costa Brasileira. Ph.D. Thesis, Instituto de Biociências da Universidade Estadual Paulista “Júlio de Mesquita Filho”, São Paulo, Brazil, 2001.
188. Pinheiro, H.T.; Mazzei, E.; Moura, R.L.; Amado-Filho, G.M.; Carvalho-Filho, A.; Braga, A.C.; Costa, P.A.S.; Ferreira, B.P.; Ferreira, C.E.L.; Floeter, S.R.; et al. Fish biodiversity of the Vitória-Trindade Seamount Chain, Southwestern Atlantic: An updated database. *PLoS ONE* **2015**, *10*, e0118180. [[CrossRef](#)] [[PubMed](#)]
189. Pinheiro, H.T.; Rocha, L.A.; Macieira, R.M.; Carvalho-Filho, A.; Anderson, A.B.; Bender, M.G.; Di Dario, F.; Ferreira, C.E.L.; Figueiredo-Filho, J.; Francini-Filho, R.; et al. South-western Atlantic reef fishes: Zoogeographical patterns and ecological drivers reveal a secondary biodiversity centre in the Atlantic Ocean. *Divers. Distrib.* **2018**, *24*, 951–965. [[CrossRef](#)]
190. Bezerra, N.P.A.; Nunes, A.R.O.P.; Viana, D.D.L.; Nunes, I.S.L.B.; Rêgo, M.G.; Roque, P.C.G.; Hazin, F.H.V. Elasmobrânquios marinhos do Nordeste brasileiro. In *Ciências Do Mar: Dos Oceanos Do Mundo Ao Nordeste Do Brasil*; Viana, D.D.L., Oliveira, J.E.L., Hazin, F.H.V., Souza, M.A.C., Eds.; Via Design Publicações: Olinda, Brazil, 2021; Volume 2, pp. 204–235. (In Portuguese)
191. Rosa, R.S.; Gadig, O.B.F. Conhecimento da diversidade dos chondrichthyes marinhos no Brasil: A contribuição de José Lima de Figueiredo. *Arq. Zool.* **2014**, *45*, 89–104, (In Portuguese, with an English abstract). [[CrossRef](#)]
192. Menezes, N.A.; Buckup, P.A.; Figueiredo, J.L.; Moura, R.L. *Catálogo Das espécies de Peixes Marinhos Do Brasil*; Museu de Zoologia da Universidade de São Paulo: São Paulo, Brazil, 2003. (In Portuguese)
193. Medeiros, A.M.; Poscai, A.N.; Vasconcelos Araújo, P.R.; Sousa Rangel, A.R.; Rodrigues, A.; do Rêgo, M.G. Peixes cartilaginosos da costa Brasileira. In *Revisões em Zoologia: Vertebrados Marinhos da Costa Brasileira*; Nascimento, G.M., Ed.; Instituto de Pesquisas Cananéia: Cananéia, Brazil, 2025; pp. 39–118, (In Portuguese). [[CrossRef](#)]
194. Garla, R.C. Ecologia e Conservação dos Tubarões do Arquipélago de Fernando de Noronha, com ênfase no Tubarão-cabeça-de-cesto *Carcharhinus perezi* (Poey, 1876) (Carcharhiniformes, Carcharhinidae). Ph.D. Thesis, Instituto de Biociências da Universidade Estadual Paulista “Júlio de Mesquita Filho”, São Paulo, Brazil, 2003. (In Portuguese, with an English abstract).
195. Garla, R.C.; Chapman, D.D.; Shivji, M.S.; Wetherbee, B.M.; de Amorim, A.F. Habitat of juvenile Caribbean reef sharks, *Carcharhinus perezi*, at two oceanic insular marine protected areas in the southwestern Atlantic Ocean: Fernando de Noronha Archipelago and Atol das Rocas, Brazil. *Fish. Res.* **2006**, *81*, 236–241. [[CrossRef](#)]
196. Schmid, K.; Silva, F.R.M.D.; Santos, B.J.V.D.; Bezerra, N.P.A.; Garla, R.C.; Giarrizzo, T. First fish fauna assessment in the Fernando de Noronha Archipelago with BRUVS: Species catalog with underwater imagery. *Biota Neotrop.* **2020**, *20*, e20201014. [[CrossRef](#)]
197. Nunes, I.B.; Bezerra, N.A.; Souza, C.N.; Nunes, D.M.; Hazin, F.H.V. Capítulo 12: Gestão de áreas costeiras e marinhas protegidas no Nordeste do Brasil. In *Ciências Do Mar: Dos Oceanos Do Mundo Ao Nordeste Do Brasil*; Viana, D.D.L., Oliveira, J.E.L., Hazin, F.H.V., de Souza, M.A.C., Eds.; Via Design Publicações: Recife, Brazil, 2021; Volume 1, pp. 298–325. (In Portuguese)
198. Rangel, B.S.; Afonso, A.S.; Garla, R. Female wound records suggest mating periods for the Caribbean reef shark at an insular marine protected area from the Equatorial Atlantic Ocean. *J. Fish Biol.* **2022**, *101*, 1591–1594. [[CrossRef](#)] [[PubMed](#)]
199. Edwards, A.J.; Lubbock, H.R. The shark population of Saint Paul's Rocks. *Copeia* **1982**, *1*, 223–225. [[CrossRef](#)] [[PubMed](#)]
200. Salmon, T.; Rangel, B.D.S.; Malavasi-Bruno, C.E.; Kfoury, J.R., Jr. New records and preliminary reproductive aspects of elasmobranchs of the Trindade-Martin Vaz insular complex. *Oecol. Aust.* **2021**, *25*, 159–165. [[CrossRef](#)]

201. Simon, T.; Macieira, R.M.; Joyeux, J.-C. The shore fishes of the Trindade-Martin Vaz insular complex: An update. *J. Fish Biol.* **2013**, *82*, 2113–2127. [[CrossRef](#)] [[PubMed](#)]
202. Carneiro, M.; Martins, R.; Reiner, F.; Batista, I. *Ichthyofauna of Portugal: Taxonomic Diversity, Common and Scientific Names of Marine Fishes*; IPMA: Olivais, Portugal, 2019; Volume 1, pp. 1–376.
203. Lozano Rey, L. *Ictiología Ibérica (Fauna Ibérica). Peces (Generalidades, Ciclóstomos y Elasmobranchios)*; Museo Nacional de Ciencias Naturales: Madrid, Spain, 1928; Volume 1, pp. 1–692. (In Spanish)
204. Moreno Garcia, J.A. *Tiburones Del Genero Carcharhinus Del Atlantico Oriental Y Mediterraneo Occidental*; Ministeria Agricultura Pesca Alimentaria, Sereteria; Generale Pesca Maritima: Madrid, Spain, 1982. (In Spanish)
205. De Maddalena, A.; Bänsch, H.; Heim, W. *Sharks of the Mediterranean: An Illustrated Study of All Species*; McFarland & Co., Inc.: Jefferson, MO, USA, 2015.
206. Falcón, J.M.; Brito, A.; Pascual, P.; González, G.; Sancho, A.; Cabrera, M.; Báez, A.; Martín-Sosa, P.; Barquín, J. Catálogo de los peces de la reserva marina de La Graciosa e islotas al norte de Lanzarote. Tropicalización reciente del poblamiento ictico. *Rev. Acad. Canar. Cienc.* **2002**, *14*, 119–138. (In Spanish, with an English abstract).
207. Wirtz, P.; Fricke, R.; Biscoito, M.J. The coastal fishes of Madeira Island—New records and an annotated check-list. *Zootaxa* **2008**, *1715*, 1–26. [[CrossRef](#)]
208. Wirtz, P.; Brito, A.; Falcón, J.M.; Freitas, R.; Fricke, R.; Monteiro, V.; Reiner, F.; Tariche, O. The coastal fishes of the Cape Verde Islands—New records and an annotated check-list (Pisces). *Spixiana* **2013**, *36*, 113–142.
209. Báez, J.C.; Rodríguez-Cabello, C.; Banon, R.; Brito, A.; Falcon, J.M.; Mano, T.; Baro, J.; Macías, D.; Meléndez, M.J.; Camiñas, J.A.; et al. Updating the national checklist of marine fishes in Spanish waters: An approach to priority hotspots and lessons for conservation. *Mediterr. Mar. Sci.* **2019**, *20*, 260–270. [[CrossRef](#)]
210. Varela, J.; Santos, C.P.; Nunes, E.; Pissarra, V.; Pires, S.; Ribeiro, B.P.; Vieira, E.; Repolho, T.; Queiroz, N.; Freitas, R.; et al. Sharks in Macaronesia and Cabo Verde: Species richness, conservation status and anthropogenic pressures. *Front. Mar. Sci.* **2025**, *12*, 1490317. [[CrossRef](#)]
211. Afonso, P.; Porteiro, F.M.; Fontes, J.; Tempera, F.; Morato, T.; Cardigos, F.; Santos, R.S. New and rare coastal fishes in the Azores islands: Occasional events or tropicalization process? *J. Fish Biol.* **2013**, *83*, 272–294. [[CrossRef](#)] [[PubMed](#)]
212. Lloris, D.; Rucabado, J.; Figueroa, H. Biogeography of the Macaronesian ichthyofauna (the Azores, Madeira, the Canary Islands, Cape Verde and the African enclave). *Bol. Mus. Munic. Funchal* **1991**, *43*, 191–241.
213. Bailly, N.; Eschmeyer, W.N.; Froese, R.; Quéro, J.-C.; van der Land, J.; Costello, M.J.; Zavodnik, D.; Serrão Santos, R.; Porteiro, F.M. Pisces. In *European Register of Marine Species. A Check-List of the Marine Species in Europe and a Bibliography of Guides to Their Identification*. *Patrimoines Naturels* 50; Costello, M.J., Embrow, C., White, R., Eds.; Publications Scientifiques du M.N.H.N.: Paris, France, 2001; pp. 357–374.
214. George, M.R.; Zidowitz, H. Checkliste der europäischen Knorpelfischarten mit wissenschaftlichen und deutschen Namen. *Z. Fisch.* **2006**, *8*, 71–81. (In German, with an English summary).
215. Hanel, L.; Plíšťil, J.; Novák, J. Checklist of the fishes and the fish-like vertebrates on the European continent and adjacent seas. *Bull. Lampetra* **2009**, *VI*, 108–180.
216. Santos, R.S.; Porteiro, F.M.; Barreiros, J.P. *Marine Fishes of the Azores: Annotated Checklist and Bibliography*; Universidade dos Açores: Ponta Delgada, Portugal, 1997. [[CrossRef](#)]
217. Froese, R.; Pauly, D. FishBase. World Wide Web Electronic Publication. Version 08/2022. Pictures Available for *Carcharhinus galapagensis*. 2022. Available online: <https://www.fishbase.org/au/photos/PicturesSummary.php?StartRow=1&ID=870&what=species&TotRec=6> (accessed on 9 December 2022).
218. Porteiro, F.; Menezes, G.; Afonso, P.; Monteiro, J.; Santos, R. Marine fish (Chondrichthyes, Actinopterygii). In *A List of the Terrestrial and Marine Biota from the Azores*; Borges, P.A.V., Costa, A., Cunha, R., Gabriel, R., Gonçalves, V., Martins, A.F., Melo, I., Parente, M., Raposeiro, P., Rodrigues, P., et al., Eds.; Princípiã Editora, Lda.: Cascais, Portugal, 2010; pp. 326–350.
219. Santos, R.S.; Novoa-Pabon, A.; Silva, H.; Pinho, M. Elasmobranch species richness, fisheries, abundance and size composition in the Azores archipelago (NE Atlantic). *Mar. Biol. Res.* **2020**, *16*, 103–116. [[CrossRef](#)]
220. Bianchi, G. *Fichas FAO de Identificacao de Espécies Para Propósitos Comerciais. Guia de Campo Para as Espécies Comerciais Marinhas e de Águas Salobras de Angola. Preparado Com O Apoio Da NORAD e Da FAO (FIRM) Programa Regular*; FAO: Rome, Italy, 1986. (In Portuguese)
221. Schneider, W. *FAO Species Identification Sheets for Fishery Purposes. Field Guide to the Commercial Marine Resources of the Gulf of Guinea*; FAO: Rome, Italy, 1990.
222. Weber, S.B.; Richardson, A.J.; Broderick, A.; Brown, J.; Campanella, F.; Godley, B.J.; Howard, F.; Hussey, N.; Meeuwig, J.; Rose, P.; et al. *A Baseline Ecological Study of Ascension Island's Shallow Water Seamounts as Candidate Marine Protected Areas*; Ascension Island Government, Conservation & Fisheries Department: Georgetown, TX, USA, 2018.

223. Weber, S.B.; Richardson, A.J.; Thompson, C.D.; Brown, J.; Campanella, F.; Godley, B.J.; Hussey, N.E.; Meeuwig, J.J.; Rose, P.; Weber, N.; et al. Shallow seamounts are “oases” and activity hubs for pelagic predators in a large-scale marine reserve. *PLoS Biol.* **2025**, *23*, e3003016. [[CrossRef](#)] [[PubMed](#)]
224. Burns, P.; Hawkins, J.; Roberts, C. Reconstructing the history of ocean wildlife around Ascension Island. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **2020**, *30*, 1220–1237. [[CrossRef](#)]
225. Edwards, A.J.; Glass, C.W. The fishes of Saint Helena Island, South Atlantic Ocean. II. The pelagic fishes. *J. Nat. Hist.* **1987**, *21*, 1367–1394. [[CrossRef](#)]
226. Edwards, A.J. *Fish and Fisheries of Saint Helena Island*; Centre for Tropical Coastal Management Studies: Newcastle upon Tyne, UK, 1990.
227. Kizhakudan, S.J.; Zacharia, P.U.; Thomas, S.; Vivekanandan, E.; Muktha, M. *Guidance on National Plan of Action for Sharks in India*; Marine Fisheries Policy Series; CMFRI: Kochi, India, 2015; Volume 2, pp. 1–102.
228. Heidrich, K.N.; Meeuwig, J.J.; Zeller, D. Reconstructing past fisheries catches for large pelagic species in the Indian Ocean. *Front. Mar. Sci.* **2013**, *10*, 1177872. [[CrossRef](#)]
229. Henderson, A.C.; McIlwain, J.L.; Al-Oufi, H.S.; Al-Sheili, S. The Sultanate of Oman shark fishery: Species composition, seasonality and diversity. *Fish. Res.* **2007**, *86*, 159–168. [[CrossRef](#)]
230. Henderson, A.C.; Al-Oufi, H.S.; McIlwain, J.L. *Survey, Status & Utilisation of the Elasmobranch Fisheries Resources of the Sultanate of Oman. Final Report*; Sultan Qaboos University: Muscat, Oman, 2008.
231. Henderson, A.C.; Reeve, A.J. Noteworthy elasmobranch records from Oman. *Afr. J. Mar. Sci.* **2011**, *33*, 171–175. [[CrossRef](#)]
232. Almojil, D.K.; Moore, A.B.M.; White, W.T. *Sharks & Rays of the Arabian/Persian Gulf*; MBG Int. Ltd.: London, UK, 2015.
233. Jabado, R.W.; Ebert, D.A. *Sharks of the Arabian Seas: An Identification Guide*; The International Fund for Animal Welfare: Dubai, United Arab Emirates, 2015.
234. Jabado, R.W.; Kyne, P.M.; Pollom, R.A.; Ebert, D.A.; Simpfendorfer, C.A.; Ralph, G.M.; Dulvy, N.K. *The Conservation Status of Sharks, Rays, and Chimaeras in the Arabian Sea and Adjacent Waters*; Environment Agency Abu Dhabi, UAE: Abu Dhabi, United Arab Emirates; IUCN Species Survival Commission Shark Specialist Group, Canada: Vancouver, BC, Canada, 2017.
235. Smith, M.M. *Common and Scientific Names of the Fishes of Southern Africa. Part 1. Marine Fishes*; The J.L.B. Smith Institute of Ichthyology—Special Publication No. 14; Rhodes University: Makhanda, South Africa, 1975; pp. 1–178.
236. Fricke, R.; Mahafina, J.; Behivoke, F.; Jaonalison, H.; Léopold, M.; Ponton, D. Annotated checklist of the fishes of Madagascar, southwestern Indian Ocean, with 158 new records. *FishTaxa* **2018**, *3*, 1–432.
237. Séret, B. Chondrichthyan fishes (sharks, rays, and chimaeras). In *The New Natural History of Madagascar*; Goodman, S.M., Ed.; Princeton University Press: Princeton, NJ, USA, 2022; pp. 368–379. [[CrossRef](#)]
238. Séret, B. *Shark Fisheries and Conservation in the Seychelles*; Consultancy Report for the Seychelles Fishing Authority; Republic of Seychelles: Mahé, Seychelles, 2002.
239. Seychelles Fishing Authority. *Seychelles National Plan of Action for the Conservation and Management of Sharks*; Republic of Seychelles: Victoria, Seychelles, 2007.
240. Seychelles Fishing Authority. *Seychelles National Plan of Action for the Conservation and Management of Sharks*; Republic of Seychelles: Mahé, Seychelles, 2016.
241. Collette, B.B.; Parin, N.V. Shallow-water fishes of Walters shoals, Madagascar Ridge. *Bull. Mar. Sci.* **1991**, *48*, 1–22.
242. Wikipedia. Walters Shoals. 2026. Available online: [https://en.wikipedia.org/wiki/Walters\\_Shoals](https://en.wikipedia.org/wiki/Walters_Shoals) (accessed on 24 April 2026).
243. Hammerschlag, N.; Fallows, C. Galapagos sharks (*Carcharhinus galapagensis*) at the Bassas da India atoll: First record from the Mozambique Channel and possible significance as a nursery area. *S. Afr. J. Sci.* **2005**, *101*, 375–377.
244. van der Elst, R.P.; Chater, S.; King, D. Fishes from Bassas Da India Atoll in the Mozambique Channel. *Atoll Res. Bull.* **2021**, *629*, 1–36. [[CrossRef](#)]
245. Bourjea, J.; Dalleau, M. *Expedition Europa 2011. Rapport de Mission Europa, 16 Novembre–2 Décembre 2011—IFREMER/KELONIA/CNRS; Département Halieutique Méditerranéen et Tropical Laboratoire Ressources Halieutiques de la Réunion*: Saint-Leu, Réunion, France, 2011. (In French)
246. Jabado, R.W.; Kyne, P.M.; García-Rodríguez, E.; Charles, R.; Armstrong, A.O.; Mouton, T.L.; Gonzalez-Pestana, A.; Battle-Morera, A.; Rohner, C.A. *Western Indian Ocean: A Regional Compendium of Important Shark and Ray Areas*; IUCN SSC Shark Specialist Group: Dubai, United Arab Emirates, 2023. [[CrossRef](#)]
247. Save Our Seas Foundation. *A Preliminary Assessment of Shark Abundance and Diversity at the Islands Europa and Bassas da India, Mozambique Channel*; Save Our Seas Foundation: Geneva, Switzerland, 2010.
248. Clarke, C.; Lea, J.; Ormond, R. Comparative abundance of reef sharks in the Western Indian Ocean. In *Proceedings of the 12th International Coral Reef Symposium*, Cairns, Australia, 9–13 July 2012.
249. Guillaume, M.M.M.; Séret, B. Observations of sharks (Elasmobranchii) at Europa Island, a remote marine protected area important for shark conservation in the southern Mozambique Channel. *PLoS ONE* **2021**, *16*, e0253867. [[CrossRef](#)] [[PubMed](#)]

250. Fricke, R.; Durville, P.; Bernardi, G.; Borsa, P.; Mou-Tham, G.; Chabanet, P. Checklist of the shore fishes of Europa Island, Mozambique Channel, southwestern Indian Ocean, including 302 new records. *Stuttg. Beitr. Naturkd. A Neue Ser.* **2013**, *6*, 247–276.
251. Fourmanoir, P. Observations sur la faune marine et la pêche à l'île Europa. *Mém. Inst. Sci. Madag. Sér. A* **1952**, *7*, 167–188. (In French)
252. Naylor, G.J.P.; Marcus, L.F. Identifying isolated shark teeth of the genus *Carcharhinus* to species: Relevance for tracking phyletic change through the fossil record. *Am. Mus. Novit.* **1994**, *3109*, 1–53.
253. Moe, T.; Thein, K.M. Shark data collection in Myanmar. In *Report on the Study on Shark Production, Utilization and Management in the ASAN Region. SEC/SP/75*; Secretariat of the Southeast Asian Fisheries Development Center SEAFDEC: Bangkok, Thailand, 2006; pp. 98–106.
254. Hutchins, J.B. Checklist of the fishes of Western Australia. *Rec. W. Aust. Mus. Suppl.* **2001**, *63*, 9–50. [[CrossRef](#)]
255. McAuley, R.; Newbound, D.; Ashworth, R. *Field Identification Guide to Western Australian Sharks and Shark-like Rays*; Department of Fisheries: Perth, Australia, 2002.
256. Australian Government; Australian Faunal Directory. Species *Carcharhinus galapagensis* (Snodgrass & Heller, 1905)—Galapagos Shark. 2023. Available online: <https://biodiversity.org.au/afd/taxa/46a70298-8d94-4948-a151-da951a9330d9> (accessed on 9 April 2023).
257. Braccini, M.; Molony, B.; Blay, N. Patterns in abundance and size of sharks in northwestern Australia: Cause for optimism. *ICES J. Mar. Sci.* **2020**, *77*, 72–82. [[CrossRef](#)]
258. Jacoby, D.M.P.; Watanabe, Y.Y.; Packard, T.; Healey, M.; Papastamatiou, Y.P.; Gallagher, A.J. First descriptions of the seasonal habitat use and residency of scalloped hammerhead (*Sphyrna lewini*) and Galapagos sharks (*Carcharhinus galapagensis*) at a coastal seamount off Japan. *Anim. Biotelem.* **2022**, *10*, 22. [[CrossRef](#)]
259. Senou, H.; Matsuura, K.; Shinohara, G. Checklist of fishes in the Sagami Sea with zoogeographical comments on shallow water fishes occurring along the coastlines under the influence of the Kuroshio Current. *Mem. Natn. Mus. Nat. Sci.* **2006**, *41*, 389–542.
260. Taniuchi, T.; Tachikawa, H.; Kurata, Y.; Nose, Y. Galapagos shark, *Carcharhinus galapagensis*, from the Ogasawara Islands, Japan. *Jpn. J. Ichthyol.* **1985**, *31*, 449–452, (In Japanese, with an English abstract). [[CrossRef](#)]
261. Horii, Y.; Saeki, T.; Nishimura, M.; Kanzawa, N.; Tanaka, S.; Ohizumi, H. The status of interactions between sharks and fisheries, and the impacts on stock status by ridding of sharks. *Nippon Suis. Gakk.* **2010**, *76*, 267–268. (In Japanese) [[CrossRef](#)]
262. Horii, Y.; Ohizumi, H.; Tanaka, S. Shark culling and its influence on marine ecosystem in the waters of Hachijo island, Izu islands, Japan. In *Report of Japanese Society for Elasmobranch Studies*; Japanese Society for Elasmobranch Studies: Tokyo, Japan, 2011; Volume 47, pp. 76–77. (In Japanese)
263. Kuriwa, K.; Arihara, H.; Chiba, S.N.; Kato, S.; Senou, H.; Matsuura, K. Checklist of marine fishes of the Zunan Islands, located between the Izu and Ogasawara (Bonin) islands, Japan, with zoogeographical comments. *Check List* **2014**, *10*, 1479–1501. [[CrossRef](#)]
264. Kawasaki, S.; Nomura, Y.; Maeda, K. The appearance of sharks of the genus *Carcharhinus* (Elasmobranchii: Carcharhiniformes: Carcharhinidae) on the coastal sea surrounding Amakusa Island, Kumamoto prefecture, Japan. *Rep. Kumamoto Prefect. Fish. Res. Cent.* **2004**, *6*, 31–38. (In Japanese)
265. Kawasaki, S.; Ootuka, T. The appearance of sharks of the genus *Carcharhinus* (Elasmobranchii: Carcharhiniformes: Carcharhinidae) on the coastal sea surrounding Amakusa Island, Kumamoto prefecture, Japan—II. *Rep. Kumamoto Prefect. Fish. Res. Cent.* **2007**, *7*, 67–72. (In Japanese)
266. Yano, K. Chondrichthyans of the Ryukyu Islands, Japan. In *Proceedings of the 5th Indo-Pacific Fisheries Conference, Noumea, 3–8 November 1997*; Seret, B., Sire, J.Y., Eds.; Ichthyological Society of France: Paris, France, 1999; pp. 351–365.
267. Masunaga, G.; Kosuge, T.; Asai, N.; Ota, H. Shark predation of sea snakes (Reptilia: Elapidae) in the shallow waters around the Yaeyama Islands of the southern Ryukyus, Japan. *Mar. Biodivers. Rec.* **2008**, *1*, e96. [[CrossRef](#)]
268. Koeda, K.; Aizawa, M.; Sakamoto, K.; Ueshima, R. *Report on the Specimens of Sharks Deposited in the Department of Zoology, The University Museum, The University of Tokyo*; Specimen Report No. 132: List of Fish Specimens in the Zoological Department of the University Museum; The University of Tokyo: Tokyo, Japan, 2024.
269. Nakabo, T. *Fishes of Japan with Pictorial Keys to the Species*, English ed.; Tokai University Press: Tokyo, Japan, 2002; Volume I.
270. Motomura, H. *List of Japan's All Fish Species. Current Standard Japanese and Scientific Names of All Fish Species Recorded from Japanese Waters*; The Kagoshima University Museum: Kagoshima, Japan, 2020.
271. Sonu, S.C. *Shark Fisheries, Trade, and Market of Japan*; NOAA Technical Memorandum NMFS-SWR-033; US Department of Commerce: Washington, DC, USA, 1998; pp. 1–70.
272. Lobel, P.S.; Lobel, L.K. Aspects of the biology and geomorphology of Johnston and Wake Atolls, Pacific Ocean. In *Coral Reefs of the World, Volume 1: Coral Reefs of the USA*; Riegel, B.M., Dodge, R.E., Eds.; Springer: New York, NY, USA, 2008; pp. 655–690. [[CrossRef](#)]
273. Lobel, P.S.; Lobel, L.K. Annotated checklist of the fishes of Wake Atoll. *Pac. Sci.* **2004**, *58*, 65–90. [[CrossRef](#)]

274. Brown, D.P. A century of Wake fish surveys: Comprehensive annotated checklist of the fishes of Wake Atoll. *Pac. Sci.* **2021**, *75*, 323–348. [CrossRef]
275. Fowler, H.W.; Ball, S.C. Fishes of Hawaii, Johnston Island, and Wake Island. *Bernice P. Bish. Mus. Bull.* **1925**, *26*, 1–31.
276. Pollerspöck, J.; Straube, N. References for *Eulamia commersonii* (Blainville, 1816). 2021. Available online: <https://shark-references.com/literature/listBySpecies/Eulamia-commersonii> (accessed on 4 March 2021).
277. Myers, R.F. *Micronesian Reef Fishes, a Practical Guide to the Coral Reef Fishes of Tropical Central and Western Pacific*; Coral Graphics: Barrigada, GU, USA, 1989.
278. Bryan, P.G. *The Inshore Sharks of Guam: Methods of Small-Boat Shark Fishing*; University of Guam: Mangilao, GU, USA, 1972.
279. Bryan, P.G. Three new shark records from Guam, Mariana Islands. *Micronesica* **1973**, *9*, 159–160.
280. Gilman, E.; Chaloupka, M.; Merrifield, M.; Malsol, N.D.; Cook, C. Standardized catch and survival rates, and effect of a ban on shark retention, Palau pelagic longline fishery. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **2016**, *26*, 1031–1062. [CrossRef]
281. Hari, K.; Jaiteh, V.F.; Chin, A. The sharks and rays of Palau: Biological diversity, status, and social and cultural dimensions. *Pac. Conserv. Biol.* **2021**, *28*, 398–413. [CrossRef]
282. Compagno, L.J.V.; Last, P.R.; Stevens, J.D.; Alava, M.N.R. *Checklist of Philippine Chondrichthyes*; CSIRO Marine Laboratories Report 243; CSIRO: Canberra, Australia, 2005; pp. 1–109.
283. Long, N. Data collection on shark fisheries in Viet Nam. In *Report on the Study on Shark Production, Utilization and Management in the ASAN Region. SEC/SP/75*; Secretariat of the Southeast Asian Fisheries Development Center SEAFDEC: Bangkok, Thailand, 2006; pp. 131–163.
284. Vidthayanon, C. Elasmobranch diversity and status in Thailand. In *Elasmobranch Biodiversity, Conservation and Management. Proceedings of the International Seminar and Workshop, Sabah, Malaysia, July 1997 (Occasional Paper of the IUCN Species Survival Commission No. 25)*; Fowler, S.L., Reed, T.M., Dipper, F.A., Eds.; IUCN SSC Shark Specialist Group & IUCN: Gland, Switzerland; Cambridge, UK, 2002; pp. 104–113.
285. Ahmad, A.; Hilmi, A.H.; Ahemad, S.; Solahuddin, A.R.; Gambang, A.C. *Elasmobranch Resources, Utilization, Trade and Management in Malaysia*; SEAFDEC/MFRDMD: Kuala Terengganu, Malaysia, 2004.
286. Yano, K.; Ahmed, A.; Gambang, A.; Hamid Idris, A.; Razel Azan, A.; Aznan, Z. *Sharks and Rays of Malaysia and Brunei, Darusalam*; Marine Fishery Resources Development and Managment Department, Southeast Asian Fisheries Development Center: Kuala Terengganu, Malaysia, 2005.
287. Last, P.R.; White, W.T.; Caira, J.N.; Jensen, K.; Lim, A.P.; Manjaji-Matsumoto, B.M.; Naylor, G.J.P.; Pogonoski, J.J.; Stevens, J.D.; Yearsley, G.K. *Sharks and Rays of Borneo*; CSIRO Publishing: Collingwood, ON, Canada, 2005.
288. Mohammad Faisal, M.S.; Yusri, A.; Abdul Rahman, A.M.; Lim, A.P.K.; Irman, I.; Nurul Syuhada, H.A.K.; Nurulazrin, M.Y.; Mohammad Fauzi, A. *Valid Local Name of Malaysian Marine Fishes*; Department of Fisheries Malaysia, Ministry of Agriculture and Agro-Based Industry: Putrajaya, Malaysia, 2009.
289. Sembiring, A.; Pertiwi, N.P.D.; Mahardini, A.; Wulandari, R.; Kurniasih, E.M.; Kuncoro, A.W.; Cahyani, N.K.D.; Anggoro, A.W.; Ulfa, M.; Madduppa, H.; et al. DNA barcoding reveals targeted fisheries for endangered sharks in Indonesia. *Fish. Res.* **2015**, *164*, 130–134. [CrossRef]
290. Paulin, C.D.; Stewart, A.L.; Roberts, C.D.; McMillan, P.J. *New Zealand Fish: A Complete Guide*; National Museum of New Zealand Miscellaneous Series; National Museum of New Zealand: Wellington, New Zealand, 1989; Volume 19, pp. 1–279.
291. Roberts, C.D.; Paulin, C.D.; Stewart, A.L.; McPhee, R.P.; McDowall, R.M. Checklist of New Zealand Chordata: Living lancelets, jawless fishes, cartilaginous fishes and bony fishes. In *New Zealand Inventory of Biodiversity: 1. Kingdom Animalia: Radiata, Lophotrochozoa, Deuterostomia*; Gordon, D.P., Ed.; Canterbury University Press: Christchurch, New Zealand, 2009; pp. 529–538.
292. Roberts, C.D.; Barker, J.J.; Stewart, A.L.; Struthers, C.D.; Kortet, S. Checklist of the fishes of New Zealand. In *The Fishes of New Zealand. Vol. 1*; Roberts, C.D., Stewart, A.L., Struthers, C.D., Eds.; Te Papa Press: Wellington, New Zealand, 2015; pp. 147–178.
293. Roberts, C.D.; Stewart, A.L.; Struthers, C.D.; Barker, J.J.; Kortet, S. *Checklist of the Fishes of New Zealand. Online Version 2.0*; Museum of New Zealand Te Papa Tongarewa: Wellington, New Zealand, 2023.
294. Francis, M.P.; Lyon, W.S. *Review of Research and Monitoring Studies on New Zealand Sharks, Skates, Rays and Chimaeras, 2008–2012*; New Zealand Aquatic Environment and Biodiversity Report No. 102; Ministry for Primary Industries: Wellington, New Zealand, 2012; pp. 1–70.
295. Struthers, C.D.; Stewart, A.L.; Roberts, C.D.; Schwarzhans, W.; Barker, J.J.; Kortet, S. Chapter 22: Kingdom Animalia, phylum Chordata (lancelets, hagfishes, cartilaginous & bony fishes, & fossil fishes identified from otoliths). In *The Marine Biota of Aotearoa New Zealand. Updating Our Marine Biodiversity Inventory. NIWA Biodiversity Memoir 136*; Kelly, M., Mills, S., Terezow, M., Sim-Smith, C., Nelson, W., Eds.; National Institute of Water and Atmospheric Research: Wellington, New Zealand, 2023; pp. 331–371.
296. Paul, L.J. *Research on New Zealand's Marine Fish and Fisheries: A Guide to the Literature, 1769 to 2015*; New Zealand Fisheries Assessment Report 2021/29; Ministry for Primary Industries: Wellington, New Zealand, 2021; pp. 1–793.

297. Francis, M.P.; Cole, R.G. Diversity, biogeography and abundance of Kermadec Islands coastal fishes. In *Deep: Talks and Thoughts Celebrating Diversity in New Zealand's Untouched Kermadecs. Proceedings of the Kermadec Symposium, August 2010*; Pew Environment Group, Ed.; Pew Environment Group: Washington, DC, USA, 2010; pp. 37–41.
298. Günther, A. *Report on the Pelagic Fishes Collected by H.M.S. Challenger During the Years 1873–1876; the Voyage of H.M.S. Challenger Zoology*; Neill: Edinburgh, UK, 1889; Volume 31, pp. 1–47. [[CrossRef](#)]
299. Murray, J. *A Summary of the Scientific Results Obtained at the Sounding, Dredging, and Trawling Stations of HMS Challenger*; HM Stationery Office: London, UK, 1895; Volume 1, pp. 1–1665.
300. Trnski, T.; Duffy, C.A.J.; Francis, M.P.; McGrouther, M.A.; Stewart, A.L.; Struthers, C.D.; Zintzen, V. Recent collections of fishes at the Kermadec Islands and new records for the region. *Bull. Auckl. Mus.* **2015**, *20*, 463–480.
301. Waite, E.R. A list of the known fishes of Kermadec and Norfolk Islands, and a comparison with those of Lord Howe Island. *Trans. N. Z. Inst.* **1910**, *42*, 370–383.
302. Cox, G.; Francis, M. *Sharks and Rays of New Zealand*; Canterbury University Press: Christchurch, New Zealand, 1997.
303. Francis, M.P. *The Kermadec Islands: A Marine Reserve Proposal*; Internal Report No. 29; Fisheries Research Division, New Zealand Ministry of Agriculture and Fisheries: Wellington, New Zealand, 1985.
304. Francis, M.P.; Grace, R.V.; Paulin, C.D. Coastal fishes of the Kermadec Islands. *N. Z. J. Mar. Freshw. Res.* **1987**, *21*, 1–13. [[CrossRef](#)]
305. Whitley, G.P. *Australian Sharks*; Lloyd O'Neil Pty. Ltd.: Melbourne, Australia, 1983.
306. UNEP/IUCN—United Nations Environment Programme/International Union the Conservation of Nature. *Coral Reefs of the World. Volume 3: Central and Western Pacific*; UNEP Regional Seas Directories and Bibliographies & IUCN: Cambridge, UK; Nairobi, Kenya, 1988.
307. Figueira, W.F.; Harianto, J. *Lord Howe Island Fishery Catch Report: 2004–2018*; New South Wales Department of Primary Industries: Sydney, Australia, 2022.
308. Rees, M.J.; Knott, N.A.; Davis, T.R.; Davis, A.R.; Gudge, S.; Neilson, J.M.; Fetterplace, L.C.; Jordan, A. Temporal stability in a protected and isolated fish community within marine parks surrounding Lord Howe Island. *Reg. Stud. Mar. Sci.* **2021**, *48*, 102038. [[CrossRef](#)]
309. Whitley, G.P. The Middleton and Elizabeth Reefs, South Pacific Ocean. *Aust. Zool.* **1937**, *8*, 199–231.
310. Choat, J.H.; van Herwerden, L.; Robbins, W.D.; Hobbs, J.P.A.; Ayling, A.M. *A Report on the Ecological Surveys Undertaken at Middleton and Elizabeth Reefs, February 2006. Report to the Australian Government Department of Environment and Heritage*; Commonwealth of Australia: Hobart, Australia, 2006.
311. Hobbs, J.P.A.; Feary, D.A. Monitoring the ecological status of Elizabeth and Middleton Reefs, February 2007. In *Report to the Australian Government Department of Environment and Water Resources; School of Marine and Tropical Biology*; James Cook University: Townsville, Australia, 2007.
312. Pratchett, M.S.; Hobbs, J.P.A.; Hoey, A.S.; Baird, A.H.; Ayling, A.M.; Gudge, S.; Choat, J.H. *Elizabeth and Middleton Reefs Marine National Nature Reserve—Marine Survey 2011*; Commonwealth of Australia: Canberra, Australia, 2011.
313. Monk, J.; Williams, J.; Barrett, N.; Jordan, A.; Lucieer, V.; Althaus, F.; Nichol, S. Biological and habitat feature descriptions for the continental shelves of Australia's temperate-water marine parks—Including collation of existing mapping in all AMPs. In *Report to the National Environmental Science Programme, Marine Biodiversity Hub*; Institute of Marine and Antarctic Studies, University of Tasmania: Hobart, Australia, 2017.
314. Edgar, G.J.; Ceccarelli, D.; Stuart-Smith, R.D.; Cooper, A.T. *Biodiversity Surveys of the Elizabeth and Middleton Reefs Marine National Park Reserve, 2013 and 2018*; Reef Life Survey Foundation Inc.: Hobart, Australia, 2018.
315. Hoey, A.S.; Pratchett, M.S.; Sambrook, K.; Gudge, S.; Pratchett, D.J. *Status and Trends for Shallow Reef Habitats and Assemblages at Elizabeth and Middleton Reefs, Lord Howe Island Marine Park*; Commonwealth of Australia: Townsville, Australia, 2018.
316. Brown, K.; Monk, J.; Williams, J.; Carroll, A.; Harasti, D.; Barrett, N. Depth and benthic habitat influence shallow and mesophotic predatory fishes on a remote, high-latitude coral reef. *PLoS ONE* **2022**, *17*, e0265067. [[CrossRef](#)] [[PubMed](#)]
317. Carroll, A.G.; Monk, J.; Barrett, N.; Nichol, S.; Dalton, S.J.; Dando, N.; Siwabessy, J.; Leplastrier, A.; Evans, H.; Huang, Z.; et al. *Elizabeth and Middleton Reefs, Lord Howe Marine Park, Post Survey Report. Report to the National Environmental Science Program, Marine Biodiversity Hub*; Geoscience Australia: Canberra, Australia, 2021.
318. Randall, J.E.; Williams, J.T.; Smith, D.G.; Kulbicki, M.; Mou Tham, G.; Labrosse, P.; Kronen, M.; Clua, E.; Mann, B.S. Checklist of the shore and epipelagic fishes of Tonga. *Atoll Res. Bull.* **2004**, *502*, 1–35. [[CrossRef](#)]
319. Snyder, J.O. A catalogue of the shore fishes collected by the steamer Albatross about the Hawaiian Islands in 1902. *Bull. U. S. Fish. Comm.* **1904**, *22*, 513–538.
320. Taylor, L.R.; Naftel, G. *Preliminary Investigations of Shark Predation on the Hawaiian Monk Seal at Pearl and Hermes Reef and French Frigate Shoals*; U.S. Marine Mammal Commission Report MMC-77/07; U.S. Marine Mammal Commission: Bethesda, MD, USA, 1978; pp. 1–34.
321. De Crosta, M.A. Age determination and growth of three species of shallow-water carcharhinid sharks in Hawaii. *Pac. Sci.* **1981**, *35*, 266–267.

322. De Crosta, M.A. Age Determination, Growth, and Energetics of Three Species of Carcharhinid Sharks in Hawaii. Master's Thesis, University of Hawaii, Honolulu, HI, USA, 1984.
323. Schultz, J.K.; O'Malley, J.M.; Kehn, E.E.; Polovina, J.J.; Parrish, F.A.; Kosaki, R.K. Tempering expectations of recovery for previously exploited populations in a fully protected marine reserve. *J. Mar. Biol.* **2011**, 749131. [[CrossRef](#)]
324. Fukunaga, A.; Pascoe, K.H.; Pugh, A.R.; Kosaki, R.K.; Burns, J.H. Underwater photogrammetry captures the initial recovery of a coral reef at Lalo Atoll. *Diversity* **2022**, *14*, 39. [[CrossRef](#)]
325. Dang, Y.; Dai, X.; Wu, F. Effects of vertical distribution and soaking time of tuna longline fishing hooks on catches in North Pacific. *S. China Fish. Sci.* **2020**, *16*, 86–93, (In Chinese, with an English abstract). [[CrossRef](#)] [[PubMed](#)]
326. Randall, J.E.; Lobel, P.S.; Chave, E.H. Annotated checklist of the fishes of Johnston Island. *Pac. Sci.* **1985**, *39*, 24–80.
327. Brainard, R.; Maragos, J.; Schroeder, R.; Kenyon, J.; Vroom, P.; Godwin, S.; Hoeke, R.; Aeby, G.; Moffitt, R.; Lammers, M.; et al. The state of coral reef ecosystems of the Pacific Remote Island Areas. In *The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States: 2005*. NOAA Technical Memorandum NOS NCCOS 11; Waddell, J., Ed.; NOAA/NCCOS Centre for Coastal Monitoring and Assessment's Biogeography Team: Silver Spring, MD, USA, 2005; pp. 338–372.
328. Wagner, D.; Kosaki, R.K.; Spalding, H.L.; Whitton, R.K.; Pyle, R.L.; Sherwood, A.R.; Tsuda, R.T.; Calcinai, B. Mesophotic surveys of the flora and fauna at Johnston Atoll, Central Pacific Ocean. *Mar. Biodivers. Rec.* **2014**, *7*, e68. [[CrossRef](#)]
329. Seeto, J.; Baldwin, W.J. *A Checklist of the Fishes of Fiji and a Bibliography of Fijian Fish*; Division of Marine Studies Technical Report No. 1/2010; The University of the South Pacific: Suva, Fiji, 2010.
330. Piovano, S.; Gilman, E. Elasmobranch captures in the Fijian pelagic longline fishery. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **2017**, *27*, 381–393. [[CrossRef](#)]
331. Randall, J.E. Expedition to Pitcairn. *Oceans* **1973**, *6*, 12–21.
332. Randall, J.E. Rapa and beyond. *Oceans* **1974**, *7*, 24–31.
333. Rehder, H.A.; Randall, J.E. Ducie Atoll: Its history, physiography and biota. *Atoll Res. Bull.* **1975**, *183*, 1–40. [[CrossRef](#)]
334. Irving, R.; Dawson, T. *The Marine Environment of the Pitcairn Islands. Report to Global Ocean Legacy, a Project of the Pew Environment Group*; Dundee University Press: Dundee, UK, 2012.
335. Siu, G.; Bacchet, P.; Bernardi, G.; Brooks, A.J.; Carlot, J.; Causse, R.; Claudet, J.; Clua, E.; Delrieu-Trottin, E.; Espiau, B.; et al. Shore fishes of French Polynesia. *Cybium* **2018**, *41*, 245–278. [[CrossRef](#)]
336. Jabado, R.W.; García-Rodríguez, E.; Armstrong, A.O.; Rohner, C.A.; Palacios, M.D.; Gonzalez-Pestana, A.; Bettcher Brito, V.; Charles, R.; Battle-Morera, A. *New Zealand and Pacific Islands: A Regional Compendium of Important Shark and Ray Areas*; IUCN SSC Shark Specialist Group: Dubai, United Arab Emirates, 2024. [[CrossRef](#)]
337. Laboute, P.; Richer de Forges, B. *Le Volcan Sous-Marin Mac Donald (Archipel des îles Australes): Nouvelles Observations Biologiques et Géomorphologiques*; Notes et Documents No. 29 Oceanographie; ORSTOM: Tahiti, French Polynesia, 1986; pp. 1–31. (In French)
338. Plessis, Y. Étude ichtyologique de Rapa. In *Rapa*; Direction des Centres D'expérimentations Nucléaires, Service Mixte de Contrôle Biologique, Eds.; DIRCEN, SMCB: Paris, France, 1986; pp. 215–230. (In French)
339. Briggs, J.C. The East Pacific Barrier and the distribution of marine shore fishes. *Evolution* **1961**, *15*, 545–554. [[CrossRef](#)]
340. Mejía-Falla, P.A.; Navia, A.F. Relationship between body size and geographic range size of elasmobranchs from the Tropical Eastern Pacific: An initial approximation for their conservation. *Cienc. Mar.* **2011**, *37*, 305–321. [[CrossRef](#)]
341. Navia, A.F.; Alfaro-Shigueto, J.; Ágreda-Arango, J.; Areano, E.; Avalos-Castillo, C.; Bizzarro, J.J.; Bustamante, C.; Cevallos, A.; Concha, F.J.; Cruz-Escalona, V.H.; et al. Unveiling macroecological patterns of elasmobranchs in the Eastern Pacific Ocean. *J. Biogeogr.* **2025**, *52*, 323–349. [[CrossRef](#)]
342. Díaz, M. Consideraciones zoogeograficas sobre los tiburones del Pacifico Colombiano. *An. Inst. Investig. Mar. Punta De Betín* **1984**, *13*, 53–65, (In Spanish, with an English abstract). [[CrossRef](#)]
343. Kato, S.; Carvallo, A.H. Shark tagging in the Eastern Pacific Ocean, 1962–1965. In *Sharks, Skates, and Rays*; Gilbert, P.W., Mathewson, R.F., Rall, D.P., Eds.; Johns Hopkins University Press: Baltimore, MD, USA, 1967; pp. 93–109.
344. Ebert, D.A. *Sharks, Rays, and Chimaeras of California*; University of California Press: Berkeley, CA, USA, 2003.
345. Beebe, W.; Tee-Van, J. Eastern Pacific expeditions of the New York Zoological Society. XXV. Fishes from the tropical eastern Pacific. [From Cedros Island, Lower California, South to the Galapagos Islands and Northern Peru.] Part 2. Sharks. *Zool. Sci. Contrib. N. Y. Zool. Soc.* **1941**, *26*, 93–122. [[CrossRef](#)]
346. Walford, L.A. Observations on the shark fishery in the central part of the Gulf of California with records of vitamin potency of liver oils and with keys to the identification of commercially important sharks. *Fish. Mark. News* **1944**, *6*, 2–8.
347. Kato, S. *Sharks of the Genus Carcharhinus Associated with the Tuna Fishery in the Eastern Tropical Pacific Ocean*; United States Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries: Washington, DC, USA, 1964; Volume 172, pp. 1–22.
348. Kato, S. White shark *Carcharodon carcharias* from the Gulf of California with a list of sharks seen in Mazatlan, Mexico, 1964. *Copeia* **1965**, *3*, 384. [[CrossRef](#)]

349. Kato, S.; Springer, S.; Wagner, M.H. *Field Guide to Eastern Pacific and Hawaiian Sharks*; US Department of the Interior, Bureau of Commercial Fisheries: Washington, DC, USA, 1967; Volume 271, pp. 1–71.
350. Steuben, K.S.; Krefft, G. *Die Haie Der Sieben Meere*, 2nd ed.; Paul Parey: Hamburg, Germany; Berlin, Germany, 1989. (In German)
351. López, M.I.; Bussing, W.A. Lista provisional de los peces marinos de la Costa Rica. *Rev. Biol. Trop.* **1982**, *30*, 5–26, (In Spanish, with an English abstract).
352. Grove, J.S.; Lavenberg, R.J. *The Fishes of the Galapagos Islands*; Stanford University Press: Stanford, CA, USA, 1997.
353. Charles Darwin Foundation. Galapagos Species Database: *Carcharhinus galapagensis* (Snodgrass & Heller, 1905). 2026. Available online: <https://www.darwinfoundation.org/en/datazone/checklist?species=7844> (accessed on 17 February 2026).
354. Chirichigno, F.N.; Cornejo, R.M.U. *Catálogo Comentado de Los Peces Marinos Del Perú*; Instituto del Mar del Perú, Publicación Especial: Lima, Peru, 2001. (In Spanish)
355. Espinosa-Pérez, H.; Castro-Aguirre, J.L.; Huidobro-Campos, L., IX. Catálogo sistemático de Tiburones (Elasmobranchii: Selachimorpha). In *Listados faunísticos de México*; Instituto de Biología UNAM: Mexico City, Mexico, 2004; pp. 1–134. (In Spanish)
356. Fricke, R.; Reséndiz-López, M.A.; Oseguera-Rodríguez, A.S. *Fishes and Lampreys of Mexico. An Annotated Checklist*; CONABIO: Mexico City, Mexico, 2024.
357. van der Heiden, A.M.; Findley, L.T. Lista de los peces marinos del sur de Sinaloa, México. *An. Inst. Cienc. Mar. Limnol. Univ. Nac. Autón. Méx.* **1988**, *15*, 209–224, (In Spanish, with an English abstract).
358. González-Acosta, A.F.; Rodiles-Hernández, R.; González-Díaz, A.A. Checklist of the marine and estuarine fishes of Chiapas, Mexico. *Mar. Biodivers.* **2018**, *48*, 1439–1454. [\[CrossRef\]](#)
359. Galeana-Villaseñor, I.; Galván-Magaña, F.; Santana-Hernandez, H. Pesca con anzuelos en barcos palangreros del Océano Pacífico mexicano: Efectos en la captura y peso de tiburones y otras especies. *Rev. Biol. Mar. Oceanogr.* **2009**, *44*, 163–172, (In Spanish, with an English abstract). [\[CrossRef\]](#)
360. Bizzarro, J.J.; Smith, W.D.; Hueter, R.E.; Tyminski, J.; Márquez-Farías, J.F.; Castillo-Géniz, J.L.; Cailliet, G.M.; Villavicencio-Garayzar, C.J. *The Status of Shark and Ray Fishery Resources in the Gulf of California: Applied Research to Improve Management and Conservation*; Technical Publication; Moss Landing Marine Laboratory: Moss Landing, CA, USA, 2007; pp. 1–242.
361. Bizzarro, J.J.; Smith, W.D.; Hueter, R.E.; Villavicencio-Garayzar, C.J. Activities and catch composition of artisanal elasmobranch fishing sites on the eastern coast of Baja California Sur, Mexico. *Bull. South. Calif. Acad. Sci.* **2009**, *108*, 137–151. [\[CrossRef\]](#)
362. Galván-Magaña, F.; Castillo-Geniz, J.L.; Hoyos-Padilla, M.; Ketchum, J.T.; Klimley, A.P.; Ramírez-Amaro, S.; Torres-Rojas, Y.E.; Tovar-Ávila, J. Chapter 3: Shark ecology, the role of the apex predator and current conservation status. In *Sharks in Mexico: Research and Conservation Part A (Adv. Mar. Biol. 83)*; Larson, S.E., Lowry, D., Eds.; Academic Press: London, UK, 2019; pp. 61–114. [\[CrossRef\]](#) [\[PubMed\]](#)
363. Santana Hernández, H.; Valdez Flores, J.J.; Valdez Carrazco, L. Pesquería semi-industrial de Manzanillo, Colima. In *Tiburones Mexicanos de Importancia Pesquera En La CITES Parte II*; Tovar Ávila, J., Castillo Géniz, J.L., Eds.; Instituto Nacional de Pesca y Acuicultura: Coyoacán, Mexico, 2021; pp. 24–30. (In Spanish)
364. Applegate, S.P.; Soltelo-Macias, F.; Espinosa-Arrubarrena, L. *An Overview of Mexican Shark Fisheries, with Suggestions for Shark Conservation in Mexico*; NOAA Technical Report NMFS; US Department of Commerce: Washington, DC, USA, 1993; Volume 115, pp. 31–38.
365. Del Moral-Flores, L.F.; Morrone, J.J.; Alcocer Durand, J.; Pérez-Ponce de León, G. Diversidad y afinidades biogeográficas de los tiburones, rayas y quimeras (Chondrichthyes: Elasmobranchii, Holocephali) de México. *Rev. Biol. Trop.* **2016**, *64*, 1469–1486, (In Spanish, with an English abstract). [\[CrossRef\]](#)
366. Velasco-Lozano, M.F.; Ramírez-Ortiz, G.; Reyes-Bonilla, H.; Hollarsmith, J.A. Fish assemblages at mesophotic depths in the Pacific: A comparison between continental and oceanic islands of Mexico. *Cienc. Mar.* **2020**, *46*, 321–342. [\[CrossRef\]](#)
367. Espinoza, M.; Araya-Arce, T.; Chaves-Zamora, I.; Chinchilla, I.; Cambra, M. Monitoring elasmobranch assemblages in a data-poor country from the Eastern Tropical Pacific using baited remote underwater video stations. *Sci. Rep.* **2020**, *10*, 17175. [\[CrossRef\]](#) [\[PubMed\]](#)
368. Harper, S.; Guzman, H.M.; Zyllich, K.; Zeller, D. Reconstructing Panama's total fisheries catches from 1950 to 2010: Highlighting data deficiencies and management needs. *Mar. Fish. Rev.* **2014**, *76*, 51–65. [\[CrossRef\]](#) [\[PubMed\]](#)
369. Mejía-Falla, P.A.; Navia, A.F.; Mejía-Ladino, L.M.; Acero, P.; Rubio, A. Tiburones y rayas de Colombia (Pisces Elasmobranchii): Lista actualizada, revisada y comentada. *Bol. Investig. Mar. Cost.* **2007**, *36*, 111–149, (In Spanish, with an English abstract).
370. Aristizábal, J.P.C.; Castro-González, E.; Puentes, V.; Rueda, M.; Lasso, C.; Duarte, L.O.; Grijalba-Bendeck, M.; Gómez, F.; Navia, A.F.; Mejía-Falla, P.A.; et al. *Plan de Acción Nacional Para La Conservación Y Manejo de Tiburones, Rayas Y Quimeras de Colombia (PAN-Tiburones Colombia)*; Instituto Colombiano Agropecuario, Secretaria Agricultura Y Pesca San Andrés Isla, Ministerio de Ambiente, Vivienda Y Desarrollo Territorial, Instituto de Investigaciones Marinas Y Costeras, Instituto Alexander Von Humboldt, Universidad Del Magdalena, Universidad Jorge Tadeo Lozano, Pontificia Universidad Javeriana, Fundación SQUALUS, Fundación Malpelo Y Otros Ecosistemas Marinos, Conservación Internacional WWF Colombia: Bogotá, Colombia, 2010. (In Spanish)

371. Navia, A.F.; Mejía-Falla, P.A. *Guía Para La Identificación de Especies de Tiburones Y Rayas Comercializadas En El Pacífico Colombiano*; Fundación SQUALUS: Cali, Colombia, 2011. (In Spanish)
372. Mejía-Falla, P.A.; Navia, A.F. Checklist of marine elasmobranchs of Colombia. *Univ. Sci.* **2019**, *24*, 164–199. [[CrossRef](#)]
373. Ágreda-Arango, J.; Ballesteros, C.; Bessudo, S.; Bent-Hooker, H.; Bolaños, N.; Caldas, J.P.; Duarte, L.O.; Gómez, F.; Lara, G.; Loaiza, J.; et al. Richness distribution patterns of marine elasmobranchs in Colombia. *Rev. Biol. Mar. Oceanogr.* **2022**, *57*, 1–12. [[CrossRef](#)]
374. Navia, A.F.; Mejía-Falla, P.A.; Hleap, J.S. Zoogeography of elasmobranchs in the Colombian Pacific Ocean and Caribbean Sea. *Neotrop. Ichthyol.* **2016**, *14*, e140134. [[CrossRef](#)]
375. Béarez, P.; Séret, B. Les poissons. In *Clipperton, Environnement et Biodiversité D'un Microcosme Océanique (Patrim. Nat. 68)*; Charpy, L., Ed.; MNHN: Paris, France; IRD: Marseille, France, 2009; pp. 143–154, (In French, with an English abstract).
376. Clua, E.; Aurat, F.; Bin, N.; Bin, S.; Boissin, E.; Chavance, Y.; Cron, D.; Hertau, M.; Elineau, A.; Lancelot, J.; et al. *Mission Tara Pacific sur l'atoll de Clipperton (île de La Passion-France) du 06 au 13 août 2018; Rapport de mission CRIOBE USR3278 CNRS-EPHE-UPVD et TARA PACIFIC. RA272*; République Française: Paris, France; République en Polynésie Française: Papeete, France, 2018. (In French)
377. Chirichigno, F.N. *Lista Sistemática de Los Peces Marinos Comunes Para Ecuador-Perú-Chile*; Comisión Permanente del Pacífico Sur, Chile-Ecuador-Perú: Guayaquil, Ecuador, 1969. (In Spanish)
378. Béarez, P. Lista de los peces marinos del Ecuador continental. *Rev. Biol. Trop.* **1996**, *44*, 731–741, (In Spanish, with an English abstract).
379. Aguilar, F.; Chalén, X.; Villón, C. *Plan de Acción Nacional de Tiburones. Proceso de Investigación Recursos Bioacuáticos Y Ambiente*; Instituto Nacional de Pesca: Quito, Ecuador, 2005. (In Spanish)
380. Coello, S. *La Administración de Los Chondrichthyes En Ecuador. Aportes Para El Plan Nacional de Tiburones*; UICN: Quito, Ecuador, 2005. (In Spanish)
381. Bustamante, C.; Lamilla, J. Realidades en la pesquería de tiburones de la costa del Pacífico Latinoamericano. In *II Taller de Cooperación Internacional. Apéndices Y Memorias*; Universidad Austral de Chile: Valdivia, Chile, 2006. (In Spanish)
382. Calle-Morán, M.D.; Béarez, P. Updated checklist of marine cartilaginous fishes from continental and insular Ecuador (Tropical Eastern Pacific Ocean). *Cybium* **2020**, *44*, 239–250. [[CrossRef](#)]
383. Rivera, G.F.; González, W.T.; Vásquez, K.B.; Zambrano, C.Z.; Macías, J.D.; Espinoza, J.P.; Zambrano, E.A.; Ormaza, E.B.; Peñaherrera Palma, C.; Diz, F.R. *Guía de Identificación de Dientes, Troncos Y Aletas de Tiburones Asociados a Pesquerías de Ecuador. Plan de Acción Nacional Para La Conservación Y El Manejo de Tiburones de Ecuador (PAT-Ec)*; Ministerio de Producción, Comercio Exterior, Inversiones y Pesca: Quito, Ecuador, 2023. (In Spanish)
384. Bostok, T.; Herdson, D. La pesca y utilización del tiburón en el Ecuador. *Bol. Cient. Tec. Inst. Nac. Pesca Ecuad.* **1985**, *8*, 21–38. (In Spanish)
385. Martínez-Ortiz, J.; Aires-da-Silva, A.M.; Lennert-Cody, C.E.; Maunder, M.N. The Ecuadorian artisanal fishery for large pelagics: Species composition and spatio-temporal dynamics. *PLoS ONE* **2015**, *10*, e0135136. [[CrossRef](#)] [[PubMed](#)]
386. Soriano, D.; Duque, R.; Herrera, M.; Zambrano, R. Vulnerable species associated with surface longline fishing in Ecuadorian mother ships. *Mar. Fish. Sci. (MAFIS)* **2025**, *38*, 173–186. [[CrossRef](#)]
387. Navarrete-Forero, G.; Del-Solar-Escardó, A.; Alfaro-Cordova, E.; Rodríguez-Escalante, L.; Andrade-Vera, S.; Willette, D.A. Chapter 15: Ecuador case study. Transboundary marine conservation and fisheries management in Ecuador and northern Peru. In *Challenges in Tropical Coastal Zone Management: Experiences and Lessons Learned*; Wolff, M., Ferse, S.C.A., Govan, H., Eds.; Springer: Cham, Switzerland, 2023; pp. 247–276. [[CrossRef](#)]
388. Romero, M.A.; Alcántara-Pizarro, P.F.; Verde, K. *Guía de Campo Para La Determinación de Tiburones En La Pesca Artesanal Del Perú*; IMARPE: Lima, Peru, 2015. (In Spanish)
389. Pequeño, G.; Rucabado, J.A.; Lloris, D. Tiburones comunes a las costas de Chile, California-Oregon y Namibia-Sud Africa. *Rev. Biol. Mar. Oceanogr.* **1990**, *25*, 65–80, (In Spanish, with an English abstract).
390. Lamilla, J.; Bustamante, C. Guía para el reconocimiento de: Tiburones, rayas y quimeras de Chile. *Oceana* **2005**, *17*, 1–80. (In Spanish)
391. Bustamante, C.; Vargas-Caro, C.; Bennett, M.B. Not all fish are equal: Functional biodiversity of cartilaginous fishes (Elasmobranchii and Holocephali) in Chile. *J. Fish Biol.* **2014**, *85*, 1617–1633. [[CrossRef](#)] [[PubMed](#)]
392. Sáez, S.; Pequeño, G. Taxonomic dental keys for the Chilean taxa of the Superorder Squalomorphi (Chondrichthyes: Elasmobranchii). *Lat. Am. J. Aquat. Res.* **2010**, *38*, 474–484, (In Spanish, with an English abstract). [[CrossRef](#)]
393. Salinas-de-León, P.; Acuña-Marrero, D.; Rastoin, E.; Friedlander, A.M.; Donovan, M.K.; Sala, E. Largest global shark biomass found in the northern Galápagos Islands of Darwin and Wolf. *PeerJ* **2016**, *4*, e1911. [[CrossRef](#)] [[PubMed](#)]
394. Pazmiño, D.A.; Maes, G.E.; Simpfendorfer, C.A.; Salinas-de-León, P.; van Herwerden, L. Genome-wide SNPs reveal low effective population size within confined management units of the highly vagile Galapagos shark (*Carcharhinus galapagensis*). *Conserv. Genet.* **2017**, *18*, 1151–1163. [[CrossRef](#)]

395. Sáez, S.; Pequeño, G.; Lamilla, J. Clave taxonómica del Superorden Squalomorphi de Chile (Pisces: Elasmobranchii). *Rev. Biol. Mar. Oceanogr.* **2010**, *45*, 619–634. (In Spanish, with an English abstract). [[CrossRef](#)]
396. Randall, J.E. Easter Island, an ichthyological expedition. *Oceans* **1970**, *3*, 48–59.
397. Froese, R.; Pauly, D. FishBase. World Wide Web electronic publication. Version 08/2022. *Carcharhinus menisorrh* (Valenciennes, 1839). Accessed Through: World Register of Marine Species. 2022. Available online: <https://www.marinespecies.org/aphia.php?p=taxdetails&id=343717> (accessed on 14 December 2022).
398. Yáñez-Arancibia, A. Zoogeografía de la fauna ictiológica de la Isla de Pascua (Easter Island). *Publ. Espec. Cent. Cienc. Mar. Limnol. Univ. Nac. Autón. Mex.* **1975**, *2*, 29–52. (In Spanish, with an English abstract).
399. Randall, J.E.; Cea Egaña, A. Native names of Easter Island fishes, with comments on the origin of the Rapanui people. *Bish. Mus. Occ. Pap.* **1984**, *25*, 1–16.
400. Gausmann, P. Synopsis of global fresh and brackish water occurrences of the bull shark *Carcharhinus leucas* Valenciennes, 1839 (Pisces: Carcharhinidae), with comments on distribution and habitat use. *Integr. Syst. Stuttg. Contr. Nat. Hist.* **2021**, *4*, 55–213. [[CrossRef](#)]
401. GBIF—Global Biodiversity Information Facility. *Carcharhinus leucas* (Müller & Henle, 1839) collected in Chile. Occurrence dataset <https://doi.org/10.15468/va0trp> via GBIF.org. 2023. Available online: <https://www.gbif.org/occurrence/1803985154> (accessed on 17 April 2023).
402. Khidas, K. Canadian Museum of Nature Fish Collection. Version 1.130. Canadian Museum of Nature. Dataset/Occurrence. <https://doi.org/10.15468/bm8amw> accessed via GBIF.org. Available online: [https://ipt.nature.ca/resource?r=cmn\\_fish&v=1.130](https://ipt.nature.ca/resource?r=cmn_fish&v=1.130) (accessed on 17 April 2023).
403. DiSalvo, L.H.; Randall, J.E.; Cea Egaña, A. Ecological reconnaissance of the Easter Island sublittoral marine environment. *Natl. Geogr. Res.* **1988**, *4*, 451–473.
404. Pequeño, G.R.; Sáez, S.B. The shark *Carcharhinus galapagensis* from Salas y Gómez Island, Chile (Chondrichthyes: Carcharhinidae). *Rev. Biol. Trop.* **2003**, *51*, 795–796. [[PubMed](#)]
405. Friedlander, A.M.; Ballesteros, E.; Beets, J.; Berkenpas, E.; Gaymer, C.F.; Gorny, M.; Sala, E. Effects of isolation and fishing on the marine ecosystems of Easter Island and Salas y Gómez, Chile. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **2013**, *23*, 515–531. [[CrossRef](#)]
406. Jabado, R.W.; García-Rodríguez, E.; Kyne, P.M.; Charles, R.; Gonzalez Pestana, A.; Priest, M.A.; Battle-Morera, A.; Notarbartolo di Sciara, G. *Central and South American Pacific: A Regional Compendium of Important Shark and Ray Areas*; IUCN SSC Shark Specialist Group: Dubai, United Arab Emirates, 2023. [[CrossRef](#)]
407. DiSalvo, L.H.; Randall, J.E. The marine fauna of Rapanui, past and present. In *Easter Island Studies: Contributions to the History of Rapanui in Memory of William T. Mulloy*; Fischer, S.R., Ed.; Oxbow Books: Oxford, UK, 1993; pp. 16–23.
408. Glynn, P.W.; Wellington, G.M.; Wieters, E.A.; Navarrete, S.A. Reef-building coral communities of Easter Island (Rapa Nui), Chile. In *Latin American Coral Reefs*; Cortés, J., Ed.; Elsevier Science BV: Amsterdam, The Netherlands, 2003; pp. 473–494. [[CrossRef](#)]
409. Morales, N.A.; Easton, E.E.; Friedlander, A.M.; Harvey, E.S.; Garcia, R.; Gaymer, C.F. Spatial and seasonal differences in the top predators of Easter Island: Essential data for implementing the new Rapa Nui multiple-uses marine protected area. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **2019**, *29*, 118–129. [[CrossRef](#)]
410. Zyllich, K.; Harper, S.; Licandeo, R.; Vega, R.; Zeller, D.; Pauly, D. Fishing in Easter Island, a recent history (1950–2010). *Lat. Am. J. Aquat. Res.* **2014**, *42*, 845–856. [[CrossRef](#)]
411. Morales, N.A.; Coghlan, A.R.; Hayden, G.; Guajardo, P. First sighting of a tropical benthic reef shark species at Rapa Nui: Chance dispersal or a sign of things to come? *J. Fish Biol.* **2019**, *95*, 642–646. [[CrossRef](#)] [[PubMed](#)]
412. Meyer, C.G.; Clark, T.B.; Papastamatiou, Y.P.; Whitney, N.M.; Holland, K.N. Long-term movements of tiger sharks (*Galeocerdo cuvier*) in Hawaii. *Mar. Ecol. Prog. Ser.* **2009**, *381*, 223–235. [[CrossRef](#)]
413. Meyer, C.G.; Papastamatiou, Y.P.; Holland, K.M. A multiple instrument approach to quantifying the movement patterns and habitat use of tiger (*Galeocerdo cuvier*) and Galapagos sharks (*Carcharhinus galapagensis*) at French Frigate Shoals, Hawaii. *Mar. Biol.* **2010**, *157*, 1857–1868. [[CrossRef](#)]
414. Papastamatiou, Y.P.; Meyer, C.G.; Kosaki, R.K.; Wallsgrove, N.J.; Popp, B.N. Movements and foraging of predators associated with mesophotic coral reefs and their potential for linking ecological habitats. *Mar. Ecol. Prog. Ser.* **2015**, *521*, 155–170. [[CrossRef](#)]
415. White, E.R.; Myers, M.C.; Flemming, J.M.; Baum, J.K. Shifting elasmobranch community assemblage at Cocos Island—An isolated marine protected area. *Conserv. Biol.* **2015**, *29*, 1186–1197. [[CrossRef](#)] [[PubMed](#)]
416. Michael, S.W. *Reef Sharks and Rays of the World: A Guide to Their Identification, Behavior, and Ecology*; Sea Challengers: Monterey, CA, USA, 1993.
417. Roff, G.; Doropoulos, C.; Rogers, A.; Bozec, Y.M.; Krueck, N.C.; Aurellado, E.; Priest, M.; Birrell, C.; Mumby, P.J. The ecological role of sharks on coral reefs. *Trends Ecol. Evol.* **2016**, *31*, 395–407. [[CrossRef](#)] [[PubMed](#)]
418. MacNeil, M.A.; Chapman, D.D.; Heupel, M.R.; Simpfendorfer, C.A.; Heithaus, M.R.; Meekan, M.; Harvey, E.; Goetze, J.; Kiszka, J.; Bond, M.E.; et al. Global status and conservation potential of reef sharks. *Nature* **2020**, *583*, 801–806. [[CrossRef](#)] [[PubMed](#)]

419. Osgood, G.J.; Baum, J.K. Reef sharks: Recent advances in ecological understanding to inform conservation. *J. Fish Biol.* **2015**, *87*, 1489–1523. [CrossRef] [PubMed]
420. Steel, R. *Sharks of the World*; Blandford: London, UK, 1998.
421. Espinoza, M.; Quesada-Perez, F.; Madrigal-Mora, S.; Naranjo-Elizondo, B.; Clarke, T.M.; Cortés, J. A decade of submersible observations revealed temporal trends in elasmobranchs in a remote island of the Eastern Tropical Pacific Ocean. *Sci. Rep.* **2024**, *14*, 13786. [CrossRef] [PubMed]
422. Hobson, E.S. Sharks increasing visual field. *Underw. Nat.* **1964**, *2*, 29.
423. Martin, R.A. A review of shark agonistic displays: Comparison of display features and implications for shark-human interactions. *Mar. Freshw. Behav. Physiol.* **2007**, *40*, 3–34. [CrossRef]
424. Klimley, A.P.; Porcher, I.F.; Clua, E.; Pratt, H.L., Jr. A review of the behaviours of the Chondrichthyes: A multi-species ethogram for the chimaeras, sharks, and rays. *Behaviour* **2023**, *1*, 1–114. [CrossRef]
425. Myrberg, A.A., Jr. Understanding shark behavior. In *Sharks: An Inquiry into Biology, Behavior, Fisheries, and Use, Proceedings of the Conference, Portland, OR, USA, 13–15 October 1985*; Cook, S., Ed.; Oregon State University Extension Service: Portland, OR, USA, 1985; pp. 41–83.
426. Johnson, R.H.; Nelson, D.R. Agonistic display in the gray reef shark, *Carcharhinus menisorrh*, and its relationship to attacks on man. *Copeia* **1973**, *1*, 76–84. [CrossRef]
427. Papastamatiou, Y.P.; Wetherbee, B.M.; Lowe, C.G.; Crow, G. Distribution and diet of four species of carcharhinid shark in the Hawaiian Islands: Evidence for resource partitioning and competitive exclusion. *Mar. Ecol. Prog. Ser.* **2006**, *320*, 239–251. [CrossRef]
428. Madigan, D.J.; Richardson, A.J.; Carlisle, A.B.; Weber, S.B.; Brown, J.; Hussey, N.E. Water column structure defines vertical habitat of twelve pelagic predators in the South Atlantic. *ICES J. Mar. Sci.* **2021**, *78*, 867–883. [CrossRef]
429. Klimley, A.P.; Ketchum, J.T.; Lara-Lizardi, F.; Papastamatiou, Y.P.; Hoyos-Padilla, E.M. Evidence for spatial and temporal resource partitioning of sharks at Roca Partida, an isolated pinnacle in the eastern Pacific. *Environ. Biol. Fish.* **2022**, *105*, 1963–1974. [CrossRef]
430. Farabaugh, N.F.; Bond, M.E.; Chapman, D.; Clua, E.; Harborne, A.R.; Heupel, M.R.; Kiszka, J.J.; Heithaus, M.R. Incorporating environmental factors is critical for determining conservation baselines for relative abundance of sharks on coral reefs. *Mar. Ecol. Prog. Ser.* **2024**, *736*, 93–105. [CrossRef]
431. Camhi, M.D.; Valenti, S.V.; Fordham, S.V.; Fowler, S.L.; Gibson, C. *The Conservation Status of Pelagic Sharks and Rays: Report of the IUCN Shark Specialist Group Pelagic Shark Red List Workshop*; IUCN SSC Shark Specialist Group: Newbury, UK, 2009.
432. Fowler, H.W. *The Fishes of the George Vanderbilt South Pacific Expedition, 1937*; Monographs Series; Academy of Natural Sciences of Philadelphia: Philadelphia, PA, USA, 1938; Volume 2, pp. 1–349.
433. Andrzejczek, S.; Lucas, T.C.D.; Goodman, M.C.; Hussey, N.; Armstrong, A.J.; Carlisle, A.; Coffey, D.M.; Gleiss, A.C.; Huveneers, C.; Jacoby, D.M.P.; et al. Diving into the vertical dimension of elasmobranch movement ecology. *Sci. Adv.* **2022**, *8*, eabo1754. [CrossRef] [PubMed]
434. Grubbs, R.D. Chapter 7: Ontogenetic shifts in movements and habitat use. In *Sharks and Their Relatives II. Biodiversity, Adaptive Physiology, and Conservation*; Carrier, J.C., Musick, J.A., Heithaus, M.R., Eds.; CRC Press: Boca Raton, FL, USA, 2010; pp. 335–366. [CrossRef]
435. Lofthus, A.J.; Beach-Mehrotra, M.; Fisher, M.R.; Wozniak, J.R.; Matich, P. Factors influencing the nursery dynamics of bull sharks *Carcharhinus leucas* in two estuaries along the Texas coast. *Mar. Ecol. Prog. Ser.* **2024**, *728*, 43–58. [CrossRef]
436. IUCN SSC Shark Specialist Group. *Review of Migratory Chondrichthyan Fishes*; CMS Technical Series No. 15; Information Press: Oxford, UK, 2007; pp. 1–68.
437. Asher, J.; Williams, I.D.; Harvey, E.S. An assessment of mobile predator populations along shallow and mesophotic depth gradients in the Hawaiian Archipelago. *Sci. Rep.* **2017**, *7*, 3905. [CrossRef] [PubMed]
438. Knip, D.M.; Heupel, M.R.; Simpfendorfer, C.A. Sharks in nearshore environments: Models, importance, and consequences. *Mar. Ecol. Prog. Ser.* **2010**, *402*, 1–11. [CrossRef]
439. Nadon, M.O.; Baum, J.K.; Williams, I.D.; Mcpherson, J.M.; Zgliczynski, B.J.; Richards, B.L.; Schroeder, R.E.; Brainard, R.E. Re-creating missing population baselines for Pacific reef sharks. *Conserv. Biol.* **2012**, *26*, 493–503. [CrossRef] [PubMed]
440. Froese, R. R Code (PrefTempBatch\_5.R) to Estimate Preferred Temperature from AquaMaps (ver. 10/2019). In FishBase. World Wide Web Electronic Publication. Version 08/2022. *Carcharhinus galapagensis* (Snodgrass & Heller, 1905): Galapagos Shark; Froese, R., Pauly, D., Eds. 2020. Available online: <https://www.fishbase.se/references/FBRefSummary.php?ID=123201> (accessed on 10 July 2023).
441. Wass, R.C. A Comparative Study of the Life History, Distribution and Ecology of the Sandbar Shark and the Gray Reef Shark in Hawaii. Ph.D. Thesis, University of Hawaii, Honolulu, HI, USA, 1971.
442. Heagney, E.C.; Lynch, T.P.; Babcock, R.C.; Suthers, I.M. Pelagic fish assemblages assessed using mid-water baited video: Standardising fish counts using bait plume size. *Mar. Ecol. Prog. Ser.* **2007**, *350*, 255–266. [CrossRef]

443. Lara-Lizardi, F. Distribution Patterns of Sharks in the Revillagigedo Archipelago and Their Connectivity in the Eastern Tropical Pacific. Ph.D. Thesis, CICIMAR—Centro Interdisciplinario de Ciencias Marinas del Instituto Politécnico Nacional, La Paz, México, 2018. (In Spanish, with an English abstract).
444. Kohler, N.E.; Turner, P.A. Shark tagging: A review of conventional methods and studies. *Environ. Biol. Fish.* **2001**, *60*, 191–224. [[CrossRef](#)]
445. Lowe, C.G.; Wetherbee, B.M.; Meyer, C.G. Using acoustic telemetry monitoring techniques to quantify movement patterns and site fidelity of sharks and giant trevally around French Frigate Shoals and Midway Atoll. *Atoll Res. Bull.* **2006**, *543*, 281–303.
446. Bass, A.J. Long-term recoveries of tagged sharks. *Copeia* **1977**, *3*, 574–575. [[CrossRef](#)]
447. Dale, J.J.; Stankus, A.M.; Burns, M.S.; Meyer, C.G. The shark assemblage at French Frigate Shoals Atoll, Hawai'i: Species composition, abundance and habitat use. *PLoS ONE* **2011**, *6*, e16962. [[CrossRef](#)] [[PubMed](#)]
448. Horn, P.L.; Ballara, S.L.; Sutton, P.J.H.; Griggs, L.H. *Evaluation of the Diets of Highly Migratory Species in New Zealand Waters*; New Zealand Fisheries Assessment Report 116; Ministry for Primary Industries: Wellington, New Zealand, 2013; pp. 1–141.
449. Fowler, S.L. *El Estado de Conservación de Los Tiburones Migratorios*; Secretaría del PNUMA/CMS: Bonn, Germany, 2014. (In Spanish)
450. Ketchum, J.T.; Hearn, A.; Shillinger, G.; Espinoza, E.; Peñaherrera, C.R.; Klimley, A.P. Shark movements and the design of protected pelagic environments within and beyond the Galapagos Marine Reserve. In *Proceedings of the Galapagos Science Symposium 2009*; Wolff, M., Gardener, M., Eds.; Charles Darwin Foundation: Puerto Ayora, Galapagos, Ecuador, 2009; pp. 127–130.
451. Friedlander, A.M.; Zgliczynski, B.J.; Ballesteros, E.; Aburto-Oropeza, O.; Bolaños, A.; Sala, E. The shallow-water fish assemblage of Isla del Coco National Park, Costa Rica: Structure and patterns in an isolated, predator-dominated ecosystem. *Rev. Biol. Trop.* **2012**, *60*, 321–338. [[CrossRef](#)]
452. Jost, C.; Bessudo, S.; De Merigo, H.; Dumas, P.; Hoyos, M.; Clua, E. *Appui au Suivi Scientifique de l'atoll de Clipperton (île de La Passion-France)—Mission PASSiOn2017 du 30 avril au 14 mai 2017*; Rapport de synthèse CRILOBE USR3278 CNRS-EPHE-UPVD, RA281; République Française: Paris, France, 2019. (In French)
453. Lara-Lizardi, F.; Hoyos-Padilla, M.; Hearn, A.; Klimley, A.P.; Galván-Magaña, F.; Arauz, R.; Bessudo, S.; Castro, E.; Clua, E.; Espinoza, E.; et al. Shark movements in the Revillagigedo Archipelago and connectivity with the Eastern Tropical Pacific. *bioRxiv* **2020**. [[CrossRef](#)]
454. Lara-Lizardi, F.; Ketchum, J.T.; Hearn, A.R.; Klimley, A.P.; Galván-Magaña, F.; Antoniou, A.; Arauz, R.; Bessudo, S.; Castro, E.; Chávez, E.J.; et al. Shark movements between islands in the Revillagigedo Archipelago and connectivity to other islands in the Eastern Tropical Pacific. *PLoS ONE* **2026**, *21*, e0341840. [[CrossRef](#)] [[PubMed](#)]
455. Peñaherrera-Palma, C.R.; Arauz, R.; Bessudo, S.; Bravo-Ormaza, E.; Chassot, O.; Chinacalle-Martínez, N.; Espinoza, E.; Forsberg, K.; García-Rada, E.; Guzmán, H.; et al. *Justificación Biológica Para La Creación de La MigraVía Coco-Galápagos*; MigraMar & Pontificia Universidad Católica del Ecuador Sede Manabí: Portoviejo, Manabí, Ecuador, 2018; (In Spanish and English).
456. Ketchum, J.T.; Hoyos-Padilla, M.; Aldana-Moreno, A.; Ayres, K.; Galván-Magaña, F.; Hearn, A.; Lara-Lizardi, F.; Muntaner-López, G.; Grau, M.; Trejo-Ramírez, A.; et al. Chapter 1: Shark movement patterns in the Mexican Pacific: A conservation and management perspective. In *Sharks in Mexico: Research and Conservation Part B (Adv. Mar. Biol. 85)*; Academic Press: Cambridge, MA, USA; Elsevier Ltd.: London, UK, 2020; pp. 1–37. [[CrossRef](#)] [[PubMed](#)]
457. Wetherbee, B.M.; Harvey, G.M.; Kresge, C.D.; Brantley, M.K.; Fleischer, O.W.; Kobasa, N.A.; Vaudo, J.J.; Shivji, M.S. Movements of Galapagos Sharks (*Carcharhinus galapagensis*) in Eastern Tropical Pacific Waters off Central and South America. *Fishes* **2025**, *10*, 459. [[CrossRef](#)]
458. Sandin, S.A.; Williams, I. *Trophic Classifications of Reef Fishes from the Tropical U.S. Pacific (Version 1.0)*; Scripps Institution of Oceanography Technical Report; UC San Diego: San Diego, CA, USA, 2010; pp. 1–18.
459. Ritter, E.K.; Munoz, A. How to kill another shark: A first inside look at a potential hunting strategy of the Galapagos shark. *Open Fish. Sci. J.* **2018**, *11*, 46–51. [[CrossRef](#)]
460. Arnés-Urgellés, C.; Pérez-Rosas, D.; Barahona, D.; Salinas-de-León, P. First direct evidence of a Galapagos sea lion (*Zalophus wollebaeki*) preyed by a Galapagos shark (*Carcharhinus galapagensis*). *Aquat. Mamm.* **2020**, *46*, 254–258. [[CrossRef](#)]
461. Hawn, D. *Galapagos shark (Carcharhinus galapagensis) Removal and Shark Sighting Observations at Trig Island, French Frigate Shoals During the 2000 Hawaiian Monk Seal Field Season*; Prepared for the National Marine Fisheries Service (NMFS); Honolulu Laboratory: Honolulu, HI, USA, 2000.
462. Hayes, S. *Galapagos Shark Predation of Monk Seal Pups at Trig Island, FFS 2001*; U.S. Department of Commerce, NOAA Internal Report; Pacific Island Fisheries Science Center: Honolulu, HI, USA, 2002.
463. Heithaus, M.R. Chapter 17: Predator-prey interactions. In *Biology of Sharks and Their Relatives*; Carrier, J.C., Musick, J.A., Heithaus, M.R., Eds.; CRC Press: Boca Raton, FL, USA, 2004; pp. 487–521.
464. Gobush, K.S. *Shark Predation on Hawaiian Monk Seals: Workshop II & Post-Workshop Developments, November 5–6, 2008*; NOAA Tech. Mem. NOAA-TM-NMFS-PIFSC-21; U.S. Department of Commerce: Washington, DC, USA, 2010; pp. 1–43.

465. Fertl; Acevedo-Gutierrez, D.; Darby, A. A report of killer whales (*Orcinus orca*) feeding on a carcharhinid shark in Costa Rica. *Mar. Mamm. Sci.* **1996**, *12*, 606–611. [[CrossRef](#)]
466. Brown, J.; Beard, A.; Clingham, E.; Fricke, R.; Henry, L.; Wirtz, P. The fishes of St Helena Island, central Atlantic Ocean—New records and an annotated check-list. *Zootaxa* **2019**, *4543*, 151–194. [[CrossRef](#)] [[PubMed](#)]
467. Ramírez-Macías, D.; Queiroz, N.; Pierce, S.J.; Humphries, N.E.; Sims, D.W.; Brunnenschweiler, J.M. Oceanic adults, coastal juveniles: Tracking the habitat use of whale sharks off the Pacific coast of Mexico. *PeerJ* **2017**, *5*, e3271. [[CrossRef](#)] [[PubMed](#)]
468. Rangel-Morales, J.M.; Rosales-López, L.P.; Díaz-Jaimes, P.; Amezcua-Martínez, F.; Ketchum, J.T.; Hoyos-Padilla, M.; Corgos, A. Regional philopatry of scalloped hammerhead sharks (*Sphyrna lewini*) to nursery areas in the Mexican Pacific. *Hydrobiologia* **2022**, *849*, 3083–3099. [[CrossRef](#)]
469. Assis, J.; Legrand, T.; Fragkopoulou, E.; Serrao, E.A.; Araujo, M. Coastal oceanographic connectivity estimates at the global scale. *bioRxiv* **2024**. [[CrossRef](#)]
470. Rosenblatt, R.H.; Baldwin, W.J. A review of the Eastern Pacific sharks of the Genus *Carcharhinus*, with a redescription of *C. malmeloensis* (Fowler) and California records of *C. remotus* (Dumeril). *Calif. Fish. Game* **1958**, *44*, 137–159.
471. Heupel, M.R.; Papastamatiou, Y.P.; Espinoza, M.; Green, M.E.; Simpfendorfer, C.A. Reef shark science—Key questions and future directions. *Front. Mar. Sci.* **2019**, *6*, 12. [[CrossRef](#)]
472. Bass, A.J. Problems in studies of sharks in the southwest Indian Ocean. In *Sensory Biology of Sharks, Skates, and Rays*; Hodgson, E.S., Mathewson, R.F., Eds.; Office of Naval Research, Department of the Navy: Arlington, TX, USA, 1978; pp. 545–594.
473. Oliveira, L.P.P.D. Abundância Relativa e uso do Habitat por Tubarões do gênero *Carcharhinus* (*C. falciformis*, *C. galapagensis* e *C. obscurus*) no Arquipélago de São Pedro e São Paulo—Brasil. Ph.D. Thesis, Universidade Federal de Pernambuco, Recife, Brazil, 2017. (In Portuguese, with an English abstract).
474. Weideli, O.C.; Daly, R.; Peel, L.R.; Heithaus, M.R.; Shivji, M.S.; Planes, S.; Papastamatiou, Y.P. Elucidating the role of competition in driving spatial and trophic niche patterns in sympatric juvenile sharks. *Oecologia* **2023**, *201*, 673–688. [[CrossRef](#)] [[PubMed](#)]
475. McKibben, J.N.; Nelson, D.R. Patterns of movement and grouping of gray reef sharks, *Carcharhinus amblyrhynchos*, at Enewetak, Marshall Islands. *Bull. Mar. Sci.* **1986**, *38*, 89–110.
476. Randall, J.E. Contribution to the biology of the whitetip reef shark (*Triaenodon obesus*). *Pac. Sci.* **1977**, *31*, 143–164.
477. Nelson, D.R.; Johnson, R.R.; McKibben, J.N.; Pittenger, G.G. Agonistic attacks on divers and submersibles by gray reef sharks, *Carcharhinus amblyrhynchos*: Antipredatory or competitive? *Bull. Mar. Sci.* **1986**, *38*, 68–88.
478. Friedlander, A.; DeMartini, E.; Wedding, L.; Clark, R. Chapter 5: Fishes. In *A Marine Biogeographic Assessment of the Northwestern Hawaiian Islands*; NOAA Tech. Mem. NOS NCCOS; Friedlander, A., Keller, K.E., Wedding, L., Clarke, A., Monaco, M., Eds.; U.S. Department of Commerce: Washington, DC, USA, 2009; Volume 84, pp. 155–189.
479. Dunn, N.; Savolainen, V.; Weber, S.; Andrzejczek, S.; Carbone, C.; Curnick, D. Elasmobranch diversity across a remote coral reef atoll revealed through environmental DNA metabarcoding. *Zool. J. Linn. Soc.* **2022**, *196*, 593–607. [[CrossRef](#)]
480. Calich, H.J.; Rodríguez, J.P.; Eguíluz, V.M.; Hammerschlag, N.; Pattiaratchi, C.; Duarte, C.M.; Sequeira, A.M. Comprehensive analytical approaches reveal species-specific search strategies in sympatric apex predatory sharks. *Ecography* **2021**, *44*, 1544–1556. [[CrossRef](#)]
481. Clua, E.; Galves, J.B.; Werry, J.M. Insight into cumulative intra-guild and intra-specific depredation among sharks. *Cybiu* **2014**, *38*, 311–313. [[CrossRef](#)]
482. Heupel, M.R.; Simpfendorfer, C.A. Estuarine nursery areas provide a low-mortality environment for young bull sharks *Carcharhinus leucas*. *Mar. Ecol. Prog. Ser.* **2011**, *433*, 237–244. [[CrossRef](#)]
483. Cramp, J.E. Evaluating the Effectiveness of Large-Scale Marine Reserves on Wide-Ranging Sharks: A Case Study of the Cook Islands Shark Sanctuary. Ph.D. Thesis, James Cook University, Townsville, Australia, 2021.
484. Bond, M.E.; Valentin-Albanese, J.; Babcock, E.A.; Hussey, N.E.; Heithaus, M.R.; Chapman, D.D. The trophic ecology of Caribbean reef sharks (*Carcharhinus perezi*) relative to other large teleost predators on an isolated coral atoll. *Mar. Biol.* **2018**, *165*, 67. [[CrossRef](#)]
485. Bezerra, N.P.A.; Oliveira, L.P.P.D.; Macena Rocha, B.C.L.; Mendonça, S.A.D.; Hazin, F.H.V. Abundance of sharks of the genus *Carcharhinus* in Saint Peter and Saint Paul archipelago, Brazil. In *Sharks International*; 3–8 June 2018 Programme and Abstracts; Editora UFPB: João Pessoa, Brazil, 2018.
486. Pardo, S.A.; Dulvy, N.K. Body mass, temperature, and depth shape the maximum intrinsic rate of population increase in sharks and rays. *Ecol. Evol.* **2022**, *12*, e9441. [[CrossRef](#)] [[PubMed](#)]
487. Niella, Y.; Smoothey, A.F.; Peddemors, V.; Harcourt, R. Predicting changes in distribution of a large coastal shark in the face of the strengthening East Australian Current. *Mar. Ecol. Prog. Ser.* **2020**, *642*, 163–177. [[CrossRef](#)]
488. Diaz-Carballido, P.L.; Mendoza-González, G.; Yañez-Arenas, C.A.; Chiappa-Carrara, X. Evaluation of shifts in the potential future distributions of carcharhinid sharks under different climate change scenarios. *Front. Mar. Sci.* **2022**, *8*, 745501. [[CrossRef](#)]

489. Talwar, B.S.; Bradley, D.; Berry, C.; Bond, M.E.; Bouyoucos, I.A.; Brooks, A.M.; Fields, C.Y.A.; Gallagher, A.J.; Guttridge, T.L.; Guttridge, A.E.; et al. Estimated life-history traits and movements of the Caribbean reef shark (*Carcharhinus perezii*) in The Bahamas based on tag-recapture data. *Mar. Biol.* **2022**, *169*, 55. [\[CrossRef\]](#)
490. Daly, R.; Smale, M.J.; Cowley, P.D.; Froneman, P.W. Residency patterns and migration dynamics of adult bull sharks (*Carcharhinus leucas*) on the east coast of Southern Africa. *PLoS ONE* **2014**, *9*, e109357. [\[CrossRef\]](#) [\[PubMed\]](#)
491. Calich, H.J.; Estevanez, M.; Hammerschlag, N. Overlap between highly suitable habitats and longline gear management areas reveals vulnerable and protected regions for highly migratory sharks. *Mar. Ecol. Prog. Ser.* **2018**, *602*, 183–195. [\[CrossRef\]](#)
492. Friedlander, A.M.; Aeby, G.; Balwani, S.; Bowen, B.; Brainard, R.; Clark, A.; Kenyon, J.; Maragos, J.; Meyer, C.; Vroom, P.; et al. The state of coral reef ecosystems of the Northwestern Hawaiian Islands. In *The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States: 2008*; NOAA Tech. Mem. NOS NCCOS; Waddell, J.E., Clarke, A.M., Eds.; U.S. Department of Commerce: Washington, DC, USA, 2008; Volume 73, pp. 263–306.
493. Luiz, O.J.; Madin, J.S.; Robertson, D.R.; Rocha, L.A.; Wirtz, P.; Floeter, S.R. Ecological traits influencing range expansion across large oceanic dispersal barriers: Insights from tropical Atlantic reef fishes. *Proc. R. Soc. Lond. B Biol. Sci.* **2012**, *279*, 1033–1040. [\[CrossRef\]](#) [\[PubMed\]](#)
494. Gove, J.M.; McManus, M.A.; Neuheimer, A.B.; Polovina, J.J.; Drazen, J.C.; Smith, C.R.; Merrifield, M.A.; Friedlander, A.M.; Ehses, J.S.; Young, C.W.; et al. Near-island biological hotspots in barren ocean basins. *Nat. Commun.* **2016**, *7*, 10581. [\[CrossRef\]](#) [\[PubMed\]](#)
495. Stevenson, C.; Katz, L.S.; Micheli, F.; Block, B.; Heiman, K.W.; Perle, C.; Wenig, K.; Dunbar, R.; Witting, J. High apex predator biomass on remote Pacific islands. *Coral Reefs* **2007**, *26*, 47–51. [\[CrossRef\]](#)
496. Mourier, J.; Maynard, J.; Parravicini, V.; Ballesta, L.; Clua, E.; Domeier, M.L.; Planes, S. Extreme inverted trophic pyramid of reef sharks supported by spawning groupers. *Curr. Biol.* **2016**, *26*, 2011–2016. [\[CrossRef\]](#) [\[PubMed\]](#)
497. Hellberg, M.E. Gene flow and isolation among populations of marine animals. *Annu. Rev. Ecol. Evol. Syst.* **2009**, *40*, 291–310. [\[CrossRef\]](#)
498. Bailleul, D.; Mackenzie, A.; Sacchi, O.; Poisson, F.; Bierne, N.; Arnaud-Haond, S. Large-scale genetic panmixia in the blue shark (*Prionace glauca*): A single worldwide population, or a genetic lag-time effect of the “grey zone” of differentiation? *Evol. Appl.* **2018**, *11*, 614–630. [\[CrossRef\]](#) [\[PubMed\]](#)
499. Corrigan, S.; Lowther, A.D.; Beheregaray, L.B.; Bruce, B.D.; Cliff, G.; Duffy, C.A.J.; Foulis, A.; Francis, M.P.; Goldsworthy, S.D.; Hyde, J.R.; et al. Population connectivity of the highly migratory shortfin mako (*Isurus oxyrinchus* Rafinesque 1810) and implications for management in the Southern Hemisphere. *Front. Ecol. Evol.* **2018**, *6*, 187. [\[CrossRef\]](#)
500. Sreelekshmi, S.; Sukumaran, S.; Kishor, T.G.; Sebastian, W.; Gopalakrishnan, A. Population genetic structure of the oceanic whitetip shark, *Carcharhinus longimanus*, along the Indian coast. *Mar. Biodivers.* **2020**, *50*, 78. [\[CrossRef\]](#)
501. Lessios, H.A.; Robertson, D.R. Crossing the impassable: Genetic connections in 20 reef fishes across the eastern Pacific barrier. *Proc. R. Soc. Lond. B Biol. Sci.* **2006**, *273*, 2201–2208. [\[CrossRef\]](#) [\[PubMed\]](#)
502. Last, P.R.; Yearsley, G.K. Zoogeography and relationships of Australasian skates (Chondrichthyes: Rajidae). *J. Biogeogr.* **2002**, *29*, 1627–1641. [\[CrossRef\]](#)
503. Clark, T.B. Population Structure of *Manta birostris* (Chondrichthyes: Mobulidae) from the Pacific and Atlantic Oceans. Master’s Thesis, Texas A&M University, Galveston, TX, USA, 2002.
504. Briggs, J.C. Fishes of worldwide (circumtropical) distribution. *Copeia* **1960**, *3*, 171–180. [\[CrossRef\]](#) [\[PubMed\]](#)
505. Springer, V.G. *Pacific Plate Biogeography, with Special Reference to Shorefishes*; Smithsonian Institution Press: Washington, DC, USA, 1982.
506. Compagno, L.J.V. *Sharks of the Order Carcharhiniformes*; Princeton University Press: Princeton, NJ, USA, 1988.
507. Brée, B.; Condamine, F.L.; Guinot, G. Combining palaeontological and neontological data shows a delayed diversification burst of carcharhiniform sharks likely mediated by environmental change. *Sci. Rep.* **2022**, *12*, 21906. [\[CrossRef\]](#) [\[PubMed\]](#)
508. Bazzi, M.; Campione, N.E.; Kear, B.P.; Pimiento, C.; Ahlberg, P.E. Feeding ecology has shaped the evolution of modern sharks. *Curr. Biol.* **2021**, *31*, 5138–5148. [\[CrossRef\]](#) [\[PubMed\]](#)
509. Latrubesse, E.M.; Bocquentin, J.; Santos, J.C.R.; Ramonell, C.G. Palaeoenvironmental model for the late Cenozoic of southwestern Amazonia: Palaeontology and geology. *Acta Amaz.* **1997**, *27*, 103–118. [\[CrossRef\]](#)
510. Castro, J.I. Resurrection of the name *Carcharhinus cerdale*, a species different from *Carcharhinus porosus*. *Aqua Int. J. Ichthyol.* **2011**, *17*, 1–15.
511. Daly, R.; Murray, T.S.; Roberts, M.J.; Schoeman, D.S.; Lubitz, N.; Barnett, A.; Cedras, R.; Bolaji, D.A.; Brokensha, G.M.; Le Noury, P.M.; et al. Breaking barriers: Transoceanic movement by a bull shark. *Ecology* **2025**, *106*, e70096. [\[CrossRef\]](#) [\[PubMed\]](#)
512. Pirog, A.; Ravigné, V.; Fontaine, M.C.; Rieux, A.; Gilabert, A.; Cliff, G.; Clua, E.; Daly, R.; Heithaus, M.R.; Kiszka, J.J.; et al. Population structure, connectivity, and demographic history of an apex marine predator, the bull shark *Carcharhinus leucas*. *Ecol. Evol.* **2019**, *9*, 12980–13000. [\[CrossRef\]](#) [\[PubMed\]](#)
513. Misra, K.S.; Menon, M.A.S. On the distribution of the elasmobranchs and chimaeras of the Indian region in relation to the mean annual isotherms. *Rec. Indian Mus.* **1955**, *53*, 73–86. [\[CrossRef\]](#)
514. Smith, J.L.B. *The Sea Fishes of Southern Africa*; Central News Agency Ltd.: Cape Town, South Africa, 1949.

515. Last, P.R.; White, W.T. Biogeographic patterns in the Australian chondrichthyan fauna. *J. Fish Biol.* **2011**, *79*, 1193–1213. [[CrossRef](#)] [[PubMed](#)]
516. González-Barba, G.; Thies, D. Asociaciones faunísticas de condriictios en el Cenozoico de la Península de Baja California, Mexico. *Profil* **2000**, *18*, 1–4. (In Spanish)
517. González-Rodríguez, K.A.; Espinosa-Arrubarrena, L.; González-Barba, G. An overview of the Mexican fossil fish record. In *Mesozoic Fishes 5—Global Diversity and Evolution*; Arratia, G., Schultze, H.P., Wilson, M.V.H., Eds.; Dr. Friedrich Pfeil: Munich, Germany, 2013; pp. 9–34.
518. Leder, R.M. Morphometrische Analyse der Kieferbezahnung Fossiler wie Rezenten Carcharhinider Selachier. Ph.D. Thesis, University of Leipzig, Leipzig, Germany, 2014. (In German)
519. Carrillo-Briceño, J.D.; Aguilera, O.A.; De Gracia, C.; Aguirre-Fernández, G.; Kindlimann, R.; Sánchez-Villagra, M.R. An early Neogene elasmobranch fauna from the southern Caribbean (western Venezuela). *Palaeontol. Electron.* **2016**, *19*, 2.27A, 1–33. [[CrossRef](#)]
520. Staig, F.; Hernández, S.; López, P.; Villafaña, J.A.; Varas, C.; Soto, L.P.; Carrillo Briceño, J.D. Late Neogene elasmobranch fauna from the Coquimbo formation, Chile. *Rev. Bras. Paleontol.* **2015**, *18*, 261–272. [[CrossRef](#)]
521. Losos, J.B.; Ricklefs, R.E. Adaptation and diversification on islands. *Nature* **2009**, *457*, 830–836. [[CrossRef](#)] [[PubMed](#)]
522. Glaus, K.B.J.; Appleyard, S.A.; Stockwell, B.; Brunnschweiler, J.M.; Shivji, M.S.; Clua, E.; Marie, A.D.; Rico, C. Insights into insular isolation of the bull shark, *Carcharhinus leucas* (Müller and Henle, 1839), in Fijian waters. *Front. Mar. Sci.* **2020**, *7*, 586015. [[CrossRef](#)]
523. Veríssimo, A.; Sampaio, I.; McDowell, J.R.; Alexandrino, P.; Mucientes, G.; Queiroz, N.; da Silva, C.; Jones, C.S.; Noble, L.R. World without borders—Genetic population structure of a highly migratory marine predator, the blue shark (*Prionace glauca*). *Ecol. Evol.* **2017**, *7*, 4768–4781. [[CrossRef](#)] [[PubMed](#)]
524. Ruck, C.L.; Shivji, M.S.; Jabado, R.W.; Bernard, A.M. Cross ocean-basin population genetic dynamics in a pelagic top predator of high conservation concern, the oceanic whitetip shark, *Carcharhinus longimanus*. *Conserv. Genet.* **2024**, *25*, 677–695. [[CrossRef](#)]
525. Pazmiño, D.A.; Maes, G.E.; Green, M.E.; Simpfendorfer, C.E.; Hoyos-Padilla, E.M.; Duffy, C.A.J.; Meyer, C.G.; Kerwath, S.E.; Salinas-de-León, P.; van Herwerden, L. Fuerte ruptura trans-pacífica y unidades de conservación local en el tiburón de Galápagos (*Carcharhinus galapagensis*) revelada mediante el uso de marcadores genómicos. *Arch. Acad. USFQ* **2019**, *20*, 15–19. (In Spanish)
526. van Herwerden, L.; Almojil, D.K.; Choat, J.H. Population genetic structure of Australian Galapagos reef sharks *Carcharhinus galapagensis* at Elizabeth and Middleton Reefs Marine National Nature Reserve and Lord Howe Island Marine Park. In *Final Report to the Department of the Environment, Water, Heritage and the Arts*; Commonwealth of Australia: Canberra, Australia, 2008.
527. van der Meer, M.H. Coming, Going, Gone? Population Connectivity and Extinction Risk in Restricted Range Coral Reef Fishes on Isolated Islands. Ph.D. Thesis, James Cook University, Townsville, Australia, 2013. [[CrossRef](#)]
528. Hearn, A.R.; Green, J.; Román, M.H.; Acuña-Marrero, D.; Espinoza, E.; Klimley, A.P. Adult female whale sharks make long-distance movements past Darwin Island (Galapagos, Ecuador) in the Eastern Tropical Pacific. *Mar. Biol.* **2016**, *163*, 214. [[CrossRef](#)]
529. Nalesso, E.; Hearn, A.; Sosa-Nishizaki, O.; Steiner, T.; Antoniou, A.; Reid, A.; Bessudo, S.; Soler, G.; Klimley, A.P.; Lara-Lizardi, F.; et al. Movements of scalloped hammerhead sharks (*Sphyrna lewini*) at Cocos Island, Costa Rica and between oceanic islands in the Eastern Tropical Pacific. *PLoS ONE* **2019**, *14*, e0213741. [[CrossRef](#)] [[PubMed](#)]
530. Phillips, N.M.; Devloo-Delva, F.; McCall, C.; Daly-Engel, T.S. Reviewing the genetic evidence for sex-biased dispersal in elasmobranchs. *Rev. Fish. Biol. Fish.* **2021**, *31*, 821–841. [[CrossRef](#)]
531. Pacoureau, N.; Carlson, J.K.; Kindsvater, H.K.; Rigby, C.L.; Winker, H.; Simpfendorfer, C.A.; Charvet, P.; Pollom, R.A.; Barreto, R.; Sherman, C.S.; et al. Conservation successes and challenges for wide-ranging sharks and rays. *Proc. Natl. Acad. Sci. USA* **2023**, *120*, e2216891120. [[CrossRef](#)] [[PubMed](#)]
532. Dulvy, N.K.; Pacoureau, N.; Rigby, C.L.; Pollom, R.A.; Jabado, R.W.; Ebert, D.A.; Finucci, B.; Pollock, C.M.; Cheok, J.; Derrick, D.H.; et al. Overfishing drives over one-third of all sharks and rays toward a global extinction crisis. *Curr. Biol.* **2021**, *31*, 4773–4787. [[CrossRef](#)] [[PubMed](#)]
533. Heupel, M.R.; Simpfendorfer, C.A.; Espinoza, M.; Smoothey, A.F.; Tobin, A.; Peddemors, V. Conservation challenges of sharks with continental scale migrations. *Front. Mar. Sci.* **2015**, *2*, 12. [[CrossRef](#)]
534. Becerril-García, E.E.; Arauz, R.; Arellano-Martínez, M.; Bonfil, R.; Ayala-Bocos, A.; Castillo-Géniz, J.L.; Carrera-Fernández, M.; Charvet, P.; Chiaramonte, G.; Cisneros-Montemayor, A.M.; et al. Research priorities for the conservation of chondrichthyans in Latin America. *Biol. Conserv.* **2022**, *269*, 109535. [[CrossRef](#)]
535. Sherman, C.S.; Digel, E.D.; Zubick, P.; Eged, J.; Haque, A.B.; Matsushiba, J.H.; Simpfendorfer, C.A.; Sant, G.; Dulvy, N.K. High overexploitation risk due to management shortfall in highly traded requiem sharks. *Conserv. Lett.* **2023**, *16*, e12940. [[CrossRef](#)]
536. Simpfendorfer, C.A.; Heithaus, M.R.; Heupel, M.R.; MacNeil, M.A.; Meekan, M.; Harvey, E.; Sherman, C.S.; Currey-Randall, L.M.; Goetze, J.S.; Kiszka, J.J.; et al. Widespread diversity deficits of coral reef sharks and rays. *Science* **2023**, *380*, 1155–1160. [[CrossRef](#)] [[PubMed](#)]

537. Gupta, T.; Karnad, D.; Kottillil, S.; Kottillil, S.; Gulland, E.M. Shark and ray research in India has low relevance to their conservation. *Ocean Coast. Manag.* **2022**, *217*, 106004. [\[CrossRef\]](#)
538. Shiffman, D.S. The causes and consequences of public misunderstanding of shark conservation. *Integr. Comp. Biol.* **2024**, *64*, 171–177. [\[CrossRef\]](#) [\[PubMed\]](#)
539. Fundación Oceana (Ed.) Description of the European Union surface longline fleet operating in the Atlantic Ocean and compilation of detailed EUROSTAT data on shark catches by EU fleets in the Atlantic. *Collect. Vol. Sci. Pap. ICCAT* **2009**, *64*, 1746–1754.
540. Kwon, Y.; An, D.H.; Moon, D.Y.; Hwang, S.J.; Lee, J.B. An ecological risk assessment for the effect of the Korean tuna longline fishery in the Western and Central Pacific Ocean. *J. Korean Soc. Fish. Ocean Technol.* **2009**, *45*, 22–33, (In Korean, with an English abstract). [\[CrossRef\]](#)
541. Barreto, R.; Ferretti, F.; Flemming, J.M.; Amorim, A.; Andrade, H.; Worm, B.; Lessa, R. Trends in the exploitation of South Atlantic shark populations. *Conserv. Biol.* **2016**, *30*, 792–804. [\[CrossRef\]](#) [\[PubMed\]](#)
542. Duffy, C.A.J.; Erdmann, M.; Finucci, B.; Griffiths, M.; Lewis, R.; Middlemiss, K.; Stewart, A.; Hitchmough, R.; Michel, P. *Conservation Status of Chondrichthyans (Chimaeras, Sharks and Rays) in Aotearoa New Zealand, 2024*; New Zealand Threat Classification Series 47; Department of Conservation Te Papa Atawhai: Wellington, New Zealand, 2025; pp. 1–29.
543. Heagney, E.C. Pelagic Fish in Coastal Waters: Hydrographic Habitats, Fine Scale Population Structure And Implications For Spatial Management. Ph.D. Thesis, University of New South Wales, Sydney, Australia, 2009. [\[CrossRef\]](#)
544. Dwyer, R.G.; Krueck, N.C.; Udyawer, V.; Heupel, M.R.; Chapman, D.; Pratt, H.L., Jr.; Garla, R.; Simpfendorfer, C.A. Individual and population benefits of marine reserves for reef sharks. *Curr. Biol.* **2020**, *30*, 480–489. [\[CrossRef\]](#) [\[PubMed\]](#)
545. Shiffman, D.S. Potential for recovery of declining reef sharks. *Science* **2023**, *380*, 1104–1105. [\[CrossRef\]](#) [\[PubMed\]](#)
546. Ward-Paige, C.A. A global overview of shark sanctuary regulations and their impact on shark fisheries. *Mar. Policy* **2017**, *82*, 87–97. [\[CrossRef\]](#)
547. Knip, D.M.; Heupel, M.R.; Simpfendorfer, C.A. Evaluating marine protected areas for the conservation of tropical coastal sharks. *Biol. Conserv.* **2012**, *148*, 200–209. [\[CrossRef\]](#)
548. Burgess, G.H.; Musick, J.A. Chapter 8.2: Wide-ranging marine species. In *Sharks, Rays and Chimaeras: The Status of the Chondrichthyan Fishes. Status Survey*; Fowler, S.L., Cavanagh, R.D., Camhi, M., Burgess, G.H., Cailliet, G.M., Fordham, S.V., Simpfendorfer, C.A., Musick, J.A., Eds.; IUCN SSC Shark Specialist Group & IUCN: Gland, Switzerland; Cambridge, UK, 2005; pp. 213–214.
549. Burns, E.S.; Bradley, D.; Thomas, L.R. Global hotspots of shark interactions with industrial longline fisheries. *Front. Mar. Sci.* **2023**, *9*, 1062447. [\[CrossRef\]](#)
550. Luiz, O.J.; Edwards, A.J. Extinction of a shark population in the Archipelago of Saint Paul’s Rocks (equatorial Atlantic) inferred from the historical record. *Biol. Conserv.* **2011**, *144*, 2873–2881. [\[CrossRef\]](#)
551. de Queiroz, J.D.G.R.; Bezerra, N.P.; Macena, B.C.; Hazin, F.H. Back from the dead? Not really. The tale of the Galapagos shark (*Carcharhinus galapagensis*) in a remote Brazilian Archipelago. *Biol. Conserv.* **2021**, *256*, 109097. [\[CrossRef\]](#)
552. Saldaña-Ruiz, L.E.; Sosa-Nishizaki, O.; Cartamil, D. Historical reconstruction of Gulf of California shark fishery landings and species composition, 1939–2014, in a data-poor fishery context. *Fish. Res.* **2017**, *195*, 116–129. [\[CrossRef\]](#)
553. Vaske, T., Jr.; Vilho, A.C.; Gadig, O.B.F. *Grandes Peixes Oceânicos da Costa Brasileira*; Instituto de Biociências: São Vicente, Brazil, 2020. (In Portuguese)
554. Smith, S.E.; Au, D.W.; Show, C. Intrinsic rebound potentials of 26 species of Pacific sharks. *Mar. Freshw. Res.* **1998**, *49*, 663–678. [\[CrossRef\]](#)
555. Phillips, B.; Hale, J.; Maliel, M. *Elizabeth and Middleton Reefs. Ramsar Wetland Ecological Character Description*; Australian Government, Department of the Environment and Heritage & Natural Heritage Trust: Canberra, Australia, 2004.
556. Hazin, F.H.V.; Macena Rocha, B.C.L.; Viana, D.D.L.; de Oliveira Lana, F.; de Oliveira, L.P.P.; Bezerra, N.P.A.; Mendonça, S.A. Capítulo 10: Elasmobrânquios do Arquipélago de São Pedro e São Paulo. In *Arquipélago de São Pedro e São Paulo: 20 Anos de Pesquisa*; Oliveira, J.E.L., Viana, D.D.L., de Souza, M.A.C., Eds.; Via Design Publicações: Recife, Brazil, 2018; pp. 143–159. (In Portuguese, with an English abstract).
557. Carr, L.A.; Stier, A.C.; Fietz, K.; Montero, I.; Gallagher, A.J.; Bruno, J.F. Illegal shark fishing in the Galápagos Marine Reserve. *Mar. Policy* **2013**, *39*, 317–321. [\[CrossRef\]](#)
558. Castrejón, M. Revealing the unseen: Shark finning in the Galapagos Marine Reserve through illegal fishers’ eyes and a situational crime prevention approach. *Biol. Conserv.* **2025**, *311*, 111452. [\[CrossRef\]](#)
559. Friedlander, A.M.; DeMartini, E.E. Contrasts in density, size, and biomass of reef fishes between the northwestern and the main Hawaiian islands: The effects of fishing down apex predators. *Mar. Ecol. Prog. Ser.* **2002**, *230*, 253–264. [\[CrossRef\]](#)
560. Williams, I.D.; Walsh, W.J.; Schroeder, R.E.; Friedlander, A.M.; Richards, B.L.; Stamoulis, K.A. Assessing the importance of fishing impacts on Hawaiian coral reef fish assemblages along regional-scale human population gradients. *Environ. Conserv.* **2008**, *35*, 261–272. [\[CrossRef\]](#)
561. Friedlander, A.M.; Caselle, J.E.; Ballesteros, E.; Brown, E.K.; Turchik, A.; Sala, E. The Real Bounty: Marine Biodiversity in the Pitcairn Islands. *PLoS ONE* **2014**, *9*, e100142. [\[CrossRef\]](#) [\[PubMed\]](#)

562. Letessier, T.B.; Mouillot, D.; Bouchet, P.J.; Vigliola, L.; Fernandes, M.C.; Thompson, C.; Boussarie, G.; Turner, J.; Juhel, J.B.; Maire, E.; et al. Remote reefs and seamounts are the last refuges for marine predators across the Indo-Pacific. *PLoS Biol.* **2019**, *17*, e3000366. [\[CrossRef\]](#) [\[PubMed\]](#)
563. Graham, N.A.J.; Spalding, M.D.; Sheppard, C.R.D. Reef shark declines in remote atolls highlight the need for multi-faceted conservation action. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **2010**, *20*, 543–548. [\[CrossRef\]](#)
564. Porcher, I.F.; Darvell, B.W. Shark Fishing vs. Conservation: Analysis and Synthesis. *Sustainability* **2022**, *14*, 9548. [\[CrossRef\]](#)
565. Hitchmough, R.; Bull, L.; Cromarty, P. *New Zealand Threat Classification System Lists: 2005. Part 1*; New Zealand Department of Conservation: Wellington, New Zealand, 2007.
566. Duffy, C.A.J.; Francis, M.P.; Dunn, M.; Finucci, B.; Ford, R.; Hitchmough, R.; Rolfe, J. *Conservation Status of New Zealand Chondrichthyans (Chimaeras, Sharks and Rays)*, 2016; N. Z. Threat Classification Series 23; Publishing Team, Department of Conservation: Wellington, New Zealand, 2018; pp. 1–13.
567. Ford, R.B.; Francis, M.P.; Holland, L.; Clark, M.R.; Duffy, C.A.J.; Dunn, M.R.; Jones, E.; Wells, R. *Qualitative (Level 1) Risk Assessment of the Impact of Commercial Fishing on New Zealand Chondrichthyans: An Update for 2017*; New Zealand Aquatic Environment and Biodiversity Report No. 201; Ministry for Primary Industries: Wellington, New Zealand, 2018; pp. 1–103.
568. Francis, M.P.; Duffy, C.A.J. New records, checklist and biogeography of Kermadec Islands' coastal fishes. *Bull. Auckl. Mus.* **2015**, *20*, 481–495.
569. Finucci, B.; Duffy, C.A.J.; Francis, M.P.; Gibson, C.; Kyne, P.M. The extinction risk of New Zealand chondrichthyans. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **2019**, *29*, 783–797. [\[CrossRef\]](#)
570. Espinoza, M. Galapagos Shark (Indo-West Pacific Subpopulation), *Carcharhinus galapagensis*. Status of Australian Fish Stocks Reports. Online Report Prepared for the Australian Government. 2019. Available online: [https://fish.gov.au/docs/SharkReport/FRDC\\_Carcharhinus\\_galapagensis.pdf](https://fish.gov.au/docs/SharkReport/FRDC_Carcharhinus_galapagensis.pdf) (accessed on 26 January 2023).
571. Kyne, P.M.; Barreto, R.; Carlson, J.; Fernando, D.; Fordham, S.; Francis, M.P.; Herman, K.; Jabado, R.W.; Liu, K.M.; Pacoureau, N.; et al. Galapagos Shark, *Carcharhinus galapagensis*. Status of Australian Fish Stocks Reports. Shark Report Cards. 2023. Available online: [https://www.fish.gov.au/docs/SharkReport/2023\\_FRDC\\_Carcharhinus\\_galapagensis\\_final.pdf](https://www.fish.gov.au/docs/SharkReport/2023_FRDC_Carcharhinus_galapagensis_final.pdf) (accessed on 25 January 2024).
572. Cerutti-Pereyra, F.; Moity, N.; Dureuil, M.; Ramírez-González, J.; Reyes, H.; Budd, K.; Jarrín, J.M.; Salinas-de-León, P. Artisanal longline fishing the Galapagos Islands—Effects on vulnerable megafauna in a UNESCO World Heritage site. *Ocean Coast. Manag.* **2020**, *183*, 104995. [\[CrossRef\]](#)
573. Schiller, L.; Alava, J.J.; Grove, J.; Reck, G.; Pauly, D. The demise of Darwin's fishes: Evidence of fishing down and illegal shark finning in the Galápagos Islands. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **2015**, *25*, 431–446. [\[CrossRef\]](#)
574. Zimmerhackel, J.S.; Schuhbauer, A.C.; Usseglio, P.; Heel, L.C.; Salinas-de-León, P. Catch, bycatch and discards of the Galapagos Marine Reserve small-scale handline fishery. *PeerJ* **2015**, *3*, e995. [\[CrossRef\]](#) [\[PubMed\]](#)
575. Klimley, A.P.; Arauz, R.; Bessudo, S.; Chávez, E.J.; Chinacalle, N.; Espinoza, E.; Green, J.; Hearn, A.R.; Hoyos-Padilla, M.E.; Nalesso, E.; et al. Studies of the movement ecology of sharks justify the existence and expansion of marine protected areas in the Eastern Pacific Ocean. *Environ. Biol. Fish.* **2022**, *105*, 2133–2153. [\[CrossRef\]](#)
576. Goetze, J.S.; Heithaus, M.R.; MacNeil, M.A.; Harvey, E.; Simpfendorfer, C.A.; Heupel, M.R.; Meekan, M.; Wilson, S.; Bond, M.E.; Speed, C.W.; et al. Directed conservation of the world's reef sharks and rays. *Nat. Ecol. Evol.* **2024**, *8*, 1118–1128. [\[CrossRef\]](#) [\[PubMed\]](#)
577. Kyne, P.M.; di Sciara, G.N.; Morera, A.B.; Charles, R.; Rodríguez, E.G.; Fernando, D.; Gonzalez Pestana, A.; Priest, M.; Jabado, R.W. Important Shark and Ray Areas: A new tool to optimize spatial planning for sharks. *Oryx* **2023**, *57*, 146–147. [\[CrossRef\]](#)
578. Talwar, B.S.; Anderson, B.; Avalos-Castillo, C.G.; Blanco-Parra, M.P.; Briones, A.; Cardenosa, D.; Carlson, J.K.; Charvet, P.; Cotton, C.F.; Crysler, Z.; et al. Extinction risk, reconstructed catches and management of chondrichthyan fishes in the Western Central Atlantic Ocean. *Fish Fish.* **2022**, *23*, 1150–1179. [\[CrossRef\]](#)
579. Ellis, J.R.; Clarke, M.W.; Cortés, E.; Heessen, H.J.; Apostolaki, P.; Carlson, J.K.; Kulka, D.W. Chapter 9: Management of elasmobranch fisheries in the North Atlantic. In *Advances in Fisheries Science: 50 Years on from Beverton and Holt*; Payne, A.I.L., Cotter, J., Potter, T., Eds.; Blackwell Publishing: Oxford, UK, 2008; pp. 184–228. [\[CrossRef\]](#)
580. Wetherbee, B.M.; Lowe, C.G.; Crow, G.L. A review of shark control in Hawaii with recommendations for future research. *Pac. Sci.* **1994**, *48*, 95–115.
581. NOAA/NMFS—National Oceanic and Atmospheric Administration/National Marine Fisheries Service. *United States National Plan of Action for the Conservation and Management of Sharks*; NOAA & NMFS: Silver Spring, MD, USA, 2001.
582. Harting, A.L. *Shark Predation on Hawaiian Monk Seals Workshop, Honolulu, Hawaii, January 8–9, 2008*; Pacific Islands Fisheries Science Center, National Marine Fisheries Service, NOAA; Pacific Islands Fisheries Science Centre: Honolulu, HI, USA, 2010. [\[CrossRef\]](#)
583. Pooley, S.G. *Supplemental Environmental Assessment of the Program for Decreasing or Eliminating Predation of Pre-Weaned Hawaiian Monk Seal Pups by Galapagos Sharks in the Northwestern Hawaiian Islands*; NOAA & NMFS: Honolulu, HI, USA, 2010.

584. Gobush, K.S.; Farry, S.C. Non-lethal efforts to deter shark predation of Hawaiian monk seal pups. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **2012**, *22*, 751–761. [\[CrossRef\]](#)
585. Littnan, C.; Barbieri, M.; Bohlander, J.L.; Norris, T.; Robinson, S. Hawaiian monk seal conservation: Past, present and future. In *Tropical Pinnipeds. Bio-Ecology, Threats and Conservation*; Alava, J.J., Ed.; CRC Press: Boca Raton, FL, USA, 2010; pp. 83–104. [\[CrossRef\]](#)
586. Weijerman, M.; Robinson, S.; Parrish, F.; Polovina, J.; Littnan, C. Comparative application of trophic ecosystem models to evaluate drivers of endangered Hawaiian monk seal populations. *Mar. Ecol. Prog. Ser.* **2017**, *582*, 215–229. [\[CrossRef\]](#)
587. Baker, J.D.; Harting, A.L.; Johanos, T.C.; London, J.M.; Barbieri, M.M.; Littnan, C.L. *Terrestrial Habitat Loss and the Long-Term Viability of the French Frigate Shoals Hawaiian Monk Seal Subpopulation*; NOAA Technical Memorandum NMFS-PIFSC 107; U.S. Department of Commerce: Washington, DC, USA, 2020; pp. 1–27. [\[CrossRef\]](#)
588. Lowry, L.F.; Laist, D.W.; Gilmartin, W.G.; Antonelis, G.A. Recovery of the Hawaiian monk seal (*Monachus schauinslandi*): A review of conservation efforts, 1972 to 2010, and thoughts for the future. *Aquat. Mamm.* **2011**, *37*, 397–419. [\[CrossRef\]](#)
589. Antonelis, G.A.; Baker, J.D.; Johanos, T.C.; Braun, R.C.; Harting, A.L. Hawaiian monk seal (*Monachus schauinslandi*): Status and conservation issues. *Atoll Res. Bull.* **2006**, *543*, 75–101.
590. Bertilsson-Friedman, P. Distribution and frequencies of shark-inflicted injuries to the endangered Hawaiian monk seal (*Monachus schauinslandi*). *J. Zool.* **2006**, *268*, 361–368. [\[CrossRef\]](#)
591. Carlson, J.K.; Heupel, M.R.; Young, C.N.; Cramp, J.E.; Simpfendorfer, C.A. Are we ready for elasmobranch conservation success? *Environ. Conserv.* **2019**, *46*, 264–266. [\[CrossRef\]](#)
592. Thiel, M.; Luna-Jorquera, G.; Álvarez-Varas, R.; Gallardo, C.; Hinojosa, I.A.; Luna, N.; Miranda-Urbina, D.; Morales, N.; Ory, N.; Pacheco, A.S.; et al. Impacts of Marine Plastic Pollution From Continental Coasts to Subtropical Gyres—Fish, Seabirds, and Other Vertebrates in the SE Pacific. *Front. Mar. Sci.* **2018**, *5*, 238. [\[CrossRef\]](#)
593. Branco-Nunes, I.; Araújo, C.; Ferreira, E.; Mendonça, S.; Alves, N.; Nunes, D.; Viana, D.; Oliveira, P. Chapter 5: Endemic species of elasmobranchs (sharks and rays) in South America: A review. In *Endemic Species from Around the World—Teaching for Sustainability*; Ortiz, C., Peña-Martínez, A., Eds.; IntechOpen: London, UK, 2025; pp. 1–23. [\[CrossRef\]](#)
594. Brunnenschweiler, J.M.; Marosi, N.D. Two years of impairment: Plastic packing strap on a bull shark (*Carcharhinus leucas*) in Fiji. *Pac. Conserv. Biol.* **2019**, *26*, 208–209. [\[CrossRef\]](#)
595. UNEP—United Nations Environment Programme. Convention on International Trade in Endangered Species of Wild Fauna and Flora. Considerations of Proposals for Amendment of Appendices I and II. In Proceedings of the Nineteenth Meeting of the Conference of the Parties, Panama City, Panama, 14–25 November 2022; Available online: [https://cites.org/sites/default/files/eng/cop/19/prop/as\\_received/E-Carcharhinidae\\_spp.pdf](https://cites.org/sites/default/files/eng/cop/19/prop/as_received/E-Carcharhinidae_spp.pdf) (accessed on 28 February 2023).
596. Bonaccorso, E.; Ordóñez-Garza, N.; Pazmiño, D.A.; Hearn, A.; Páez-Rosas, D.; Cruz, S.; Muñoz-Pérez, J.P.; Espinoza, E.; Suárez, J.; Muñoz-Rosado, L.D.; et al. International fisheries threaten globally endangered sharks in the Eastern Tropical Pacific Ocean: The case of the Fu Yuan Yu Leng 999 reefer vessel seized within the Galápagos Marine Reserve. *Sci. Rep.* **2021**, *11*, 14959. [\[CrossRef\]](#) [\[PubMed\]](#)
597. Jabado, R.W.; García-Rodríguez, E.; Kyne, P.M.; Rohner, C.A.; Palacios, M.D.; Armstrong, A.O.; Gonzalez-Pestana, A.; Bettcher Brito, V.; Charles, R.; Battle-Morera, A. *Australia and Southeast Indian Ocean: A Regional Compendium of Important Shark and Ray Areas*; IUCN SSC Shark Specialist Group: Dubai, United Arab Emirates, 2026. [\[CrossRef\]](#)
598. Sosa-Nishizaki, O.; Galván-Magaña, F.; Larson, S.E.; Lowry, D. Chapter 4: Conclusions: Do we eat them or watch them, or both? Challenges for conservation of sharks in Mexico and the NEP. In *Sharks in Mexico: Research and Conservation Part B (Adv. Mar. Biol. 85)*; Lowry, D., Larson, S.E., Eds.; Academic Press, Elsevier Ltd.: London, UK, 2020; pp. 93–102. [\[CrossRef\]](#) [\[PubMed\]](#)
599. Meyer, C.G.; Dale, J.J.; Papastamatiou, Y.P.; Whitney, N.M.; Holland, K.N. Seasonal cycles and long-term trends in abundance and species composition of sharks associated with cage diving ecotourism activities in Hawaii. *Environ. Conserv.* **2009**, *36*, 104–111. [\[CrossRef\]](#)
600. Clua, E. The pros and cons of shark feeding. *SPC Fish. Newsl.* **2010**, *133*, 40–44.
601. Gallagher, A.J.; Hammerschlag, N. Global shark currency: The distribution, frequency, and economic value of shark ecotourism. *Curr. Issues Tour.* **2011**, *14*, 797–812. [\[CrossRef\]](#)
602. Healy, T.J.; Hill, N.J.; Barnett, A.; Chin, A. A global review of elasmobranch tourism activities, management and risk. *Mar. Policy* **2020**, *118*, 103964. [\[CrossRef\]](#)
603. González Mantilla, P.G. Analysis of the Potential and Economic Impact of Shark-Diving Tourism in the Macaronesian Archipelagos. Ph.D. Thesis, University of Las Palmas, Gran Canarias, Las Palmas, Spain, 2021.
604. Darwin, C. *Journal of Researches into the Natural History and Geology of the Countries Visited During the Voyage of the H.M.S. 'Beagle' Round the World Under the Command of Cap; Fitz Roy, R.N., Ed.; John Murray: London, UK, 1845.* [\[CrossRef\]](#)
605. Moseley, H.N. *A Naturalist on the "Challenger". An Account of Observations Made During the Voyage of H.M.S. Challenger in the Years 1872–1876, Under the Command of Capt. Sir G.S. Nares, and Capt. F.T. Thomson; T. Werner Laurie Ltd.: London, UK, 1892.* [\[CrossRef\]](#)

606. Edwards, A.J. Saint Paul's Rocks: A bibliographical review of the natural history of a Mid-Atlantic island. *Arch. Nat. Hist.* **1985**, *12*, 31–49. [[CrossRef](#)]
607. Edwards, A.J. Marine biology of Saint Paul's Rocks, equatorial Atlantic Ocean. *Mem. Univ. Nfld. Occas. Pap. Biol.* **1984**, *9*, 58–75.
608. Smith, H.G.; Hardy, P.; Leith, I.M.; Spaul, V.W.; Twelves, E.L. A biological survey of St. Paul's Rocks in the equatorial Atlantic Ocean. *Biol. J. Linn. Soc.* **1974**, *6*, 89–96. [[CrossRef](#)]
609. Bowen, V.T. St. Paul's on the subway. *Oceanus* **1966**, *12*, 2–4.
610. Masch, D. Life on the rocks. *Oceanus* **1966**, *12*, 5–7.
611. Oliveira, G.D.; Evangelista, J.E.V.; Ferreira, B.P. Considerações sobre a biologia ea pesca no Arquipélago dos Penedos São Pedro e São Paulo. *Bol. Téc. Cient. CEPENE* **1997**, *5*, 31–52, (In Portuguese, with an English abstract).
612. Vaske, T., Jr.; Lessa, R.P.T.; Ribeiro, A.B.C.; de Nóbrega, M.F.; Pereira, A.D.A.; de Andrade, C.D.P. A pesca comercial de peixes pelágicos no Arquipélago de São Pedro e São Paulo, Brasil. *Trop. Oceanogr.* **2008**, *36*, 47–54, (In Portuguese, with an English abstract). [[CrossRef](#)]
613. Pinheiro, E.; Layman, C.A.; Castello, J.P.; Leite, T.S. Trophic role of demersal mesopredators on rocky reefs in an equatorial Atlantic Ocean island. *J. Appl. Ichthyol.* **2017**, *33*, 47–53. [[CrossRef](#)]
614. Soto, J.M.R. Capítulo 13: Ações antrópicas negativas nas Ilhas Oceânicas Brasileiras. In *Ilhas Oceânicas Brasileiras: Da Pesquisa Ao Manejo*; Mohr, L.V., Castro, J.W.A., Costa, P.M.S., Alves, R.J.V., Eds.; Ministério do Meio Ambiente: Brasília, Brazil, 2009; Volume 2, pp. 329–350. (In Portuguese)
615. Meurer, E. *Segredos Submersos Do Atlântico: Bastidores de Uma Expedição*; Ed. Termo Literário: São Paulo, Brazil, 2004. (In Portuguese)
616. Feitoza, B.M.; Rocha, L.A.; Luiz-Júnior, O.J.; Floeter, S.R.; Gasparini, J.L. Reef fishes of St. Paul's Rocks: New records and notes on biology and zoogeography. *Aqua Int. J. Ichthyol. Aquat. Biol.* **2003**, *7*, 61–82.
617. Vaske, T., Jr.; de Nóbrega, M.F.; Santana, F.M.; Lessa, R.P.; Ribeiro, A.C.B.; de Andrade Pereira, A.; de Andrade, C.D.P. Capítulo 7: Peixes. In *Arquipélago de São Pedro e São Paulo: Histórico e Recursos Naturais*; Vaske, J.T., Lessa, R.P., de Nóbrega, M.F., do Amaral, F.M.D., O'Brien, S.R.M., da Costa, F.D.A.P., Eds.; NAVE/LABOMAR UFC: Fortaleza, Brazil, 2010; pp. 83–180. (In Portuguese)
618. Viana, D.F.; Hazin, F.H.V.; Andrade, H.A.; Nunes, D.M.; Viana, D.D.L. Fisheries in the Saint Peter and Saint Paul Archipelago: 13 years of monitoring. *Bol. Inst. Pesca.* **2015**, *41*, 239–248.
619. Ferreira, C.E.L.; Luiz, O.J.; Feitoza, B.M.; Ferreira, C.G.W.; Gasparini, J.L.; Noguchi, R.C.; Godoy, E.A.; Joyeux, J.C.; Rangel, C.A.; Rocha, L.A.; et al. Peixes recifais: Síntese do atual conhecimento. In *O Arquipélago de São Pedro e São Paulo: 10 Anos de Estação Científica*; Viana, D.D.L., Hazin, F.H.V., Souza, M.A.C., Eds.; SECIRM: Brasília, Brazil, 2009; pp. 244–340, (In Portuguese, with an English abstract).
620. Serafini, T.Z.; de França, G.B.; Andriguetto-Filho, J.M. Ilhas oceânicas brasileiras: Biodiversidade conhecida e sua relação com o histórico de uso e ocupação humana. *J. Integr. Coast. Zone Manag.* **2010**, *10*, 281–301, (In Portuguese, with an English abstract). [[CrossRef](#)]
621. Rosa, M.R. Reef Communities of the Saint Peter and Saint Paul's Archipelago Across an Euphotic-Mesophotic Depth Gradient (0–90 m). Ph.D. Thesis, Universidade de São Paulo, São Paulo, Brazil, 2014.
622. Luiz, O.J.; Mendes, T.C.; Barneche, D.R.; Ferreira, C.G.; Noguchi, R.; Villaça, R.C.; Rangel, C.A.; Gasparini, J.L.; Ferreira, C.E. Community structure of reef fishes on a remote oceanic island (St Peter and St Paul's Archipelago, equatorial Atlantic): The relative influence of abiotic and biotic variables. *Mar. Freshw. Res.* **2015**, *66*, 739–749. [[CrossRef](#)]
623. Magalhães, G.M.; Amado-Filho, G.M.; Rosa, M.R.; de Moura, R.L.; Brasileiro, P.S.; De Moraes, F.C.; Francini-Filho, R.B.; Pereira-Filho, G.H. Changes in benthic communities along a 0–60 m depth gradient in the remote St. Peter and St. Paul Archipelago (Mid-Atlantic Ridge, Brazil). *Bull. Mar. Sci.* **2015**, *91*, 377–396. [[CrossRef](#)]
624. Rosa, M.R.; Alves, A.C.; Medeiros, D.V.; Coni, E.O.; Ferreira, C.M.; Ferreira, B.; Rosa, R.S.; Amado-Filho, G.; Pereira-Filho, G.; Moura, R.; et al. Mesophotic reef fish assemblages of the remote St. Peter and St. Paul's Archipelago, Mid-Atlantic Ridge, Brazil. *Coral Reefs* **2016**, *35*, 113–123. [[CrossRef](#)]
625. Giglio, V.J.; Pinheiro, H.T.; Bender, M.G.; Bonaldo, R.M.; Costa-Lotufo, L.V.; Ferreira, C.E.; Floeter, S.R.; Freire, A.; Gasparini, J.L.; Joyeux, J.C.; et al. Large and remote marine protected areas in the South Atlantic Ocean are flawed and raise concerns: Comments on Soares and Lucas. *Mar. Policy* **2018**, *96*, 13–17. [[CrossRef](#)]
626. Quimbayo, J.P.; Mendes, T.C.; Cordeiro, C.A.M.M.; Longo, G.O.; Giglio, V.J.; Vergara, D.C.; Floeter, S.R.; Villaça, R.; Freire, A.S.; Francini-Filho, R.B.; et al. Capítulo 8: Variação Temporal das Comunidades Recifais no Arquipélago de São Pedro e São Paulo: Ações do Projeto de Monitoramento de Longa Duração (PELD). In *Arquipélago de São Pedro e São Paulo: 20 Anos de Pesquisa*; Oliveira, J.E.L., Viana, D.D.L., de Souza, M.A.C., Eds.; Via Design Publicações: Recife, Brazil, 2018; pp. 111–127, (In Portuguese, with an English abstract).
627. Soares, M.O.; Tavares, T.C.L.; Carneiro, P.B.M. Mesophotic ecosystems: Distribution, impacts and conservation in the South Atlantic. *Divers. Distrib.* **2019**, *25*, 255–268. [[CrossRef](#)]
628. Vaske, T., Jr.; Lessa, R.P.; de Nobrega, M.; Montealegre-Quijano, S.; Marcante-Santana, F.; Bezerra, J.L., Jr. A checklist of fishes from Saint Peter and Saint Paul Archipelago, Brazil. *J. Appl. Ichthyol.* **2005**, *21*, 75–79. [[CrossRef](#)]

629. Lessa, R.; Vaske, T., Jr. A ictiofauna com ênfase aos peixes-voadores (Exocoetidae). In *O Arquipélago de São Pedro e São Paulo: 10 Anos de Estação Científica*; Viana, D.D.L., Hazin, F.H.V., Souza, M.A.C., Eds.; SECIRM: Brasília, Brazil, 2009; pp. 219–226. (In Portuguese, with an English abstract).
630. Gadig, O.B.F.; Rosa, R.S. Capítulo 2: Diversidade de peixes cartilaginosos do Brasil. In *PAN Tubarões: Primeiro Ciclo Do Plano de Ação Nacional Para a Conservação Dos Tubarões e Raias Marinhos Ameaçados de Extinção*; Kotas, J.E., Vizuet, E.P., dos Santos, R.A., Ribeiro Baggio, M., Salge, G., Barreto, P., Eds.; ICMBio/CEPSUL: Brasília, Brazil, 2023; pp. 44–85. (In Portuguese)
631. Bezerra, N.P.A.; Macena, B.C.L.; Mendonça, S.A.; Paoliello, L.; Hazin, F.H.V. Uso de hábitat, segregación espacial y relación interespecífica entre tiburones sedosos, *Carcharhinus falciformis*, y galápagos, *Carcharhinus galapagensis*, en un archipiélago remoto en el océano Atlántico ecuatorial. In *Libro de Resúmenes. Primer Congreso Latinoamericano de Tiburones, Rayas y Quimeras. VIII Simposium Nacional de Tiburones y Rayas, Playa del Carmen, Quintana Roo, México, Marzo 2019*; Gonzáles, E.C.O., Méndez, O., Sánchez, A.W.D., García, E.E.B., Eds.; Sociedad Mexicana de Peces Cartilaginosos, A.C.: Mexico City, Mexico, 2019; p. 66. (In Spanish)
632. Pimentel, C.R.; Andrades, R.; Ferreira, C.E.; Gadig, O.B.F.; Harvey, E.S.; Joyeux, J.C.; Giarrizzo, T. BRUVS reveal locally extinct shark and the way for shark monitoring in Brazilian oceanic islands. *J. Fish Biol.* **2020**, *96*, 539–542. [[CrossRef](#)] [[PubMed](#)]
633. Pimentel, C.R.; Pinheiro, H.T.; Giarrizzo, T.; Francini-Filho, R.B.; Reis-Filho, J.A.; Rocha, L.A.; Ferreira, C.E.L.; Barbosa, M.C.; Joyeux, J.C. Ecological links between pelagic and mesophotic reef fishes in an oceanic archipelago of the equatorial Atlantic Ocean. *Diversity* **2022**, *14*, 273. [[CrossRef](#)]
634. Pinheiro, H.T.; Macena, B.C.; Francini-Filho, R.B.; Ferreira, C.E.; Albuquerque, F.V.; Bezerra, N.P.; Carvalho-Filho, A.; Ferreira, R.C.P.; Luiz, O.J.; Mello, T.J.; et al. Fish biodiversity of Saint Peter and Saint Paul's Archipelago, Mid-Atlantic Ridge, Brazil: New records and a species database. *J. Fish Biol.* **2020**, *97*, 1143–1153. [[CrossRef](#)] [[PubMed](#)]
635. Viana, D.D.L.; Hazin, F.H.V.; Oliveira, J.E.L.; Souza, M.A.C. *Saint Peter and Saint Paul Archipelago: Brazil in the Mid Atlantic*; Vedas Edições: Recife, Brazil, 2007.
636. Cruz, M.M.; Hoffmann, L.S.; de Freitas, T.R. Saint Peter and Saint Paul Archipelago barcoded: Fish diversity in the remoteness and DNA barcodes reference library for metabarcoding monitoring. *Genet. Mol. Biol.* **2022**, *45*, e20210349. [[CrossRef](#)] [[PubMed](#)]
637. Alcantara, R.A.K.D. Estudo da Assembleia de Peixes do Arquipélago de São Pedro e São Paulo com o uso de Estação Remota de Vídeo Subaquático com Isca (BRUVS). Master's Thesis, Universidade Federal de Pernambuco, Recife, Brazil, 2021. (In Portuguese and English).
638. Heupel, M.R.; Carlson, J.R.; Simpfendorfer, C.A. Shark nursery areas: Concepts, definition, characterization and assumptions. *Mar. Ecol. Prog. Ser.* **2007**, *337*, 287–297. [[CrossRef](#)]
639. Lesturgie, P.; Braun, C.D.; Clua, E.; Mourier, J.; Thorrold, S.R.; Vignaud, T.; Planes, S.; Mona, S. Like a rolling stone: Colonization and migration dynamics of the gray reef shark (*Carcharhinus amblyrhynchos*). *Ecol. Evol.* **2023**, *13*, e9746. [[CrossRef](#)] [[PubMed](#)]
640. Lesturgie, P.; Lainé, H.; Suwalski, A.; Chifflet-Belle, P.; Maisano Delser, P.; Clua, E.; Jaquemet, S.; Magalon, H.; Mona, S. Ecological and biogeographic features shaped the complex evolutionary history of an iconic apex predator (*Galeocerdo cuvier*). *BMC Ecol. Evol.* **2022**, *22*, 147. [[CrossRef](#)] [[PubMed](#)]
641. Hyde, C.A.; di Sciara, G.N.; Sorrentino, L.; Boyd, C.; Finucci, B.; Fowler, S.L.; Kyne, P.M.; Leurs, G.; Simpfendorfer, C.A.; Tetley, M.J.; et al. Putting sharks on the map: A global standard for improving shark area-based conservation. *Front. Mar. Sci.* **2022**, *9*, 968853. [[CrossRef](#)]
642. Rand, T.G.; Wiles, M.; Odense, P. Attachment of *Dermophthirius carcharhini* (Monogenea: Microbothriidae) to the Galapagos Shark *Carcharhinus galapagensis*. *Trans. Am. Microsc. Soc.* **1986**, *105*, 158–169. [[CrossRef](#)]
643. Jarvis, S.A. When There's Nothing Better to Eat: Subsistence Strategies in Eighteenth Century Bermuda. Master's Thesis, College of William & Mary, Williamsburg, VA, USA, 1997. [[CrossRef](#)]
644. Stafford-Deitsch, J. *Sharks of Florida, the Bahamas, the Caribbean and the Gulf of Mexico*; Trident Press Ltd.: London, UK, 2000.
645. Bullard, S.A.; Dippenaar, S.M.; Hoffmayer, E.R.; Benz, G.W. New locality records for *Dermophthirius carcharhini* (Monogenea: Microbothriidae) and *Dermophthirius maccallumi* and a list of hosts and localities for species of *Dermophthirius*. *Comp. Parasitol.* **2004**, *71*, 78–80. [[CrossRef](#)] [[PubMed](#)]
646. Dewailly, E.; Rouja, P.; Schultz, E.; Julien, P.; Tucker, T. Vitamin A intoxication from reef fish liver consumption in Bermuda. *J. Food Prot.* **2011**, *74*, 1581–1583. [[CrossRef](#)] [[PubMed](#)]
647. Laffoley, D.D.; Roe, H.S.J.; Angel, M.V.; Ardron, J.; Bates, N.R.; Boyd, I.L.; Brooke, S.; Buck, K.N.; Carlson, C.A.; Causey, B.; et al. *The Protection and Management of the Sargasso Sea: The Golden Floating Rainforest of the Atlantic Ocean. Summary Science and Supporting Evidence Case*; Sargasso Sea Alliance: Hamilton, ON, Canada, 2011.
648. Maisano Delser, P.; Corrigan, S.; Hale, M.; Li, C.; Veuille, M.; Planes, S.; Naylor, G.J.P.; Mona, S. Population genomics of *C. melanopterus* using target gene capture data: Demographic inferences and conservation perspectives. *Sci. Rep.* **2016**, *6*, 33753. [[CrossRef](#)] [[PubMed](#)]
649. Schneider, C.W.; Flook, C.T. Could marine animal conservation laws be responsible for the decline or extirpation of macroalgal populations in Bermuda over the past century? *Bot. Mar.* **2017**, *60*, 591–602. [[CrossRef](#)]

650. Noyes, T.J.; Blanco-Bercial, L.; Mariani, S.; Goodbody-Gringley, G.; McDevitt, A.D. Complementary assessment of fish biodiversity across the upper/lower mesophotic interface in a subtropical coral reef using eDNA metabarcoding and baited cameras. *bioRxiv* **2025**. [CrossRef]
651. Hairr, J. *North Carolina Shark Attacks*; The History Press: Charleston, SC, USA, 2023.
652. Nelson, J.S.; Crossman, E.J.; Espinosa-Pérez, H.; Findley, L.T.; Gilbert, C.R.; Lea, R.N.; Williams, J.D. *Common and Scientific Names of Fishes from the United States, Canada, and Mexico*, 6th ed.; American Fisheries Society Special Publication 29; American Fisheries Society: Bethesda, MD, USA, 2004; pp. 1–386.
653. Gilbert, C.R. Book review: Carpenter, K.E. (ed.) (2003): The living marine resources of the Western Central Atlantic (FAO fishing area 31). FAO Species Identification Guide for Fishery Purposes and American Society of Ichthyologists and Herpetologists, Special Publication 5. *Copeia* **2005**, *1*, 201–212. [CrossRef]
654. Pina-Amargós, F.; Olivera-Espinosa, Y.; Ruiz-Abierno, A.; Graham, R.; Hueter, R.; Márquez-Farías, J.F.; Hernández-Betancourt, A.; Borroto-Vejerano, R.; Figueredo-Martín, T.; Briones, A.; et al. Sharks and Rays in Cuban Coral Reefs: Ecology, Fisheries, and Conservation. In *Coral Reefs of Cuba. Coral Reefs of the World*; Zlatarski, V.N., Reed, J.K., Pomponi, S.A., Brooke, S., Farrington, S., Eds.; Springer: Cham, Switzerland, 2023; Volume 18, pp. 229–252. [CrossRef]
655. Dennis, G.D. *Annotated Checklist of Shallow-Water Marine Fishes from the Puerto Rico Plateau Including Puerto Rico, Culebra, Vieques, St. Thomas, St. John, Tortola, Virgin Gorda and Anegada*; Florida Caribbean Science Center: Gainesville, FL, USA, 2000. [CrossRef]
656. Smith-Vaniz, W.F.; Jelks, H.L. Marine and inland fishes of St. Croix, U.S. Virgin Islands: An annotated checklist. *Zootaxa* **2014**, *3803*, 1–120. [CrossRef] [PubMed]
657. Robertson, D.R.; Estapé, C.J.; Estapé, A.M.; Richter, L.; Peña, E.; Victor, B. An updated, illustrated inventory of the marine fishes of the US Virgin Islands. *ZooKeys* **2022**, *1103*, 79–122. [CrossRef] [PubMed]
658. Edwards, A.J.; Lubbock, H.R. The ecology of Saint Paul's Rocks (Equatorial Atlantic). *J. Zool.* **1983**, *200*, 51–69. [CrossRef]
659. Lessa, R.; Santana, F.M.; Rincón, G.; Gadig, O.B.F.; El-Deir, A.C.A. *Biodiversidade de Elasmobrânquios Do Brasil*; Ministério do Meio Ambiente: Recife, Brazil, 1999; (In Portuguese). [CrossRef]
660. Soto, J.M.R.; Mincarone, M.M. Collections of the Museu Oceanográfico do Vale do Itajaí. I. Catalog of cartilaginous fishes (Myxini, Cephalaspidomorphi, Elasmobranchii, Holocephali). *Mare Magnum* **2004**, *2*, 1–125.
661. Gadig, O.B.F.; Juliano, M.F.; Barreiros, J.P. Further notes on the capture of a *Carcharhinus leucas* in a northeastern Atlantic oceanic insular shelf, the Azores Archipelago, Portugal. *Cybiuim* **2006**, *30*, 31–33. [CrossRef]
662. Wirtz, P.; Ferreira, C.E.L.; Floeter, S.R.; Fricke, R.; Gasparini, J.L.; Iwamoto, T.; Rocha, L.; Sampaio, C.L.S.; Schlieuwen, U.K. Coastal Fishes of São Tomé and Príncipe islands, Gulf of Guinea (Eastern Atlantic Ocean)—An update. *Zootaxa* **2007**, *1523*, 1–48. [CrossRef]
663. Macedo-Soares, L.C.P.D. Ecologia do Ictioplâncton no Arquipélago de São Pedro e São Paulo. Bachelor's Thesis, Universidade Federal de Santa Catarina, Florianópolis, Brazil, 2008. (In Portuguese)
664. Soto, J.M.R.; Macena, B.; Hazin, F. Novas informações sobre a presença do tubarão-das-galápagos, *Carcharhinus galapagensis* (Snodgrass & Heller, 1905) (Carcharhiniformes, Carcharhinidae), no Arquipélago São Pedro e São Paulo. *Reun. Soc. Bras. Est. Elasm.* **2011**, *7*, 17. (In Portuguese)
665. Martínez-Ortiz, J.; García-Domínguez, M. Guía de Campo de Condrictios del Ecuador: Quimeras, Tiburones y Rayas/Chondrichthyes of Ecuador Field Guide. In *Chimaeras, Sharks and Rays*; Ministerio de Agricultura, Ganadería, Acuicultura y Pesca: Manta, Ecuador, 2013; (In Spanish and English).
666. Bennemann, B. *Aninhamento Vs Modularidade: Qual O Padrão de Distribuição Das Espécies de Elasmobrânquios Das Ilhas Oceânicas Brasileiras?* Coursepaper, Centro de Ciências Biológicas, Universidade Federal de Santa Catarina: Florianópolis, Brazil, 2021; (In Portuguese, with an English abstract).
667. Barcellos, L.R.; Barreto, R.; Lessa, R.P. Occurrence and population structure of sharks in two ecologically or biologically significant marine areas off north-eastern Brazil. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **2022**, *32*, 713–726. [CrossRef]
668. Fermon, Y.; Bailly, N.; Cardie, F.; Causse, R.; Chartrain, E.; Chirio, L.; de Bruyne, G.; Deynat, P.; Hopkins, C.D.; Lamboj, A.; et al. An annotated checklist of the fishes of Gabon. *Cybiuim* **2022**, *46*, 69–317. [CrossRef]
669. Lima, D.P. *Levantamento de Espécies de Peixes Elasmobrânquios (Chondrichthyes: Elasmobranchii) Da Costa Nordeste Do Brasil*; Coursepaper, Ciências Biológicas, Universidade Federal da Paraíba: João Pessoa, Brazil, 2022; (In Portuguese, with an English abstract).
670. IUCN Species Survival Commission Shark Specialist Group. Saint Peter and Saint Paul Archipelago ISRA Factsheet. Dubai (IUCN SSC Shark Specialist Group). 2025. Available online: <https://sharkrayareas.org/portfolio-item/saint-peter-and-saint-paul-archipelago-isra> (accessed on 6 May 2025).
671. Arruda, L.M. Checklist of the marine fishes of the Azores. *Arq. Mus. Bocage Nova Sér.* **1997**, *3*, 13–164.
672. Barreiros, J.P.; Gadig, O.B.F. Chondrichthyan diversity from Azores Archipelago, Portugal. In *Proceedings of the 7th Indo-Pacific Fish Conference, Taipei, Taiwan, 16–20 May 2005*; Book of Abstracts: Taipei, Taiwan, 2005.
673. Bailly, N. *Carcharhinus galapagensis* (Snodgrass & Heller, 1905). 2014. Available online: <http://www.eu-nomen.eu/portal/taxon.php?GUID=urn:lsid:marinespecies.org:taxname:105790> (accessed on 28 February 2023).

674. Das, D.; Afonso, P. Review of the Diversity, Ecology, and Conservation of Elasmobranchs in the Azores Region, Mid-North Atlantic. *Front. Mar. Sci.* **2017**, *4*, 354. [\[CrossRef\]](#)
675. Biscoito, M.; Ribeiro, C.; Freitas, M. Annotated checklist of the fishes of the archipelago of Madeira (NE Atlantic): I—Chondrichthyes. *Zootaxa* **2018**, *4429*, 459–494. [\[CrossRef\]](#) [\[PubMed\]](#)
676. Barcelos, L.M.D.; Barreiros, J.P. Chondrichthyes diversity in Azores' EEZ. In Proceedings of the Poster Presentation, XIX Congresso Nacional de Ecologia, Lissabon, Portugal, 9–11 December 2020. [\[CrossRef\]](#)
677. Barcelos, L.M.D.; Azevedo, J.M.N.; Barreiros, J.P. Updated checklist of Azores Chondrichthyes (Vertebrata: Gnathostomata). *Biodivers. Data J.* **2021**, *9*, e62813. [\[CrossRef\]](#) [\[PubMed\]](#)
678. McIvor, A.J.; Williams, C.T.; Alves, F.; Dinis, A.; Pais, M.P.; Canning-Clode, J. The status of marine megafauna research in Macaronesia: A systematic review. *Front. Mar. Sci.* **2022**, *9*, 819581. [\[CrossRef\]](#)
679. Brito, A. *Catálogo de Los Peces de Las Islas Canarias*; Francisco Lemus: La Laguna, Tenerife, 1991. (In Spanish)
680. Brito, A.; Pascual, P.J.; Falcón, J.M.; Sancho, A.; González, G. *Peces de Las Islas Canarias. Catálogo Comentado e Ilustrado*; Francisco Lemus: La Laguna, Tenerife, 2002. (In Spanish)
681. Brito Hernández, A.; Sancho Rafel, A. Chondrichthyes. In *Lista de Espécies Marinas de Canarias (algas, Hongos, Plantas Y Animales)*; Moro, L., Martín, J.L., Garrido, M.J., Ozquierdo, I., Eds.; Consejería de Política Territorial y Medio Ambiente del Gobierno de Canarias: La Laguna, Tenerife, 2003; pp. 116–118. (In Spanish)
682. Madina, M.; Lascurain, A.; López, M.; Pérez, M.; Saez, A.; Villanueva, E. *La Belleza de La Bestia. Elasmobranquios En Europa: Situación Actual Y Futura*; Oceana Europe: Madrid, Spain, 2008. (In Spanish)
683. Compagno, L.J.V. Carcharhinidae. In *FAO Species Identification Sheets for Fishery Purposes Eastern Central Atlantic; Fishery Areas 34, 47 (in Part)*; Fischer, W., Bianchi, G., Scott, W.B., Eds.; FAO & Department of Fisheries and Oceans, Canada: Rome, Italy; Ottawa, ON, Canada, 1981; Volume 5.
684. Quéro, J.C.; Hureau, J.C.; Karrer, C.; Post, A.; Saldanha, L. *Check-List of the Fishes of the Eastern Tropical Atlantic (CLOFETA). Vol. I.*; JNICT, SEI & UNESCO: Lisbon, Portugal; Paris, France, 1990.
685. Reiner, F. Catálogo dos peixes do Arquipélago de Cabo Verde. In *Publicações Avulsas Do IPIMAR 2*; IPIMAR: Lisbon, Portugal, 1996. (In Portuguese)
686. Reiner, F. *Peixes Do Arquipélago de Cabo Verde*; INDP & República de Cabo Verde: Mindelo, Cape Verde, 2005. (In Portuguese)
687. Hanel, R.; John, H.C. A revised checklist of Cape Verde Islands sea fishes. *J. Appl. Ichthyol.* **2015**, *31*, 135–169. [\[CrossRef\]](#)
688. Reiner, F.; Freitas, R. *Peixes Da Zona Económica Exclusiva Caboverdiana*; Self-Published: Cascais, Portugal, 2022. (In Portuguese)
689. Barcelos, L.M.D.; Freitas, R.; Barreiros, J.P. Checklist of coastal fishes from Cabo Verde Archipelago. *Biodivers. Data J.* **2025**, *13*, e148234. [\[CrossRef\]](#) [\[PubMed\]](#)
690. Freitas, R.; Barcelos, L.M.D.; Barreiros, J.P. Checklist List of Coastal fishes of Cabo Verde. Version 1.0. Universidade dos Açores. Checklist Dataset. 2025. Available online: [http://ipt.gbif.pt/ipt/resource?r=cabo\\_verde\\_coastal\\_fishes&v=1.0](http://ipt.gbif.pt/ipt/resource?r=cabo_verde_coastal_fishes&v=1.0) (accessed on 14 January 2025).
691. Debelius, H. *Mediterranean and Atlantic Fish Guide*; Ikan Unterwasserarchive: Frankfurt a.M., Germany, 1997.
692. Afonso, P.; Porteiro, F.M.; Santos, R.S.; Barreiros, J.P.; Worms, J.; Wirtz, P. Coastal marine fishes of São Tomé Island (Gulf of Guinea). *Arquipélago Life Mar. Sci.* **1999**, *17*, 65–92.
693. da Costa, L.M.; Maia, H.A.; Almeida, A.J. Chapter 17: The fishes of the Gulf of Guinea oceanic islands. In *Biodiversity of the Gulf of Guinea Oceanic Islands. Science and Conservation*; Ceriaco, L.M.P., de Lima, R.F., Melo, M., Bell, R.C., Eds.; Springer: Cham, Switzerland, 2022; pp. 431–478. [\[CrossRef\]](#)
694. Reiner, F. *Peixes Do Arquipélago de São Tomé e Príncipe, Golfo Da Guiné (Oceano Atlântico Oriental)*; Centro Português de Actividades Subaquáticas: Lisboa, Portugal, 2022. (In Portuguese)
695. Pissarra, V.; Santana, A.; Panisi, M.; Santos, C.P.; Maia, H.; Vasconcelos, L.; Nuno, A.; Porriños, G.; Vieira da Silva, C.; Rosa, R.; et al. Fisher's perceptions on shark fisheries in Sao Tome Island (Gulf of Guinea, West Africa). *Reg. Stud. Mar. Sci.* **2024**, *77*, 103711. [\[CrossRef\]](#)
696. Porriños, G.; Metcalfe, K.; Nuno, A.; da Graça, M.; Walker, K.; Dixon, A.; Guedes, M.; Nazaré, L.; dos Santos, A.; Colman, L.P.; et al. Fish community composition in the tropical archipelago of São Tome' and Príncipe. *PLoS ONE* **2024**, *19*, e0312849. [\[CrossRef\]](#) [\[PubMed\]](#)
697. Rosenshein, I.L. Immunoglobulins of Carcharhine Sharks and Phylogenetic Conservation of Variable Region Determinants Among Vertebrate Immunoglobulins. Ph.D. Thesis, Faculty of the Medical University of South Carolina, Charleston, SC, USA, 1985.
698. Rosenshein, I.L.; Marchalonis, J.J. Broad phylogenetic expression of heavy-chain determinants detected by rabbit antisera to VHa allotypes. *Mol. Immunol.* **1985**, *22*, 1177–1183. [\[CrossRef\]](#) [\[PubMed\]](#)
699. Rosenshein, I.L.; Schluter, S.F.; Marchalonis, J.J. Conservation among the immunoglobulins of carcharhine sharks and phylogenetic conservation of variable region determinants. *Vet. Immunol. Immunopathol.* **1986**, *12*, 13–20. [\[CrossRef\]](#) [\[PubMed\]](#)
700. Rosenshein, I.L.; Marchalonis, J.J. The immunoglobulins of carcharhine sharks: A comparison of serological and biochemical properties. *Comp. Biochem. Physiol. B* **1987**, *86*, 737–747. [\[CrossRef\]](#)

701. Bingeman, J.; Bingeman, J. *Ascension Island: Inshore Sea Life*; Coach House Publications: Sandown, UK, 2005.
702. Irving, R. The offshore marine environment of Ascension Island, South Atlantic: Scientific review and conservation status assessment. In *Report to the Royal Society for the Protection of Birds (RSPB)*; Sea-Scope Marine Environmental Consultants: Dulverton, UK, 2015. [\[CrossRef\]](#)
703. Burns, P. The Old man and the Sea: Reconstructing the History of Ocean Life Around Ascension Island. Master's Thesis, University of York, York, UK, 2018.
704. Croke, R. Incorporating Climate Change Adaptation into Large Marine Protected Areas: The Case of Ascension Island MPA. Master's Thesis, Dalhousie University, Halifax, NS, Canada, 2021.
705. Orrell, D.L.; Questel, J.M.; Smoot, C.A.; Simpson, T.; Hussey, N.E. *Alembion carchariae* (Copepod: Caligidae) host plasticity and distribution: A new host and locality record from Ascension Island. *J. Mar. Biol. Assoc. UK* **2023**, *103*, e3. [\[CrossRef\]](#)
706. Orrell, D.L.; Sadd, D.; Jones, K.L.; Chadwick, K.; Simpson, T.; Philpott, D.E.; Hussey, N.E. Coexistence, resource partitioning, and fisheries management: A tale of two mesopredators in equatorial waters. *J. Fish Biol.* **2025**, *106*, 1377–1399. [\[CrossRef\]](#) [\[PubMed\]](#)
707. Collins, C.; Weber, S.; Clarke, L.; Gollock, M.; Hussey, N.E.; Simpson, D.; Simpson, T.; Curnick, D. Social dimensions of shark–human interactions in a large remote marine protected area. *People Nat.* **2025**, *7*, 3067–3080. [\[CrossRef\]](#)
708. Günther, A. *Catalogue of the Fishes in the British Museum*; British Museum: London, UK, 1870; Volume 8.
709. Melliss, J.C. *St. Helena: A Physical, Historical and Topographical Description of the Island, Including Its Geology, Fauna, Flora, and Meteorology*; Reeve & Co.: London, UK, 1875.
710. Fowler, H.W. The marine fishes of West Africa. *Bull. Am. Mus. Nat. Hist.* **1936**, *70*, 1–1493.
711. Obura, D.O.; Church, J.E.; Gabri  , C. *Assessing Marine World Heritage from an Ecosystem Perspective: The Western Indian Ocean*; UNESCO: Paris, France, 2012.
712. van der Elst, R.P.; Everett, B.I. *Offshore Fisheries of the Southwest Indian Ocean: Their Status and the Impact on Vulnerable Species*; Special Publication; Oceanographic Research Institute: Durban, South Africa, 2015; Volume 10, pp. 1–448.
713. Chabanet, P.; Bigot, L.; Nicet, J.B.; Durville, P.; Mass  , L.; Mulochau, T.; Russo, C.; Tessier, E.; Obura, D. Coral reef monitoring in the Iles Eparses, Mozambique Channel (2011–2013). *Acta Oecol.* **2016**, *72*, 62–71. [\[CrossRef\]](#)
714. Davies, D.H.; Joubert, L.S. *Tag Evaluation and Shark Tagging in South African Waters*; South African Association for Marine Biology Research Investigational Report; Oceanographic Research Institute: Durban, South Africa, 1966; Volume 12, pp. 1–36.
715. Davies, D.H.; Joubert, L.S. Tag evaluation and shark tagging in South African waters, 1964–1965. In *Sharks, Skates, and Rays*; Gilbert, P.W., Mathewson, R.F., Rall, D.P., Eds.; Johns Hopkins University Press: Baltimore, MD, USA, 1967; pp. 111–140.
716. Winton, M.V.; Ebert, D.A. Family Carcharhinidae—Requiem sharks. In *Coastal Fishes of the Western Indian Ocean. Vol. 1*; Heemstra, P.C., Heemstra, E., Ebert, D.A., Holleman, W., Randall, J.E., Eds.; South African Institute for Aquatic Biodiversity: Makhanda, South Africa, 2022; pp. 510–538.
717. McGrouther, M. Galapagos Shark, *Carcharhinus galapagensis* (Snodgrass & Heller, 1905). In *Animal Factsheets: Fishes*; Australian Museum: Sydney, Australia, 2021; Available online: <https://australian.museum/learn/animals/fishes/galapagos-shark-carcharhinus-galapagensis> (accessed on 9 April 2023).
718. Bray, D.J. Galapagos Shark, *Carcharhinus galapagensis* (Snodgrass & Heller 1905). In *Fishes of Australia*; Museums Victoria: Melbourne, Australia, 2023; Available online: <https://fishesofaustralia.net.au/home/species/1956> (accessed on 9 April 2023).
719. Mori, T.; Horii, Y.; Tanoue, H.; Komatu, T.; Sato, K.; Ohizumi, H. Behavior of pelagic sharks (Carcharhinidae spp.) in waters of Hachijo island, Tokyo. In *Report of Japanese Society for Elasmobranch Studies*; Japanese Society for Elasmobranch Studies: Tokyo, Japan, 2011; Volume 47, p. 78. (In Japanese)
720. Nakaya, K. A fatal attack by a white shark in Japan and a review of shark attacks in Japanese waters. *Jpn. J. Ichthyol.* **1993**, *40*, 35–42. [\[CrossRef\]](#)
721. Nakaya, K. Hydrodynamic function of the head in the hammerhead sharks (Elasmobranchii: Sphyrnidae). *Copeia* **1995**, *2*, 330–336. [\[CrossRef\]](#)
722. Asahida, T.; Ida, H.; Hayashizaki, K.I. Karyotypes and cellular DNA contents of some sharks in the order Carcharhiniformes. *Jpn. J. Ichthyol.* **1995**, *42*, 21–26. [\[CrossRef\]](#)
723. Randall, J.E.; Ida, H.; Kato, K.; Pyle, R.L.; Earle, J.L. Annotated checklist of the inshore fishes of the Ogasawara Islands. *Natl. Sci. Mus. Monogr.* **1997**, *11*, 1–74.
724. Kami, H.T. Check-list of Guam fishes, Supplement II. *Micronesica* **1975**, *11*, 115–121.
725. Myers, R.F. An annotated checklist of the fishes of the Mariana Islands. *Micronesica* **1988**, *21*, 115–180.
726. Haight, W.R.; Dalzell, P. Catch and management of sharks in pelagic fisheries in Hawaii and the Western Pacific region. In *Proceedings of the Paper Prepared for the International Pelagic Shark Workshop Asilomar Conference Center, Pacific Grove, California, 14–17 February 2000*; Western Pacific Regional Fishery Management Council: Honolulu, HI, USA, 2000.
727. Myers, R.F.; Donaldson, T.J. The fishes of the Mariana Islands. *Micronesica* **2003**, *35–36*, 594–648.

728. Dalzell, P.J.; Laurs, R.M.; Haight, W.R. Chapter 23: Case study: Catch and management of pelagic sharks in Hawaii and the US Western Pacific Region. In *Sharks of the Open Ocean: Biology, Fisheries and Conservation*; Camhi, M.D., Pikitch, E.K., Babcock, E.A., Eds.; Blackwell Publishing Ltd.: Oxford, UK, 2008; pp. 268–274. [\[CrossRef\]](#)
729. Samson, J.; O'Malley, J. *Project Report: NOAA Ship Rainier, RA-22-01, Rainier Integrates Charting, Hydrography, and Reef Demographics (RICHARD)*; NOAA & NMFS: Honolulu, HI, USA, 2022. [\[CrossRef\]](#)
730. Webb, M.K.; Kraft, D.W.; Hampp, M.N.; Meyer, C.G. Kit-based sampling by trained fishers yields successful DNA identification of depredating shark species in the Marianas. *Mar. Coast. Fish.* **2022**, *14*, e10204. [\[CrossRef\]](#)
731. Jaiteh, V.; Peatman, T.; Lindfield, S.; Gilman, E.; Nicol, S. Bycatch estimates from a Pacific tuna longline fishery provide a baseline for understanding the long-term benefits of a large, blue water marine sanctuary. *Front. Mar. Sci.* **2021**, *8*, 720603. [\[CrossRef\]](#)
732. Schiel, D.R.; Kingsford, M.J.; Choat, J.H. Depth distribution and abundance of benthic organisms and fishes at the subtropical Kermadec Islands. *N. Z. J. Mar. Freshw. Res.* **1986**, *20*, 521–535. [\[CrossRef\]](#)
733. Francis, M.P. Checklist of the coastal fishes of Lord Howe, Norfolk, and Kermadec Islands, southwest Pacific Ocean. *Pac. Sci.* **1993**, *47*, 136–170.
734. Francis, M.P. Geographic distribution of marine reef fishes in the New Zealand region. *N. Z. J. Mar. Freshw. Res.* **1996**, *30*, 35–55. [\[CrossRef\]](#)
735. Francis, M.P. Checklist of the Coastal Fishes of Lord Howe, Norfolk and Kermadec Islands, Southwest Pacific Ocean. Version: 2019.1. Online Resource. 2019. Available online: [https://figshare.com/collections/Checklist\\_of\\_the\\_coastal\\_fishes\\_of\\_Lord\\_Howe\\_Norfolk\\_and\\_Kermadec\\_Islands\\_southwest\\_Pacific\\_Ocean/4428305/2](https://figshare.com/collections/Checklist_of_the_coastal_fishes_of_Lord_Howe_Norfolk_and_Kermadec_Islands_southwest_Pacific_Ocean/4428305/2) (accessed on 24 April 2022). [\[CrossRef\]](#)
736. Francis, M.P. Checklist of the Coastal Fishes of Lord Howe, Norfolk and Kermadec Islands. Version: 2022.2. Online Resource. 2022. Available online: <https://figshare.com/ndownloader/files/38224923> (accessed on 24 June 2023).
737. Duffy, C.A.J. *Trip Report: Southern Salvor Kermadec Islands Expedition, 1–12 November 2004*; Internal Technical Report AKDCO-57141, DOC; Marine Conservation Unit: Auckland, New Zealand, 2005; pp. 1–28. [\[CrossRef\]](#)
738. Duffy, C.A.J. Chapter 17: Family Carcharhinidae. In *The Fishes of New Zealand. Vol. 2*; Roberts, C.D., Stewart, A.L., Struthers, C.D., Eds.; Te Papa Press: Wellington, New Zealand, 2015; pp. 97–106.
739. Eddy, T.D. New Zealand's largest and most isolated marine reserve: The subtropical Kermadec Islands. *JMBA Glob. Mar. Environ.* **2009**, *9*, 8–9.
740. Eddy, T.D. Marine Reserves as Conservation and Management Tools: Implications for Coastal Resource Use. Ph.D. Thesis, Victoria University of Wellington, Wellington, New Zealand, 2011.
741. Francis, M.P.; Gordon, D.P.; Ah Yong, S.T.; Griggs, L.H. *Marine Biodiversity of the Kermadec Region*; NIWA Client Report No. WLG 2009–2020. NIWA Project PEG09301; New Zealand Institute for Earth Science Limited: Auckland, New Zealand, 2009.
742. Griggs, L.H.; Francis, M.P. *Fishing Activity in the Kermadec Fisheries Management Area (FMA 10)*; NIWA Client Report No. WLG 2009–2015. NIWA Project PEG09301; New Zealand Institute for Earth Science Limited: Auckland, New Zealand, 2009.
743. Duffy, C.A.J.; Francis, M.P. Sharks and rays of the Kermadec Islands and north Kermadec Ridge: Species of interest, conservation and scientific significance. In *Deep: Talks and Thoughts Celebrating Diversity in New Zealand's Untouched Kermadecs. Proceedings of the Kermadec Symposium*; Pew Environment Group, Ed.; Pew Environment Group: Washington, DC, USA, 2010; pp. 76–80.
744. Stuart-Smith, R.D.; Crawford, T.; Cooper, A.; Kininmonth, S.; Stuart-Smith, J.; Berkhout, J.; Edgar, G. *Coral Sea Marine Biodiversity*; Institute for Marine and Antarctic Studies, University of Tasmania & Reef Life Survey: Hobart, Australia, 2013.
745. Duffy, C.A.J.; Ah Yong, S.T. Annotated checklist of the marine flora and fauna of the Kermadec Islands Marine Reserve and northern Kermadec Ridge, New Zealand. *Bull. Auckl. Mus.* **2015**, *20*, 19–124.
746. Trnski, T.; de Lange, P.J. Introduction to the Kermadec Biodiscovery Expedition 2011. *Bull. Auckl. Mus.* **2015**, *20*, 1–18.
747. Clark, M.R.; Trnski, T.; Constantine, R.; Aguirre, J.D.; Barker, J.; Betty, E.; Bowden, D.A.; Connell, A.; Duffy, C.A.J.; George, S.; et al. *Biodiversity of the Kermadec Islands and Offshore Waters of the Kermadec Ridge: Report of a Coastal, Marine Mammal and Deep-Sea Survey (TAN1612)*; New Zealand Aquatic Environment and Biodiversity Report 179; Ministry for Primary Industries: Wellington, New Zealand, 2017; pp. 1–95.
748. Francis, M.P.; Hoese, D.F. Checklist of the Coastal Fishes of Lord Howe, Norfolk and Kermadec Islands. Version: 2025.1. Online Resource. 2025. Available online: [https://figshare.com/articles/dataset/Checklist\\_of\\_the\\_coastal\\_fishes\\_of\\_Lord\\_Howe\\_Norfolk\\_and\\_Kermadec\\_islands\\_April\\_2025/28844246?file=53906909](https://figshare.com/articles/dataset/Checklist_of_the_coastal_fishes_of_Lord_Howe_Norfolk_and_Kermadec_islands_April_2025/28844246?file=53906909) (accessed on 14 April 2026).
749. Francis, M.P.; Randall, J.E. Further additions to the fish faunas of Lord Howe and Norfolk Islands, southwest Pacific Ocean. *Pac. Sci.* **1993**, *47*, 118–135.
750. Corrigan, S.; Eddy, C.; Duffy, C.A.J.; Naylor, G.J.P. *Are Dusky and Galapagos Sharks Conspecific? A Thousand Genes Indicate Genetic Homogeneity In Spite of Morphological Disparity*; Programme and Abstracts; Sharks International: Durban, South Africa, 2014.
751. Duffy, C.A.J.; Scott, M. Confirmation of the occurrence of the sandbar shark *Carcharhinus plumbeus* (Nardo, 1827) at Norfolk Island, Tasman Sea. *Zootaxa* **2016**, *4171*, 187–190. [\[CrossRef\]](#) [\[PubMed\]](#)

752. Edgar, G.J.; Ceccarelli, D.; Stuart-Smith, R.D.; Cooper, A.T. *Biodiversity Survey of the Temperate East Coast Commonwealth Marine Reserve Network: Elizabeth & Middleton Reefs, Lord Howe Island & Norfolk Island*; Report to Parks Australia, Department of the Environment; Reef Life Survey Foundation Inc.: Hobart, Australia, 2017.
753. Heather, F.J.; Stuart-Smith, R.D.; Cooper, A.T.; Edgar, G.J. *Reef Life Survey Assessment of Marine Biodiversity in Norfolk Marine Park*; Reef Life Survey Foundation Inc.: Hobart, Australia, 2022.
754. Hesse, R.D. Exploring the Virome of Carcharhinid Shark Skin. Master's Thesis, San Diego State University, San Diego, CA, USA, 2022.
755. Hesse, R.D.; Roach, M.; Kerr, E.N.; Papudeshi, B.; Lima, L.F.O.; Goodman, A.Z.; Hoopes, L.; Scott, M.; Meyer, L.; Huveneers, C.; et al. Phage diving: An exploration of the carcharhinid shark epidermal virome. *Viruses* **2022**, *14*, 1969. [CrossRef] [PubMed]
756. Roberts, C. Trophic niche overlap and segregation among elasmobranch predators in a unique island environment. In Proceedings of the Sharks International Conference 2022, Abstract Booklet, Valencia, Spain, 10–14 October 2022.
757. O'Shea, O.R.; Kingsford, M.J.; Seymour, J. Tide-related periodicity of manta rays and sharks to cleaning stations on a coral reef. *Mar. Freshw. Res.* **2010**, *61*, 65–73. [CrossRef]
758. Australian Museum. *A survey of Elizabeth and Middleton Reefs, South Pacific. Kowari 3*; Australian National Parks and Wildlife: Sydney, Australia, 1992.
759. Coleman, N. *Australia's Sharks and Rays*; Weldon Publishing: Sydney, Australia, 1992.
760. Oxley, W.G.; Ayling, A.M.; Cheal, A.J.; Osborne, K. *Marine Surveys Undertaken in the Elizabeth Middleton Reefs Marine National Nature Reserve, December 2003. Report to the Australian Government Department of Environment and Heritage*; Australian Institute of Marine Science: Townsville, Australia, 2004.
761. Hobbs, J.P.A.; Choat, J.H.; Robbins, W.D.; van Herwerden, L.; Feary, D.A. Unique fish assemblages at world's southernmost oceanic coral reefs, Elizabeth and Middleton Reefs, Tasman Sea, Australia. *Coral Reefs* **2008**, *27*, 15. [CrossRef]
762. Hobbs, J.P.A.; Neilson, J.; Gilligan, J.J. *Distribution, Abundance, Habitat Association and Extinction Risk of Marine Fishes Endemic to the Lord Howe Island Region. Report to Lord Howe Island Marine Park November 2009*; James Cook University: Townsville, Australia, 2009.
763. Hoey, A.S.; Pratchett, M.S.; Johansen, J.; Hoey, J. *2014 Marine Ecological Survey of Elizabeth and Middleton Reefs, Lord Howe Commonwealth Marine Reserve*; Commonwealth of Australia: Barton, Australia, 2014.
764. McKinley, S.J.; Hansen, S.F.; Fierro-Arcos, D.; Cundy, M.E.; Mossbrucker, M.; Vianna, G.M.S.; Suarez-Moncada, J.; Hoyos-Padilla, M.; Bessudo-Lion, S.; Sala, E.; et al. Relative abundance and diversity of sharks and predatory fishes across Marine Protected Areas of the Tropical Eastern Pacific. *PLoS ONE* **2025**, *20*, e0334164. [CrossRef] [PubMed]
765. Waite, E.R. Additions to the fish-fauna of Lord Howe Island, No. 4. *Rec. Aust. Mus.* **1904**, *5*, 135–186. [CrossRef]
766. Randall, J.E. Randall's tank photos. Collection of 10,000 large-format photos (slides) of dead fishes. Unpublished. In *FishBase. World Wide Web Electronic Publication. Version 08/2022. Pictures Available for Carcharhinus Galapagensis. Australia*; Froese, R., Pauly, D., Eds.; 2022; Available online: <https://www.fishbase.org.au/photos/PicturesSummary.php?ID=870&what=species> (accessed on 3 March 2023).
767. Speare, P.P.; Cappel, M.M.; Rees, M.M.; Brownlie, J.J.; Oxley, W.W. *Deeper Water Fish and Benthic Surveys in the Lord Howe Island Marine Park (Commonwealth Waters): February 2004*; Australian Government, Department of the Environment and Heritage: Townsville, Australia, 2004.
768. Rees, M.J. Incorporating Seascape Ecology into the Design and Assessment of Marine Protected Areas. Ph.D. Thesis, University of Wollongong, Wollongong, Australia, 2017.
769. Rees, M.J.; Knott, N.A.; Neilson, J.M.; Linklater, M.; Osterloh, I.; Jordan, A.; Davis, A.R. Accounting for habitat structural complexity improves the assessment of performance in no-take marine reserves. *Biol. Conserv.* **2018**, *224*, 100–110. [CrossRef]
770. Mitchell, J.D. *Discussion Paper for the Fisheries Research & Development Corporation National Workshop on Shark Depredation in Australian Fisheries*; Queensland Government, Department of Agriculture and Fisheries, Animal Science: Canberra, Australia, 2022.
771. Mitchell, J.D. Using a multi-disciplinary approach to manage shark bycatch and depredation at an offshore marine park. In Proceedings of the Sharks International Conference 2022, Abstract Booklet, Valencia, Spain, 10–14 October 2022.
772. Green, S.; Hearn, A.; Green, J. Species associated with whale sharks (*Rhincodon typus*) in the Galapagos Archipelago. *ARPHA Prepr.* **2022**, *3*, e98091. [CrossRef]
773. Tester, A.L. *Cooperative Shark Research and Control Program. Final Report 1967-69*; University of Hawai'i: Honolulu, HI, USA, 1969.
774. Carvajal, J.; Campbell, R.A.; Cornford, E.M. Some trypanorhynch cestodes from Hawaiian fishes, with descriptions of four new species. *J. Parasitol.* **1976**, *62*, 70–77. [CrossRef] [PubMed]
775. Polovina, J.J.; Tagami, D.T. Preliminary results from ecosystem modeling at French Frigate Shoals. In *Investigations in the Northwestern Hawaiian Islands. Proceedings of the Symposium on Status of Resource, 24th–25th April 1980 & Sea Grant Miscellaneous Reports UNIHI-SEAGRANT-MR-80-04*; Griggs, R.W., Pfund, R.T., Eds.; University of Hawaii: Honolulu, HI, USA, 1980; pp. 286–298.
776. Polovina, J.J. Model of a coral reef ecosystem: I. The ECOPATH model and its application to French Frigate Shoals. *Coral Reefs* **1984**, *3*, 1–11. [CrossRef]
777. Dollar, S.J.; Grigg, R.W. Impact of a kaolin clay spill on a coral reef in Hawaii. *Mar. Biol.* **1981**, *65*, 269–276. [CrossRef]

778. Gooding, R.M. Predation on released spiny lobster, *Panulirus marginatus*, during tests in the northwestern Hawaiian Islands. *Mar. Fish. Rev.* **1985**, *47*, 27–35.
779. Uchida, R.N.; Uchiyama, J.H. *Fishery Atlas of the Northwestern Hawaiian Islands*; NOAA Technical Report NMFS 38; US Department of Commerce: Washington, DC, USA, 1986; pp. 1–142.
780. Wilson, M.T.; Jokiel, P.L. *Ciguatera at Midway: An Assessment Using the Hokama “Stick Test” for Ciguatoxin*; SWFSC Honolulu Laboratory National Marine Fishery Services NOAA Administrative Report; NOAA Technical Report NMFS 38; US Department of Commerce: Washington, DC, USA, 1986; Volume 86, pp. 1–23.
781. Hobson, E.S.; Chave, E.H. *Hawaiian Reef Animals: Revised Edition*; University of Hawaii Press: Honolulu, HI, USA, 1990.
782. Haight, W.R.; Polovina, J.J. *Status of Lobster Stocks in the Northwestern Hawaiian Islands, 1993*; U.S. Department of Commerce: Washington, DC, USA, 1993.
783. Crow, G.L.; Lowe, C.G.; Wetherbee, B.M. Shark records from longline fishing programs in Hawai‘i with comments on Pacific Ocean distributions. *Pac. Sci.* **1996**, *50*, 382–392.
784. Robertson, D.R.; Allen, G.R. Zoogeography of the shorefish fauna of Clipperton Atoll. *Coral Reefs* **1996**, *15*, 121–131. [[CrossRef](#)]
785. Heithaus, M.R. Predator-prey and competitive interactions between sharks (order Selachii) and dolphins (suborder Odontoceti): A review. *J. Zool.* **2001**, *253*, 53–68. [[CrossRef](#)]
786. Itano, D.G. Tuna tagging by the numbers: Structured tagging experiments or sportfish tagging? In *Proceedings of the 1998 Pacific Island Gamefish Symposium: Facing the Challenges of Resource Conservation, Sustainable Development, and the Sportfishing Ethic (29 July–1 August, 1998, Kailua-Kona, Hawaii, USA)*; Miller, M.L., Daxboeck, C., Dahl, C., Kelly, K., Dalzell, P., Eds.; Western Pacific Regional Fishery Management Council: Honolulu, HI, USA, 2001; pp. 47–62.
787. Rauzon, M.J. *Isles of Refuge: Wildlife and History of the Northwestern Hawaiian Islands*; University of Hawai‘i Press: Honolulu, HI, USA, 2001.
788. Crow, G.L.; Crites, J. *Sharks and Rays of Hawai‘i*; Mutual Publishing: Honolulu, HI, USA, 2002.
789. Lowe, C.G.; Wetherbee, B.M.; Holland, K.N.; Meyer, C.G. Movement patterns of tiger and Galapagos sharks around French Frigate Shoals, Hawaii. In *Proceedings of the American Elasmobranch Society 19th Annual Meeting*, Manaus, Brazil, 26 June–1 July 2003.
790. Vatter, A. *Bottom Longline Fishing for Sharks in the Northwestern Hawaiian Islands*; National Marine Fisheries Service Pacific Islands Region Administrative Report ARPIR-03-01; U.S. Department of Commerce: Washington, DC, USA, 2003; pp. 1–16.
791. DeMartini, E.E.; Friedlander, A.M. Spatial patterns of endemism in shallow-water reef fish populations of the Northwestern Hawaiian Islands. *Mar. Ecol. Prog. Ser.* **2004**, *271*, 281–296. [[CrossRef](#)]
792. NMFS & NOAA. *NMFS/NOAA—National Marine Fisheries Service/National Oceanic and Atmospheric Administration Cruise Report, NOAA Ship Hi‘ialakai, Cruise 04-01, 13 September–17 October 2004, Northwestern Hawaiian Islands*; PIFSC Cruise Report; Project HA-04-01; NMFS & NOAA: Honolulu, HI, USA, 2004.
793. Daly-Engel, T.S.; Holland, K.N.; Grubbs, R.D.; Toonen, R.J.; Bowen, B.W. Multiple paternity assessments for three species of congeneric sharks (Carcharhinus) in Hawaii. In *Proceedings of the American Elasmobranch Society 21th Annual Meeting*, Tampa, FL, USA, 6–11 July 2005.
794. Daly-Engel, T.S.; Grubbs, R.D.; Holland, K.N.; Toonen, R.J.; Bowen, B.W. Assessment of multiple paternity in single litters from three species of carcharhinid sharks in Hawaii. *Environ. Biol. Fish.* **2006**, *76*, 419–424. [[CrossRef](#)]
795. Friedlander, A.M.; Aeby, G.; Brainard, R.; Clark, A.; DeMartini, E.; Godwin, S.; Kenyon, J.; Kosaki, R.; Maragos, J.; Vroom, P. *The State of Coral Reef Ecosystems of the Northwestern Hawaiian Islands*; NOAA Technical Memorandum NOS NCCOS; U.S. Department of Commerce: Washington, DC, USA, 2005; Volume 11, pp. 270–311.
796. Friedlander, A.; Keller, K.E.; Monaco, M. Chapter 1: Introduction. In *A Marine Biogeographic Assessment of the Northwestern Hawaiian Islands*; NOAA Technical Memorandum NOS NCCOS 84; U.S. Department of Commerce: Washington, DC, USA, 2009; pp. 1–16.
797. Friedlander, A.; Kobayashi, D.; Bowen, B.; Meyers, C.; Papastamatiou, Y.P.; DeMartini, E.; Parrish, F.; Trembl, E.; Currin, C.; Hiltling, A.; et al. Chapter 9: Connectivity and integrated ecosystem studies. In *A Marine Biogeographic Assessment of the Northwestern Hawaiian Islands*; NOAA Technical Memorandum NOS NCCOS 84; U.S. Department of Commerce: Washington, DC, USA, 2009; pp. 291–330.
798. Holzwarth, S.R.; DeMartini, E.E.; Schroeder, R.E.; Zgliczynski, B.J.; Laughlin, J.L. Sharks and jacks in the Northwestern Hawaiian Islands from towed-diver surveys 2000–2003. *Atoll Res. Bull.* **2006**, *543*, 257–279.
799. Juncker, M.; Robert, M.; Clua, E. Coastal shark fisheries in the Pacific: A brief overview of current knowledge. In *Report for the CRISP Programme; CRISP; Coral Reef Initiative for the South Pacific*: Nouméa, New Caledonia, 2006.
800. Papastamatiou, Y.P.; Meyer, C.G.; Maragos, J.E. Sharks as cleaners for reef fish. *Coral Reefs* **2007**, *26*, 277. [[CrossRef](#)]
801. Papastamatiou, Y.P.; Itano, D.G.; Dale, J.J.; Meyer, C.G.; Holland, K.N. Site fidelity and movements of sharks associated with ocean-farming cages in Hawaii. *Mar. Freshw. Res.* **2010**, *61*, 1366–1375. [[CrossRef](#)]

802. Wang, J.; McNaughton, L.; Swimmer, Y. Galapagos and sandbar shark aversion to electropositive metal (Pr-Nd alloy). In *Shark Deterrent and Incidental Capture Workshop, 10–11 April 2008*; Swimmer, Y., Wang, J.H., McNaughton, L., Eds.; NOAA: Honolulu, HI, USA, 2008; pp. 28–32.
803. Holland, K.N.; Meyer, C.G.; Dagorn, L.C. Inter-animal telemetry: Results from first deployment of acoustic ‘business card’ tags. *Endanger. Species Res.* **2009**, *10*, 287–293. [[CrossRef](#)]
804. Office of National Marine Sanctuaries. *Papahānaumokuākea Marine National Monument Condition Report 2009*; NOAA: Silver Spring, MD, USA, 2009.
805. Walsh, W.A.; Bigelow, K.A.; Sender, K.L. Decreases in shark catches and mortality in the Hawaii-based longline fishery as documented by fishery observers. *Mar. Coast. Fish.* **2009**, *1*, 270–282. [[CrossRef](#)]
806. Randall, J.E. *Shore Fishes of Hawaii: Revised Edition*; University of Hawaii Press: Honolulu, HI, USA, 2010.
807. Dale, J.J.; Meyer, C.G.; Clark, C.E. The ecology of coral reef top predators in the Papahānaumokuākea Marine National Monument. *J. Mar. Biol.* **2011**, *2011*, 725602. [[CrossRef](#)]
808. Richards, B.L.; Williams, I.D.; Nadon, M.O.; Zgliczynski, B.J. A towed-diver survey method for mesoscale fishery-independent assessment of large-bodied reef fishes. *Bull. Mar. Sci.* **2011**, *8*, 55–74. [[CrossRef](#)]
809. Hilting, A.K.; Currin, C.A.; Kosaki, R.K. Evidence for benthic primary production support of an apex predator-dominated coral reef food web. *Mar. Biol.* **2013**, *160*, 1681–1695. [[CrossRef](#)]
810. Sprague, R.; Littnan, C.; Walters, J. *Estimation of Hawaiian Monk Seal Consumption in Relation to Ecosystem Biomass and Overlap with Fisheries in the Main Hawaiian Islands*; NOAA Technical Memorandum NMFS-PIFSC 37; U.S. Department of Commerce: Washington, DC, USA, 2013; pp. 1–43.
811. Zgliczynski, B.J.; Williams, I.D.; Schroeder, R.E.; Nadon, M.O.; Richards, B.L.; Sandin, S.A. The IUCN Red List of Threatened Species: An assessment of coral reef fishes in the US Pacific Islands. *Coral Reefs* **2013**, *32*, 637–650. [[CrossRef](#)]
812. Helfman, G.; Burgess, G.H. *Sharks: The Animal Answer Guide*; Johns Hopkins University Press: Baltimore, MD, USA, 2014.
813. Curran, D.S.; Bigelow, K. *Length-Weight Relationships for 73 Species and Species Groups as Reported in the 2011–2013 National Bycatch Reports for Pelagic Longline Fisheries in Hawaii and American Samoa*; PIFSC Data Report DR-16-004; U.S. Department of Commerce: Washington, DC, USA, 2016; pp. 1–9. [[CrossRef](#)]
814. Pyle, R.L.; Boland, R.; Bolick, H.; Bowen, B.W.; Bradley, C.J.; Kane, C.; Kosaki, R.K.; Langston, R.; Longenecker, K.; Montgomery, A.; et al. A comprehensive investigation of mesophotic coral ecosystems in the Hawaiian Archipelago. *PeerJ* **2016**, *4*, e2475. [[CrossRef](#)] [[PubMed](#)]
815. Asher, J.; Williams, I.D.; Harvey, E.S. Is seeing believing? Diver and video-based censuses reveal inconsistencies in roving predator estimates between regions. *Mar. Ecol. Prog. Ser.* **2019**, *630*, 115–136. [[CrossRef](#)]
816. Spalding, H.L.; Copus, J.M.; Bowen, B.W.; Kosaki, R.K.; Longenecker, K.; Montgomery, A.D.; Padilla-Gamiño, J.L.; Parrish, F.A.; Roth, M.S.; Rowley, S.J.; et al. Chapter 25: The Hawaiian Archipelago. In *Mesophotic Coral Ecosystems. Coral Reefs of the World, Vol. 12*; Loya, Y., Puglise, K., Bridge, T., Eds.; Springer: Cham, Switzerland, 2019; pp. 445–464. [[CrossRef](#)]
817. Kraft, D.W. Conservation Genetics of Sharks. Ph.D. Thesis, University of Hawai‘i at Manoa, Honolulu, HI, USA, 2020.
818. Kraft, D.W.; Meyer, L.; Webb, M.; Scidmore-Rossing, K.; Huveneers, C.; Clua, E.; Meyer, C. Development and successful real-world use of a transfer DNA technique to identify species involved in shark bite incidents. *J. Forensic Sci.* **2021**, *66*, 2438–2443. [[CrossRef](#)] [[PubMed](#)]
819. Blandino, C.A. Habitat Partitioning in Sympatric Sharks at French Frigate Shoals Atoll. Master’s Thesis, University of Hawai‘i at Manoa, Honolulu, HI, USA, 2021.
820. Blandino, C.A.; Papastamatiou, Y.P.; Dale, J.J.; Meyer, C.G. Seabirds mediate intraguild and competitive interactions in a shark community. *Ecosphere* **2025**, *16*, e70486. [[CrossRef](#)]
821. Gilman, E.; Chaloupka, M.; Pacini, A.; Kingma, E. Exploring odontocete depredation rates in a pelagic longline fishery. *PLoS ONE* **2024**, *19*, e0301072. [[CrossRef](#)] [[PubMed](#)]
822. Ralston, S.; Gooding, R.M.; Ludwig, G. An ecological survey and comparison of bottom fish resource assessments (submersible versus handline fishing) at Johnston Atoll. *Fish. Bull.* **1986**, *84*, 141–155.
823. Randall, J.E. 106 new records of fishes from the Marshall Islands. *Bull. Mar. Sci.* **1986**, *38*, 170–252.
824. Randall, J.E. Randall’s tank photos. Collection of 10,000 large-format photos (slides) of dead fishes. Unpublished. In *FishBase. World Wide Web Electronic Publication. Version 08/2022. Pictures Available for Carcharhinus Galapagensis. Marshall Islands*; Froese, R., Pauly, D., Eds.; 2022; Available online: <https://www.fishbase.org/au/photos/PicturesSummary.php?StartRow=2&ID=870&what=species&TotRec=6> (accessed on 3 March 2023).
825. Randall, J.E.; Randall, H.A. Chapter 27: Annotated checklist of the fishes of Enewetak Atoll and other Marshall Islands. In *The Natural History of Enewetak Atoll. Volume II: Biogeography and Systematics*; Devaney, D.M., Reese, E.S., Burch, B.L., Helfrich, P., Eds.; U.S. Department of Energy: Oak Ridge, TN, USA, 1987; pp. 289–324. [[CrossRef](#)]
826. Myers, R.F. *Micronesian Reef Fishes: A Comprehensive Guide to the Coral Reef Fishes of Micronesia*, 3rd ed.; Coral Graphics: Barrigada, Guam, 1999.

827. Bromhead, D.; Clarke, S.; Hoyle, S.; Muller, B.; Sharples, P.; Harley, S. Identification of factors influencing shark catch and mortality in the Marshall Islands tuna longline fishery and management implications. *J. Fish Biol.* **2012**, *80*, 1870–1894. [CrossRef] [PubMed]
828. National Museum of Natural History—Smithsonian Institution. Fish collections Search. Fish Collections Data at NMNH. 2022. Search the Division of Fishes Collections. Available online: <https://collections.nmnh.si.edu/search/fishes/> (accessed on 26 August 2022).
829. Smithsonian National Museum of Natural History. Special Collections: Fish Illustration Collections. Catalog Number USNM FIN 27605: *Carcharhinus galapagensis*. 2023. Available online: <http://n2t.net/ark:/65665/34a8453cc-f623-499b-bf66-f5951314ea16> (accessed on 28 February 2023).
830. Lack, M.; Meere, F. *Regional Action Plan for Sharks: Guidance for Pacific Island Countries and Territories on the Conservation and Management of Sharks*; Shellack Pty Ltd.: Canberra, Australia, 2009.
831. Mundy, B.C.; Wass, E.D.; Greene, B.; Zgliczynski, B.; Schroeder, R.E.; Musberger, C. Inshore fishes of Howland Island, Baker Island, Jarvis Island, Palmyra Atoll, and Kingman Reef. *Atoll Res. Bull.* **2010**, *585*, 1–131. [CrossRef]
832. McCormack, G. Cook Islands biodiversity and natural heritage database. In *FishBase. World Wide Web Electronic Publication. Version 08/2022*; Froese, R., Pauly, D., Eds.; 2000; Available online: [https://fishbase.net.br/country/CountrySpeciesSummary.php?c\\_code=184&id=870](https://fishbase.net.br/country/CountrySpeciesSummary.php?c_code=184&id=870) (accessed on 18 January 2023).
833. Wass, R.C. *An Annotated Checklist of the Fishes of Samoa*; NOAA Technical Report SSRF 781; U.S. Department of Commerce: Washington, DC, USA, 1984; pp. 1–43.
834. Nunis, T.; Grant, M.I.; Chin, A. Sharks and rays of the Samoan archipelago: A review of their biological diversity, social and cultural values, and conservation status. *Pac. Conserv. Biol.* **2024**, *30*, PC23039. [CrossRef]
835. Aeby, G.; Cooper Aletto, S.; Anderson, P.; Carroll, B.; DiDonato, E.; DiDonato, G.; Farmer, V.; Fenner, D.; Gove, J.; Gulick, S.; et al. The state of coral reef ecosystems of American Samoa. In *The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States: 2008*. NOAA Technical Memorandum NOS NCCOS 73; Waddell, J.E., Clarke, A.M., Eds.; NOAA/NCOS Center for Coastal Monitoring and Assessment's Biogeography Team: Silver Spring, MD, USA, 2009; pp. 307–351.
836. Friedlander, A.M.; Arribas, J.; Ballesteros, E.; Betz, J.; Bosserelle, P.; Brown, E.; Caselle, J.E.; Cramp, J.E.; Gataua, L.; Helagi, N.; et al. *Exploring the Marine Ecosystems of Niue and Beveridge Reef. Report to the Government of Niue*; National Geographic Pristine Seas: Washington, DC, USA, 2017.
837. Biquet, J.A.; Tixier, P.; Richard, G.; Soehnlen, M.; Thellier, T.; Carzon, P.; Clua, E.; Guinet, C. Toothed whale and shark depredation and bycatch in the longline fishery of French Polynesia. *Fish. Res.* **2024**, *271*, 106928. [CrossRef]
838. Randall, J.E. Fauna and Flora, a First Compendium of French Polynesian Sea-Dwellers. In *Proceedings of the Fifth International Coral Reef Congress, Tahiti, French Polynesia, 27 May–1 June 1985*; Richard, G., Ed.; Antenne Museum-Ephe: Moorea, French Polynesia; Volume 1, 1985; pp. 462–481.
839. Mourier, J.; Planes, S. Les requins et raies des îles Australes, espèces emblématiques de la conservation. In *Environnement Marin Des Îles Australes, Polynésie Française*; Salvat, B., Bambridge, T., Tanret, D., Petit, J., Eds.; Institut Récifs Coralliens Pacifique, CRILOBE & The Pew Charitable Trusts Polynésie française: Tahiti, French Polynesia, 2015; pp. 112–119. (In French)
840. Séguigne, C.; Mourier, J.; Clua, E.; Buray, N.; Planes, S. Citizen science provides valuable data to evaluate elasmobranch diversity and trends throughout the French Polynesia's shark sanctuary. *PLoS ONE* **2023**, *18*, e0282837. [CrossRef] [PubMed]
841. Bacchet, P.; Zysman, T.; Lefèvre, Y. Guide des poissons de Tahiti et ses îles. In *Éditions Au Vent Des Îles*; Collection Nature et Environnement d'Océanie: Tahiti, French Polynesia, 2007. (In French)
842. Randall, J.E.; Smith, C.L.; Feinberg, M.N. *Report on Fish Collections from Rapa, French Polynesia*; Number 2966; American Museum of Natural History: New York, NY, USA, 1990; pp. 1–42.
843. Galzin, R.; Lecchini, D.; Williams, J.T.; Planès, S.; Menou, J.L. Diversité de l'ichtyofaune corallienne à Rapa (Polynésie française). *Cybium* **2006**, *30*, 227–234. (In French, with an English abstract).
844. Friedlander, A.M.; Ballesteros, E.; Berkenpas, E.; Brown, E.; Bouchet, P.; Du Prel, P.; Petit, J.; Rose, P.; Siu, G.; Tickler, D.; et al. Biodiversité marine à Rapa et à Marotiri: Les îles du bout du monde. In *Environnement Marin Des Îles Australes, Polynésie Française*; Salvat, B., Bambridge, T., Tanret, D., Petit, J., et al., Eds.; Institut Récifs Coralliens Pacifique, CRILOBE & The Pew Charitable Trusts Polynésie française: Tahiti, French Polynesia, 2015; pp. 130–143. (In French)
845. Bouchet, P.J.F. Submarine Topography as a Predictor of Mobile Predator Hotspots: Relevance and Applications to Conservation Planning in the Pelagic Ocean. Ph.D. Thesis, The University of Western Australia, Perth, Australia, 2015.
846. Randall, J.E. Report on fish collections from the Pitcairn Islands. *Atoll Res. Bull.* **1999**, *461*, 1–50. [CrossRef]
847. Duffy, C.A.J.; Struthers, C.D. A major range extension for *Carcharhinus altimus* (Springer, 1950) in the South Pacific Ocean. *Zootaxa* **2017**, *4323*, 132–138. [CrossRef]
848. Berdegúe, A.J. *Peces de Importancia Comercial En La Costa Nor-occidental de México*; Comisión para el Fomento de la Piscicultura Rural: México, Mexico, 1956. (In Spanish)

849. Fowler, H.W. Results of the fifth George Vanderbilt expedition (1941) (Bahamas, Caribbean Sea, Panama, Galápagos Archipelago and Mexican Pacific islands). The fishes. *Monogr. Acad. Nat. Sci. Phila.* **1944**, *6*, 57–529.
850. Galván-Magaña, F.; Nienhuis, H.J.; Klimley, A.P. Seasonal abundance and feeding habits of sharks of the lower Gulf of California, Mexico. *Calif. Fish. Game* **1989**, *75*, 74–84.
851. Allen, G.R.; Robertson, D.R. *Fishes of the Tropical Eastern Pacific*; University of Hawaii Press: Honolulu, HI, USA, 1994.
852. Compagno, L.J.V.; Krupp, F.; Schneider, W. Tiburones. In *Guía FAO Para La identificación de Especies Para Los Fines de La Pesca. Pacifico Centro-Oriental. Vol. 2: Vertebrados—Parte 1*; Fischer, W., Krupp, F., Schneider, W., Sommer, C., Carpenter, K.E., Niem, V.H., Eds.; FAO: Rome, Italy, 1995; pp. 648–743. (In Spanish)
853. De La Cruz Agüero, J.; Arellano-Martínez, M.; Gómez, V.M.C.; De La Cruz Agüero, G. *Catálogo de Los Peces Marinos de Baja California Sur*; Instituto Politécnico Nacional, Centro Interdisciplinario de Ciencias Marinas: La Paz, Bolivia, 1997. (In Spanish)
854. Mould, B. *Classification of the Recent Elasmobranchii. A Classification of the Living Sharks and Rays of the World*; Copyright Brian Mould; Unpublished manuscript draft; The University of Nottingham: Nottingham, UK, 1997.
855. Love, M.S.; Mecklenburg, C.W.; Mecklenburg, T.A.; Thorsteinson, L.K. *Resource Inventory of Marine and Estuarine Fishes of the West Coast and Alaska: A Checklist of North Pacific and Arctic Ocean Species from Baja California to the Alaska-Yukon Border*; US Department of the Interior, US Geological Survey, Biological Resources Division: Seattle, WA, USA, 2005. [[CrossRef](#)]
856. Del Moral-Flores, L.F.; Morrone, J.J.; Alocer Durand, J.; Espinosa-Pérez, H.; Pérez-Ponce De León, G. Lista patrón de los tiburones, rayas y quimeras (Chondrichthyes, Elasmobranchii, Holocephali) de México. *Arx. Misc. Zool.* **2015**, *13*, 47–163, (In Spanish, with an English abstract). [[CrossRef](#)]
857. Saldaña-Ruiz, L.E.; García-Rodríguez, E.; Pérez-Jiménez, J.C.; Tovar-Ávila, J.; Rivera-Téllez, E. Chapter 2: Biodiversity and conservation of sharks in Pacific Mexico. In *Sharks in Mexico: Research and Conservation Part A (Adv. Mar. Biol. 83)*; Larson, S.E., Lowry, D., Eds.; Academic Press: London, UK, 2019; pp. 11–60. [[CrossRef](#)] [[PubMed](#)]
858. Ayala-Bocos, A.; Fernández-Rivera-Melo, F.; Reyes Bonilla, H. Updated checklist of fishes at Cabo Pulmo reef, Gulf of California, Mexico. *Rev. Cienc. Mar. Cost.* **2018**, *10*, 9–29. [[CrossRef](#)]
859. González-Acosta, A.F.; Monsalvo-Flores, A.E.; Tovar-Ávila, J.; Jiménez-Castañeda, M.F.; Alejo-Plata, M.D.C.; de la Cruz-Agüero, G. Diversity and conservation of Chondrichthyes in the Gulf of California. *Mar. Biodivers.* **2021**, *51*, 46. [[CrossRef](#)]
860. Bonfil, R. Capítulo 15: Marco normativo para la conservación y manejo sustentable de tiburones y batoides en México. In *Conservación, Uso Y Aprovechamiento Sustentable de Tiburones Mexicanos Listados En La Cites*; Sosa-Nishizaki, O., Castillo-Géniz, J.L., Benítez-Díaz, H., Eds.; Comisión Nacional para el Conocimiento y Uso de la Biodiversidad: México, Mexico, 2022; pp. 290–323. (In Spanish)
861. Gotshall, D.W. Fishes of Rocas Alijos. In *Rocas Alijos. Monographiae Biologicae 75*; Schmieder, R.W., Ed.; Springer: Dordrecht, The Netherlands, 1996; pp. 347–354. [[CrossRef](#)]
862. van der Heiden, A.M.; Hendrickx, M.E. *Inventario de La Fauna Marina Y Costera Del Sur de Sinaloa, Mexico*; Universidad Nacional Autónoma de México—UNAM, Instituto de Ciencias del Mar y Limnología: Estacion Mazatlan, Mexico, 1982. (In Spanish)
863. Hernández, H.S.; Flores, J.J.V.; Carrasco, L.V. Pesquería semi-industrial de Manzanillo, Colima. In *Tiburones Mexicanos de Importancia Pesquera En La Cites Parte II*; Ávila, J.T., Géniz, J.L.C., Eds.; INAPESCA: Coyoacán, Mexico, 2021; pp. 24–30. (In Spanish)
864. Celaya-Castillo, C.; Romero-Berny, E.I.; Galván-Magaña, F.; López-Vila, J.M.; Matamoros, W.A. Characterization of surface and bottom longline artisanal shark fisheries in the northern Gulf of Tehuantepec, Mexico. *Thalassas* **2025**, *41*, 1–11. [[CrossRef](#)]
865. Cressey, R.F. Revision of the family Pandaridae (Copepoda: Caligoida). *Proc. U. S. Natl. Mus.* **1967**, *121*, 1–133. [[CrossRef](#)]
866. Howe, J.C.; Springer, V.G. Catalog of type specimens of recent fishes in the National Museum of Natural History, Smithsonian Institution. *Smithson. Contrib. Zool.* **1994**, *540*, 1–19. [[CrossRef](#)]
867. Castro-Aguirre, J.L.; Balart, E.F. Capítulo 11: La ictiofauna de las Islas Revillagigedo y sus relaciones zoogeográficas, con comentarios acerca de su origen y evolución. In *Libro Jubilar En Honor Al Dr. Salvador Contreras Balderas*; Lozano-Vilano, M.L., Ed.; Universidad Autónoma de Nuevo León: San Nicolás de los Garza, Mexico, 2002; pp. 153–170, (In Spanish, with an English abstract).
868. Del Moral-Flores, L.F.; Gracian-Negrete, J.M.; Guzmán-Camacho, A.F. Peces del archipiélago de las Islas Revillagigedo: Una actualización sistemática y biogeográfica. *BIOCYT Biol. Cienc. Tecnol.* **2016**, *9*, 596–619, (In Spanish, with an English abstract). [[CrossRef](#)]
869. Clua, E. *Mission Internationale sur l'atoll de Clipperton (île de La Passion—France) et les îles Revillagigedo (Mexique) du 28 janvier au 11 février 2016; Rapport de mission. CRIIBE USR3278 CNRS-EPHEUPVD. RA231; République Française & République en Polynésie Française*: Paris, France; Papeete, French Polynesia, 2016. (In French)
870. Fourriére, M.; Reyes-Bonilla, H.; Ayala-Bocos, A.; Ketchum, J.T.; Chávez-Comparan, J.C. Checklist and analysis of completeness of the reef fish fauna of the Revillagigedo Archipelago, Mexico. *Zootaxa* **2016**, *4150*, 436–466. [[CrossRef](#)] [[PubMed](#)]
871. Aburto-Oropeza, O.; Ballesteros, E.; Ezcurra, E.; Friedlander, A.; Henning, B.; Hoyos, M.; Johnson, A.F.; Mascareñas-Osorio, I.; Mayorga, J.S.; Muñoz, A.; et al. *Archipiélago de Revillagigedo: Biodiversidad, Amenazas Y Necesidades de Conservación*; National Geographic Pristine Seas & Mares Mexicanos: Washington, DC, USA; México, Mexico, 2017. (In Spanish)

872. CONANP—Comisión Nacional de Áreas Naturales Protegidas. *Estudio Previo Justificativo Para La Declaratoria Del Parque Nacional Revillagigedo*; Comisión Nacional de Áreas Naturales Protegidas, Secretaría de Medio Ambiente y Recursos Naturales: México, Mexico, 2017. (In Spanish)
873. Lara-Lizardi, F. Shark connectivity among insular sites in the Eastern Tropical Pacific. In Proceedings of the Abstracts of the 6th International Bio-Logging Science Symposium, Konstanz, Germany, 25–29 September 2017.
874. Lara-Lizardi, F.; Hoyos-Padilla, M.; Ketchum, J.; Galván-Magaña, F. Uso de técnicas no invasivas para el monitoreo de especies pelágicas en el Parque Nacional Revillagigedo. In *Libro de Resúmenes. Primer Congreso Latinoamericano de Tiburones, Rayas y Quimeras. VIII Simposium Nacional de Tiburones y Rayas, Playa del Carmen, Quintana Roo, México, Marzo 2019*; Gonzáles, E.C.O., Méndez, O., Sánchez, A.W.D., García, E.E.B., Eds.; Sociedad Mexicana de Peces Cartilaginosos, A.C.: México, Mexico, 2019; p. 22. (In Spanish)
875. Castillo-Cárdenas, A.D. Efecto de los buceadores en el comportamiento de tiburones y mantas gigantes en el Parque Nacional Revillagigedo. In *Libro de Resúmenes. Primer Congreso Latinoamericano de Tiburones, Rayas y Quimeras. VIII Simposium Nacional de Tiburones y Rayas, Playa del Carmen, Quintana Roo, México, Marzo 2019*; Gonzáles, E.C.O., Méndez, O., Sánchez, A.W.D., García, E.E.B., Eds.; Sociedad Mexicana de Peces Cartilaginosos, A.C.: México, Mexico, 2019; p. 38. (In Spanish)
876. Cortés-Fuentes, C.; Martínez-Rincón, R.O.; Jaime-Rivera, M.; Reyes-Bonilla, H.; Ayala-Bocos, A. Influencia de factores ambientales sobre la abundancia relativa de tiburones en el Parque Nacional Revillagigedo. In *Libro de Resúmenes. Primer Congreso Latinoamericano de Tiburones, Rayas y Quimeras. VIII Simposium Nacional de Tiburones y Rayas, Playa del Carmen, Quintana Roo, México, Marzo 2019*; Gonzáles, E.C.O., Méndez, O., Sánchez, A.W.D., García, E.E.B., Eds.; Sociedad Mexicana de Peces Cartilaginosos, A.C.: México, Mexico, 2019; p. 62. (In Spanish)
877. Becerril-García, E.E.; Hoyos-Padilla, E.M.; Henning, B.; Salinas-de-León, P. Sharks, rays, and chimaeras of the Revillagigedo National Park: An update of new and confirmed records. *J. Fish Biol.* **2020**, *97*, 1228–1232. [[CrossRef](#)] [[PubMed](#)]
878. Carter, A.L.; Wilson, A.M.W.; Bello, M.; Hoyos-Padilla, E.M.; Inall, M.E.; Ketchum, J.T.; Schurer, A.; Tudhope, A.W. Assessing opportunities to support coral reef climate change refugia in MPAs: A case study at the Revillagigedo Archipelago. *Mar. Policy* **2020**, *112*, 103769. [[CrossRef](#)]
879. Klimley, A.P.; Ketchum, J.T.; Hoyos-Padilla, E.M.; Rubin, R.; Lara-Lizardi, F. *The Creation of the Revillagigedos National Park*; Poster Presentation; University of California: Davis, CA, USA, 2020. [[CrossRef](#)]
880. Klimley, A.P.; Cogliati, K.M.; Kuroki, M.; Docker, M.F. A review of molecular, physiological, behavioral, and ecological studies in a Special Issue devoted to the movement ecology of fishes. *Environ. Biol. Fish.* **2022**, *105*, 1683–1695. [[CrossRef](#)]
881. Szpilman, M. Mergulhando com o grande tubarão branco. In *Encontros e Desencontros Com Tubarões e Raías: Uma História (não Contada Por Pesquisadores Brasileiros)*; Bornatowski, H., Ed.; MarBrasil: Blumenau, Brazil, 2021; pp. 180–188. (In Portuguese)
882. Chávez, A.N. Interacciones de Limpieza y Estructura de la Comunidad de Peces en Arrecifes Rocosos del Archipiélago de Revillagigedo. Master's Thesis, Centro de Investigación Científica y de Educación Superior de Ensenada, Baja California, Ensenada, Mexico, 2022. (In Spanish)
883. National Museum of Natural History—Smithsonian Institution. Fish Collections Search. Fish Collections Data at NMNH. 2022. Image Catalog Number: USNM RAD 107036. Available online: <http://n2t.net/ark:/65665/3dc86ef6e-38b5-417e-964d-712b317ffd5a> (accessed on 26 August 2022).
884. Pancaldi, F.; Becerril-García, E.E.; Higuera-Rivas, J.E. Chafing behaviour from two carcharhinid shark species *Carcharhinus falciformis* and *C. galapagensis* on whale sharks *Rhincodon typus*. *Rev. Biol. Mar. Oceanogr.* **2022**, *57*, 119–122. [[CrossRef](#)]
885. Sánchez Gómez, H. Uso de Cámaras Remotas para el Estudio de Comunidades de Peces Pelágicos en el Suroeste del Golfo de California y el Archipiélago de Revillagigedo. Master's Thesis, Centro de Investigaciones Biológicas del Noroeste, S.C., Baja California Sur, La Paz, Mexico, 2022. (In Spanish, with an English summary).
886. Sánchez Gómez, H. The importance of a no-take zone for top predators in the Mexican Pacific: Implications for the conservation and management of predatory fish. In Proceedings of the Sharks International Conference 2022, Abstract Booklet, Valencia, Spain, 10–14 October 2022.
887. Le Croizier, G.; Lorrain, A.; Hoyos-Padilla, E.M.; Ketchum, J.T.; Amezcua-Martínez, F.; Le Loc'h, F.; Munaron, J.M.; Schaal, G.; Point, D. Do marine protected areas influence mercury exposure? Insights from a shark community in the tropical Northeast Pacific. *Environ. Pollut.* **2023**, *336*, 122352. [[CrossRef](#)] [[PubMed](#)]
888. Beauvais, S.M.S.; Martínez-Rincón, R.O.; Ketchum, J.T.; Schaal, G.; Lluch-Cota, S.E.; Hoyos-Padilla, E.M. Movement patterns and residency of silvertip sharks (*Carcharhinus albimarginatus*) in a remote archipelago of the Eastern Tropical Pacific. *Environ. Biol. Fish.* **2025**, *108*, 571–589. [[CrossRef](#)]
889. Carone, E.; Hoyos-Padilla, E.M.; Ayala Bocos, A.; Ketchum, J.T. Capítulo 6: Condrictios: Perspectivas ecológicas y de conservación. In *Área Marina Del Parque Nacional Revillagigedo: Pasado, Presente Y Futuro de La Investigación Marina*. UC San Diego Technical Reports; Favoretto, F., Carone, E., Eds.; Centro para la Biodiversidad Marina y la Conservación, A.C.: La Paz, Baja California Sur, Mexico, 2024; pp. 205–234. (In Spanish)

890. Pereira Cabral, M.; Nevels, C.; Ayala-Bocos, A. Chafing Behavior by Carcharhinid Sharks on Oceanic Manta Rays in North America's Largest MPA. *Preprints* **2025**, 2025041307. [\[CrossRef\]](#)
891. Cabral, M.M.P.; Nevels, C.R.; Ayala-Bocos, A. Chafing behavior by Galapagos sharks on oceanic manta rays in North America's largest marine protected area. *Mar. Biodivers.* **2026**, *56*, 34. [\[CrossRef\]](#)
892. Vinesky, J.; Ketchum, J.; Hoyos, M. Scraping the surface: First records of cleaning associations between sharks and oceanic manta rays. *bioRxiv* **2025**. [\[CrossRef\]](#)
893. Ehrhardt, J.P.; Plessis, Y. Aperçu de la faune ichthyologique de Clipperton. *Actes Congr. Natl. Soc. Savantes Sect. Sci.* **1972**, *3*, 757–769. (In French)
894. Yesaki, M. Rainbow runner: A latent oceanic resource? *Mar. Fish. Rev.* **1979**, *41*, 1–6.
895. Allen, G.R.; Robertson, D.R. An annotated checklist of the fishes of Clipperton Atoll, tropical eastern Pacific. *Rev. Biol. Trop.* **1997**, *45*, 813–843.
896. Fourrière, M.; Reyes-Bonilla, H.; Rodríguez-Zaragoza, F.A.; Crane, N. Fishes of Clipperton Atoll, Eastern Pacific: Checklist, endemism, and analysis of completeness of the inventory. *Pac. Sci.* **2014**, *68*, 375–395. [\[CrossRef\]](#)
897. Fundación Malpelo; Parques Nacionales Naturales de Colombia. Comité Técnico Fondo Patrimonial Informe Final Año 2016, No Pagination; Fundación Malpelo & Parques Nacionales Naturales de Colombia: Bogotá, Colombia, 2017. (In Spanish)
898. Clua, E.; Almeda Jauregui, C.O.; López, L.A.; Alatorre Alba, A.J.; Barbosa Solomieu, V.; Berr, T.; Campo Hernandez, D.; de Méringo, D.; Huidobro, L.; Cruz, D.H.; et al. Misión científica CLIPPERTON-2019 en el atolón de Clipperton (Isla de la Passion—Francia) del 20 de octubre al 3 de noviembre de 2019. In *Forme de La Misión. CRILOBE USR3278 CNRS-EPHE-UPVD, RA284*; République Française & Gobierno de la República de Mexico: Paris, France; México, Mexico, 2020; (In French and Spanish). [\[CrossRef\]](#)
899. Friedlander, A.M.; Giddens, J.; Ballesteros, E.; Blum, S.; Brown, E.K.; Caselle, J.E.; Henning, B.; Jost, C.; Salinas-de-León, P.; Sala, E. Marine biodiversity from zero to a thousand meters at Clipperton Atoll (Île de La Passion), Tropical Eastern Pacific. *PeerJ* **2019**, *7*, e7279. [\[CrossRef\]](#) [\[PubMed\]](#)
900. Glynn, P.W. Megafauna. In *Coral Reef Resilience in the Anthropocene: A History of Discovery and Research in the Eastern Tropical Pacific Region*; Glynn, P.W., Ed.; Springer Nature: Cham, Switzerland, 2025; pp. 213–234.
901. Ordoñez, T.M.M.; House, P.R. *Especies de Preocupación Especial En Honduras*; Secretaria de Recursos Naturales y Ambiente, ENBII: Tegucigalpa, Honduras, 2008. (In Spanish)
902. Zárate, P.; Hearn, A. *Estado de Conservación de Los Tiburones de Nicaragua, Costa Rica, Panamá, Colombia Y Ecuador*; Fundación Charles Darwin: Santa Cruz, Galápagos, 2008. (In Spanish)
903. Fowler, H.W. The fishes obtained by the Pinchot South Seas Expedition of 1929, with description of one new genus and three new species. *Proc. U. S. Natl. Mus.* **1932**, *80*, 1–16. [\[CrossRef\]](#)
904. Eibl-Eibesfeldt, I.; Hass, H. Erfahrungen mit Haien. *Z. Tierpsychol.* **1959**, *16*, 733–746. (In German) [\[CrossRef\]](#)
905. Robertson, D.R. *Cocos Island Expedition on STRI's Research Vessel, RV Urraca, 22 October–4 November 1997*; Washington, DC, USA, 1997.
906. Bussing, W.A.; López, M. Peces de la Isla del Coco y peces arrecifales de la costa Pacífica de América Central meridional. *Rev. Biol. Trop.* **2005**, *53*, 1–192. (In Spanish)
907. Garrison, G. *Peces de La Isla Del Coco*, 2nd ed.; Editorial INBio: San José, Costa Rica, 2005. (In Spanish)
908. Velasco, L.C. *Capacidad de Carga Turística Del Parque Nacional Isla Del Coco. Project Study, No Pagination*; French Facility for Global Environment & United Nations Development Programme: San José, Costa Rica, 2008. (In Spanish)
909. Combs, B.J. A Shark Attack: Implications of Fin Trade in a Pacific Costa Rican Seascape. Master's Thesis, The University of Georgia, Athens, GA, USA, 2013.
910. Alvarado, J.J.; Beita-Jiménez, A.; Mena, S.; Fernández-García, C.; Guzman-Mora, A.G.; Cortés, J. Ecosistemas coralinos del Parque Nacional Isla del Coco, Costa Rica: Estructura y comparación 1987–2014. *Rev. Biol. Trop.* **2016**, *64*, 153–175. (In Spanish, with an English abstract). [\[CrossRef\]](#)
911. Fourrière, M.; Alvarado, J.J.; Ayala Bocos, A.; Cortés, J. Updated checklist and analysis of completeness of the marine fish fauna of Isla del Coco, Pacific of Costa Rica. *Mar. Biodivers.* **2017**, *47*, 813–821. [\[CrossRef\]](#)
912. Fourrière, M.; Alvarado, J.J.; Cortés, J.; Taylor, M.H.; Ayala-Bocos, A.; Azofeifa-Solano, J.C.; Arauz, R.; Heidemeyer, M.; López-Garro, A.; Zanella, I.; et al. Energy flow structure and role of keystone groups in shallow water environments in Isla del Coco, Costa Rica, Eastern Tropical Pacific. *Ecol. Model.* **2019**, *396*, 74–85. [\[CrossRef\]](#)
913. Arnés-Urgellés, C.; Hoyos-Padilla, E.M.; Pochet, F.; Salinas-de-León, P. First observation on the mating behaviour of the marbled ray, *Taeniurops meyeri*, in the tropical Eastern Pacific. *Environ. Biol. Fish.* **2018**, *101*, 1693–1699. [\[CrossRef\]](#)
914. Bettoni-Rodríguez, G.; Chávez, E.J.; Arauz, R.; Barquero-Calvo, E. Antimicrobial resistance on highly migratory sharks of Cocos Island: A pristine and pelagic marine ecosystem. In *Proceedings of the Belgian Wildlife Disease Society & Dutch Society for Wildlife Health Joint Symposium, Utrecht, The Netherlands, 13 October 2022*. Poster presentation. [\[CrossRef\]](#)
915. Cambra Agustí, M. *Uso de Cámaras Remotas Submarinas Para Caracterizar Ensamblajes de Depredadores en Ambientes Remotos del Pacífico Este Tropical*. Master's Thesis, Ciudad Universitaria Rodrigo Facio, San José, Costa Rica, 2022. (In Spanish and English).

916. Fernández-Martínez, S.; Madrigal-Mora, S.; Golfín-Duarte, G.; Espinoza, M. Unoccupied aerial vehicle (Uav) observations of large-bodied fishes on a tropical oceanic island. *SSRN Prepr.* **2025**, 5261444, 1–20. [CrossRef]
917. García, M.D.J.G.; Moll, R.J.; Hearn, A.; Espinoza, M.; White, E.R. Inter-specific relationships and their ecological role in an oceanic elasmobranch community. *ecoevorxiv [Preprint]* **2025**. [CrossRef]
918. ARAP—Autoridad de los Recursos Acuáticos de Panamá. Situación de las Poblaciones de Tiburones en Panamá (Conference Presentation). 2014. Available online: <http://hdl.handle.net/1834/8146> (accessed on 23 February 2023). (In Spanish)
919. Arriatti, Y.R.; Tavares, R.; Alvarado, S. Assessment of the artisanal shark fishery in the Pacific coast of Panama highlights a high proportion of immature and threatened species. *Pan-Am. J. Aquat. Sci.* **2021**, *16*, 189–195.
920. Garcés, H. Lista sistemática preliminar de los peces marinos comerciales del Pacífico de Panamá. *Tecnociencia* **2021**, *23*, 198–237, (In Spanish, with an English abstract). [CrossRef]
921. Morales-Saldaña, J.M.; Guzmán, H.M.; Vega, A.J.; Robles, Y.A.; Montes, L.A.; Kyne, P.M. A review of the status of sharks, rays and chimaeras of Panama to guide research and conservation. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **2025**, *35*, e70122. [CrossRef]
922. Stanford University. *Stanford Oceanographic Expedition 20: A Broad Inquiry Into the Biological Oceanography of the Eastern Tropical Pacific, 16th September—1st December 1968*; Stanford University: Stanford, CA, USA, 1968.
923. Ardila, C.; Rubio, E.A. Análisis preliminar sobre la ictiofauna y las pesquerías artesanales en la zona de influencia de la Ensenada de Guapi (Pacífico colombiano). In *VIII Seminario Nacional de las Ciencias y las Tecnologías del Mar*; SENALMAR, Ed.; Comision Colombiana de Oceanografía: Santa Marta, Colombia, 1992; pp. 859–872. (In Spanish)
924. Mantilla, A. Lista de Especies Elasmobranquias de Colombia. *Rev. Fenol. Anat.* **1998**, *1*. (In Spanish, with an English abstract).
925. Mejía-Falla, P.A.; Navia, A.F.; Puentes, V. *Guía Para La Identificación de Especies de Tiburones, Rayas Y Quimeras de Colombia; Gobernación de San Andrés, Providencia y Santa Catalina, Fundación SQUALUS, 2011; Ministerio de Ambiente y Desarrollo Sostenible, Corporación para el Desarrollo, Sostenible del Archipiélago de San Andrés, Providencia y Santa Catalina—CORALINA: Bogotá, Colombia.* (In Spanish)
926. Fernández, P. Estudio Biológico y Pesquero de Algunas Especies de Tiburones del Pacífico Colombiano Pertenecientes al Orden Lamniformes (Berg). Ph.D. Thesis, Universidad Jorge Tadeo Lozano, Bogotá, Colombia, 1975. (In Spanish)
927. Rubio-Rincón, E.A.; Suárez, A.; Estupiñán, F.; Henao, W.; Vargas, B. Los recursos ictiológicos de la Isla Malpelo (Colombia) I. Una revisión de su conocimiento y nuevos registros para la ictiofauna de la isla. In *VIII Seminario Nacional de las Ciencias y las Tecnologías del Mar*; SENALMAR, Ed.; Comision Colombiana de Oceanografía: Santa Marta, Colombia, 1992; pp. 642–658, (In Spanish, with an English abstract).
928. Cubero-Pardo, P.; Herrón, P.; González-Pérez, F. Shark reactions to scuba divers in two marine protected areas of the Eastern Tropical Pacific. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **2011**, *21*, 239–246. [CrossRef]
929. Bessudo, S.; Álvarez-León, R. La ictiofauna presente en el Santuario de Fauna y Flora, isla Malpelo, Pacifico Oriental Colombiano. *Arq. Ciénc. Mar. Fortaleza* **2014**, *47*, 93–101, (In Spanish, with an English abstract).
930. Bessudo, S.; Ladino, F.; Domínguez-López, M.; Pineda-Muñoz, A. Primer acercamiento para estimar patrones de movimiento y residencia del tiburón aleti-blanco (*Triaenodon obesus*) y el tiburón galápagos (*Carcharhinus galapagensis*) en el Santuario de Fauna y Flora Malpelo utilizando telemetría acústica. In *Seminario Nacional de Ciencias Y Tecnologías Del Mar. Libro de Memorias. Simposio 23: Biodiversidad Y Dinámica de Ecosistemas Marinos. Peces. VXI-SENALMAR-COLACMAR, Octubre 2015*; Campos, N., Ospino, M., Arellano, E., Garay, C., Rodríguez, L., Eds.; SENALMAR, COLACMAR: Santa Marta, Colombia, 2015; p. 520. (In Spanish)
931. Bessudo, S.; Lefevre, I. *Guía de Peces Isla Malpelo*; Fundación Malpelo: Bogotá, Colombia, 2017. (In Spanish)
932. Bessudo, S.; Ladino, F.; Becerril-García, E.E.; Shepard, C.M.; Salinas-de-León, P.; Hoyos-Padilla, E.M. The elasmobranchs of Malpelo Flora and Fauna Sanctuary, Colombia. *J. Fish Biol.* **2021**, *99*, 1769–1774. [CrossRef] [PubMed]
933. Quimbayo, J.P.; Dias, M.S.; Schlickmann, O.R.C.; Mendes, T.C. Fish cleaning interactions on a remote island in the Tropical Eastern Pacific. *Mar. Biodivers.* **2017**, *47*, 603–608. [CrossRef]
934. Diaz Sanchez, C.M.; Dalmau, M.; Villegas Vallejo, N.; Prieto, C.; Rodríguez, L.; Cerón, C.C.; Niño Pinzón, D.C.; Bermúdez-Rivas, C.; Grisales López, C.H.; Caicedo Laurido, A.L.; et al. *Malpelo Es Colombia: Maravilla Estratégica*; Fenix Media Group S.A.S.: Bogotá, Colombia, 2019; (In Spanish). [CrossRef]
935. Ladino Archila, F.; Martínez-Mondragón, S.B.; Duarte-Fajardo, M.A.; Vélez, N.; Bessudo, S. Monitoring of the status of eleven bony and cartilaginous fish populations in the Malpelo Sanctuary of Fauna and Flora, Colombian Pacific. *Bol. Investig. Mar. Cost.* **2021**, *50*, 105–120. [CrossRef]
936. Estupiñán-Montaño, C.; Sánchez-Gómez, P.M.; López-Montoya, J.O. Albinism in the Galapagos shark, *Carcharhinus galapagensis* (Snodgrass & Heller, 1905) at Malpelo Island, Colombia. *Thalassas* **2024**, *40*, 59–64. [CrossRef]
937. Díaz, M. Dentición y remplazo dental en algunos tiburones Carcharhinidos del Pacifico colombiano. *An. Inst. Investig. Mar. Punta De Betin* **1979**, *11*, 135–145, (In Spanish, with an English summary). [CrossRef]
938. Gómez, C.; Díaz, J.M. *Tiburones Colectados En La Isla Gorgona*; Gorgona, Prah, H.V., Guhl, F., Grögl, M., Eds.; Universidad de Los Andes: Bogotá, Colombia, 1979; pp. 169–188. (In Spanish)

939. Martínez, J. *Casos de Estudios Sobre el Manejo de Las Pesquerías de Tiburones en el Ecuador*; FAO Fisheries Technical Paper 378; FAO: Rome, Italy, 1999; pp. 1–57. (In Spanish)
940. Jiménez-Prado, P.; Béarez, P. *Peces Marinos Del Ecuador Continental. T. 1: Clave Para La Identificación de Peces = Marine Fishes of Continental Ecuador. Vol. I: Key for the Identification of the Fishes*; SIMBIOE/NAZCA/IFEA: Quito, Ecuador, 2004; (In Spanish and English).
941. Martínez-Ortíz, J.; Galván-Magaña, F.; Carrera-Fernández, M.; Mendoza-Intriago, D.; Estupiñán-Montaño, C.; Cedeño-Figueroa, L. Abundancia estacional de tiburones desembarcados en Manta—Ecuador. In *Tiburones En El Ecuador: Casos de Estudio*; Martínez-Ortíz, J., Galván-Magaña, F., Eds.; EPESPO—PRMC: Manta, Ecuador, 2007; pp. 9–27, (In Spanish, with an English abstract).
942. Hidalgo Manosalvas, C.E. Protocolo de Identificación Molecular de Especies de Tiburón Analizando Muestras de Galápagos y Puerto López. Bachelor's Thesis, Universidad San Francisco de Quito, Quito, Ecuador, 2013. (In Spanish, with an English abstract).
943. Briones-Mendoza, J.; Mejía, D.; Carrasco-Puig, P. Catch composition, seasonality, and biological aspects of sharks caught in the Ecuadorian Pacific. *Diversity* **2022**, *14*, 599. [\[CrossRef\]](#)
944. Bailón Vera, N.J. Análisis Morfológico de los Dentículos Dérmicos en 5 Especies de Tiburones Comercializados en el Puerto de Santa Rosa, Ecuador. Bachelor's Thesis, Universidad Estatal Península de Santa Elena, La Libertad, Ecuador, 2023. (In Spanish)
945. Mejía, D.; Briones-Mendoza, J. Estimating the total and precaudal lengths of the main shark species from interdorsal measurements in the eastern-central Pacific Ocean. *Thalassas* **2024**, *40*, 885–896. [\[CrossRef\]](#)
946. Beebe, W. *The Arcturus Adventure*; G.P. Putnam's Sons: New York, NY, USA, 1926.
947. Orces, V.G. Observaciones sobre los elasmobranquios del Ecuador. *Rev. Biol. Mar. Oceanogr.* **1952**, *5*, 85–110. (In Spanish)
948. Orcés, V.G. Peces marinos del Ecuador que se conservan en las colecciones de Quito. *Cienc. Nat.* **1959**, *2*, 72–91. (In Spanish)
949. Barlow, G.W. A paternal role for bulls of the Galapagos Islands sea lion. *Evolution* **1972**, *26*, 307–310. [\[CrossRef\]](#) [\[PubMed\]](#)
950. Massay, S. *Revisión de la Lista de los Peces Marinos del Ecuador*; Instituto Nacional de Pesca del Ecuador: Guayaquil, Ecuador, 1983; Volume 6, pp. 1–113. (In Spanish)
951. McCosker, J.E. The fishes of the Galápagos Islands. *Oceanus* **1987**, *30*, 28–32.
952. McCosker, J.E.; Rosenblatt, R.H. The inshore fish fauna of the Galápagos Islands. In *Key Environment: Galápagos*; Perry, R., Ed.; Pergamon Press: Oxford, UK, 1984; pp. 133–144.
953. McCosker, J.E.; Rosenblatt, R.H. The fishes of the Galápagos Archipelago: An update. *Proc. Calif. Acad. Sci.* **2010**, *61*, 167–196.
954. Wellington, G.M. Marine environment and protection. In *Key Environment: Galápagos*; Perry, R., Ed.; Pergamon Press: Oxford, UK, 1984; pp. 247–263.
955. Camhi, M.D. Sharks in Galapagos in peril. *Shark News* **1994**, *2*, 1–2.
956. Lavenberg, R.J.; Grove, J.S.; Seigel, J.A. Conservation alert: Status of fisheries for Galápagos sharks, with a checklist of known species. *Chondros* **1994**, *5*, 10–11.
957. Constant, P. *The Galapagos Islands. A Natural History Guide*; Passport Books: Lincolnwood, IL, USA, 1997.
958. Chirichigno, F.N.; Vélez, D.J. *Clave Para Identificar Los Peces Marinos Del Perú*, Segunda Edición ed; Instituto del Mar del Perú: Lima, Peru, 1998. (In Spanish)
959. Edgar, G.J.; Fariña, J.M.; Calvopiña, M.; Martínez, C.; Banks, S. Capítulo 4: Comunidades submareales rocosas II: Peces y macroinvertebrados móviles. In *Reserva Marina de Galápagos. Línea Base de La Biodiversidad*; Danulat, E., Edgar, G.J., Eds.; Fundación Charles Darwin/Servicio Parque Nacional Galápagos: Santa Cruz, Ecuador, 2002; pp. 68–97. (In Spanish)
960. Edgar, G.J.; Banks, S.; Fariña, J.M.; Calvopiña, M.; Martínez, C. Regional biogeography of shallow reef fish and macro-invertebrate communities in the Galapagos archipelago. *J. Biogeogr.* **2004**, *31*, 1107–1124. [\[CrossRef\]](#)
961. Zárate, P. Capítulo 20: Tiburones. In *Reserva Marina de Galápagos. Línea Base de La Biodiversidad*; Danulat, E., Edgar, G.J., Eds.; Fundación Charles Darwin/Servicio Parque Nacional Galápagos: Santa Cruz, Ecuador, 2002; pp. 373–388. (In Spanish)
962. Humann, P.; Deloach, N. *Reef Fish Identification—Galapagos*; New World Publications: Jacksonville, FL, USA, 2003.
963. Murillo, J.C.; Reyes, H.; Zárate, P.; Banks, S.; Danulat, E. *Evaluación de La Captura Incidenta Durante El Plan Piloto de Pesca de Altura Con Palangre En La Reserva Marina de Galápagos*; Parque Nacional Galápagos & Fundación Charles Darwin: Santa Cruz, Ecuador, 2004. (In Spanish)
964. Bustamante, R.H.; Okey, T.A.; Banks, S. Chapter 6: Biodiversity and food-web structure of a Galápagos shallow rocky-reef ecosystem. In *Food Webs and the Dynamics of Marine Reefs*; McClanahan, T.R., Branch, G.M., Eds.; Oxford University Press: New York, NY, USA, 2008; pp. 135–161.
965. Alava, J.J.; Merlen, G. Video-documentation of a killer whale (*Orcinus orca*) predatory attack on a giant manta (*Manta birostris*) in the Galápagos Islands. *Lat. Am. J. Aquat. Mamm.* **2009**, *7*, 81–84. [\[CrossRef\]](#)
966. Banks, S.; Vera, M.; Chiriboga, A. Establishing reference points to assess long-term change in zooxanthellate coral communities of the northern Galapagos coral reefs. *Galapagos Res.* **2009**, *66*, 43–64.
967. Ketchum, J.T.; Hearn, A.; Klimley, A.P.; Espinoza, E.; Peñaherrera, C.R.; Largier, J.L. Seasonal changes in movements and habitat preferences of the scalloped hammerhead shark (*Sphyrna lewini*) while refuging near an oceanic island. *Mar. Biol.* **2014**, *161*, 755–767. [\[CrossRef\]](#)

968. Ketchum, J.T.; Hearn, A.; Klimley, A.P.; Espinoza, E.; Peñaherrera, C.R.; Bessudo, S.; Soler, G.; Arauz, R.; Chapple, T.K.; Hoyos-Padilla, E.M. *Shark Movements and the Design of Pelagic Marine Reserves; Programme and Abstracts*; Sharks International: Durban, South Africa, 2014.
969. Llerena Martillo, Y.Y. Identificación de Tiburones Juveniles y Caracterización de sus Hábitats en las Zonas Costeras de Pesca de la isla San Cristóbal—Reserva Marina de Galápagos. Bachelor's Thesis, Universidad de Guayaquil, Guayaquil, Ecuador, 2009. (In Spanish, with an English abstract).
970. Acuña-Marrero, D.; Peñaherrera-Palma, C.R. *Interacciones Entre Tiburones Y Humanos En Galápagos: Primera Recopilación Y Análisis de Ataques de Tiburones Registrados Desde 1989*; Fundación Charles Darwin: Puerto Ayora, Ecuador, 2011. (In Spanish)
971. Ruiz, D.J.; Wolff, M. The Bolivar Channel Ecosystem of the Galapagos Marine Reserve: Energy flow structure and role of keystone groups. *J. Sea Res.* **2011**, *66*, 123–134. [\[CrossRef\]](#)
972. Winship, A.J.; Jorgensen, S.J.; Shaffer, S.A.; Jonsen, I.D.; Robinson, P.W.; Costa, D.P.; Block, B.A. State-space framework for estimating measurement error from double-tagging telemetry experiments. *Methods Ecol. Evol.* **2012**, *3*, 291–302. [\[CrossRef\]](#)
973. Peñaherrera-Palma, C.R.; Llerena, Y.; Keith, I. Perceptions of the economic value of sharks for single-day dive tourism and commerce in Santa Cruz Island. In *Galapagos Report 2011–2012*; Charles Darwin Foundation, Galapagos National Park Directorate, Consejo de Gobierno de Galapagos, Galapagos Conservancy, Eds.; Charles Darwin Foundation, Galapagos National Park Directorate, Consejo de Gobierno de Galapagos & Galapagos Conservancy: Puerto Ayora, Ecuador, 2013; pp. 114–120.
974. Peñaherrera-Palma, C.R.; van Putten, I.; Karpievitch, Y.V.; Frusher, S.; Llerena-Martillo, Y.; Hearn, A.R.; Semmens, J.M. Evaluating abundance trends of iconic species using local ecological knowledge. *Biol. Conserv.* **2018**, *225*, 197–207. [\[CrossRef\]](#)
975. Peñaherrera-Palma, C.R. Abundance, Distribution and Conservation Value of Sharks in the Galápagos Marine Reserve. Ph.D. Thesis, University of Tasmania, Hobart, Australia, 2016.
976. Hearn, A.R.; Acuna, D.; Ketchum, J.T.; Penaherrera, C.; Green, J.; Marshall, A.; Guerrero, M.; Shillinger, G. Chapter 2: Elasmobranchs of the Galapagos Marine Reserve. In *The Galapagos Marine Reserve*; Denkinger, J., Vinueza, L., Eds.; Springer: Cham, Switzerland, 2014; pp. 23–59. [\[CrossRef\]](#)
977. Klimley, A.P. Shark trails of the eastern Pacific. *Am. Sci.* **2015**, *103*, 276–283. [\[CrossRef\]](#)
978. Tirado-Sanchez, N.; McCosker, J.; Ruiz, D.; Chiriboga, A.; Banks, S. CDF Checklist of Galapagos Fish. 2016. Available online: <http://darwinfoundation.org/datazone/checklists/vertebrates/pisces> (accessed on 10 January 2023).
979. Ryan, J.P.; Green, J.R.; Espinoza, E.; Hearn, A.R. Association of whale sharks (*Rhincodon typus*) with thermo-biological frontal systems of the eastern tropical Pacific. *PLoS ONE* **2017**, *12*, e0182599. [\[CrossRef\]](#) [\[PubMed\]](#)
980. Witman, J.D.; Smith, F.; Novak, M. Experimental demonstration of a trophic cascade in the Galápagos rocky subtidal: Effects of consumer identity and behavior. *PLoS ONE* **2017**, *12*, e0175705. [\[CrossRef\]](#) [\[PubMed\]](#)
981. Cerutti, F.; Salinas-de-León, P.; Jarrín, J.M.; Reyes, H.; Ramírez-González, J.; Moity, N.; Budd, K.; Dureuil, M. Understanding the impacts of longline fisheries on marine megafauna in a UNESCO World Heritage site, the Galapagos Marine Reserve. In *Proceedings of the Sharks International, João Pessoa, João Pessoa, Brazil, 3–8 June 2018. Programme and Abstracts*.
982. Buglass, S.; Nagy, S.; Ebert, D.A.; Sepa, P.; Turchik, A.; Bell, K.L.; Rivera, F.; Giddens, J. First records of the seven-gilled *Notorynchus cepedianus* and six-gilled *Hexanchus griseus* sharks (Chondrichthyes: Hexanchiformes: Hexanchidae) found in the Galápagos Marine Reserve. *J. Fish Biol.* **2020**, *97*, 926–929. [\[CrossRef\]](#) [\[PubMed\]](#)
983. Smith, A.N.H.; Acuña-Marrero, D.; Salinas-de-León, P.; Harvey, E.S.; Pawley, M.D.; Anderson, M.J. Instantaneous vs. non-instantaneous diver-operated stereo-video (DOV) surveys of highly mobile sharks in the Galápagos Marine Reserve. *Mar. Ecol. Prog. Ser.* **2020**, *649*, 111–123. [\[CrossRef\]](#)
984. García Zambrano, M.S. Long Term Residence, diel Patterns and Site Preferences of *Carcharhinus falciformis*, *Carcharhinus limbatus*, *Carcharhinus galapagensis*, *Sphyrna lewini* and *Galeocerdo cuvier* in the Galapagos Marine Reserve, Ecuador. Bachelor's Thesis, Pontificia Universidad Católica del Ecuador, Quito, Ecuador, 2021.
985. Riofrío-Lazo, M.; Reck, G.; Páez-Rosas, D.; Zetina-Rejón, M.J.; Del Monte-Luna, P.; Reyes, H.; Murillo-Posada, J.C.; Hernández-Padilla, J.C.; Arreguín-Sánchez, F. Food web modeling of the southeastern Galapagos shelf ecosystem. *Ecol. Indic.* **2021**, *132*, 108270. [\[CrossRef\]](#)
986. Grove, J.S.; Long, D.J.; Robertson, D.R.; Victor, B.C. List of fishes of the Galapagos Archipelago, Ecuador. *J. Ocean Sci. Found.* **2022**, *39*, 14–22. [\[CrossRef\]](#)
987. McKinley, S.J.; Saunders, B.J.; Rastoin-Laplane, E.; Salinas-de-León, P.; Harvey, E.S. Functional vulnerability and biogeography of reef fish assemblages in the Galapagos Archipelago. *Estuar. Coast. Shelf Sci.* **2023**, *286*, 108301. [\[CrossRef\]](#)
988. Rastoin-Laplane, E.; Salinas-de-León, P.; Goetze, J.S.; Saunders, B.J.; McKinley, S.J.; Norris, C.; Gosby, C.; Mattingly, A.; Garcia, R.; Harvey, E.S. Fluctuations of galapagos mid-water and benthic reef fish populations during the 2015–2016 ENSO. *Estuar. Coast. Shelf Sci.* **2023**, *294*, 108523. [\[CrossRef\]](#)
989. Victor, B.C.; Grove, J.S.; Long, D.J.; Robertson, D.R.; Keith, I.; Bensted-Smith, W.; Salinas-de-Leon, P. List of Fishes of the Galapagos Archipelago, Ecuador (Version 2.0). *J. Ocean Sci. Found.* **2024**, *41*, 54–111. [\[CrossRef\]](#)

990. Vianna, G.; Moity, N.; Viteri Mejía, C.; Green, S.M.; Suárez-Moncada, J.; Salinas-de-León, P. The socio-economic value of shark-watching tourism in the Galapagos Marine Reserve and its implications for conservation. *SSRN Prepr.* **2026**, 6017076, 1–38. [[CrossRef](#)]
991. Chirichigno, F.N. *Clave para Identificar los Peces Marinos del Peru*; Informe No. 44; Instituto del Mar del Peru: Callao, Perú, 1974; pp. 1–378. (In Spanish)
992. Cornejo, R.; Vélez-Zuazo, X.; González-Pestana, A.; Kouri, C.; Mucientes, G. An updated checklist of Chondrichthyes from the southeast Pacific off Peru. *Check List* **2015**, *11*, 1809. [[CrossRef](#)]
993. Gonzalez-Pestana, A.; Kouri, J.C.; Velez-Zuazo, X. Shark fisheries in the Southeast Pacific: A 61-year analysis from Peru. *F1000Research* **2016**, *3*, 164. [[CrossRef](#)] [[PubMed](#)]
994. Randall, J.E.; Cea Egaña, A. *Shore Fishes of Easter Island*; University of Hawai'i Press: Honolulu, HI, USA, 2011. [[CrossRef](#)]
995. Pequeño, G. Peces de Chile. Lista sistematica revisada y comentada. *Rev. Biol. Mar. Oceanogr.* **1989**, *24*, 1–132, (In Spanish, with an English abstract).
996. Pequeño, G. Peces litorales de la Isla Salas y Gómez, Chile, capturados durante el crucero CIMAR-ISLAS, en 1999. *Cienc. Tecnol. Mar.* **2004**, *27*, 95–101, (In Spanish, with an English abstract).
997. National Geographic Society; Oceana Chile. *Expedición a Isla de Pascua Y Salas Y Gómez Febrero—Marzo 2011*; National Geographic Society & Oceana Chile: Washington, DC, USA; Santiago de Chile, Chile, 2011. (In Spanish)
998. Fernández, M.; Pappalardo, P.; Rodríguez-Ruiz, M.C.; Castilla, J.C. Synthesis of the state of knowledge about species richness of macroalgae, macroinvertebrates and fishes in coastal and oceanic waters of Easter and Salas y Gómez islands. *Lat. Am. J. Aquat. Res.* **2014**, *42*, 760–802. [[CrossRef](#)]
999. Acuña, E.; Gaymer, C.F.; Hinojosa, I.; Aburto, J.; Cortés, A.; Sfeir, R.; Petit, I.; Véliz, C.; Hey, M.; García, M. Estudio biológico-pesquero y evaluación del estado de situación de las pesquerías costeras de importancia para la Isla de Pascua. In *Forme Final Proyecto FIPA N°2016-35*; Universidad Católica del Norte: Coquimbo, Chile, 2018. (In Spanish)
1000. Coghlan, A.R.; Morales, N. New shark in the park: Tiger shark *Galeocerdo cuvier* observations in the remote South Pacific. *J. Fish Biol.* **2024**, *104*, 2098–2101. [[CrossRef](#)] [[PubMed](#)]
1001. Mouillot, D.; Velez, L.; Albouy, C.; Casajus, N.; Claudet, J.; Delbar, V.; Devillers, R.; Letessier, T.B.; Loiseau, N.; Manel, S.; et al. The socioeconomic and environmental niche of protected areas reveals global conservation gaps and opportunities. *Nat. Commun.* **2024**, *15*, 9007. [[CrossRef](#)] [[PubMed](#)]
1002. Contreras, I.; Zagal, C.J.; Ruiz, J. *Tiburones, Rayas Y Quimeras de Chile*; Fundación Oceanósfera: Valdivia, Chile, 2025; (In Spanish and English).
1003. Gaymer, C.F.; Wagner, D.; Álvarez-Varas, R.; Boteler, B.; Bravo, L.; Brooks, C.M.; Chavez-Molina, V.; Currie, D.; Delgado, J.; Dewitte, B.; et al. Research advances and conservation needs for the protection of the Salas y Gómez and Nazca ridges: A natural and cultural heritage hotspot in the southeastern Pacific ocean. *Mar. Policy* **2025**, *171*, 106453. [[CrossRef](#)]
1004. Morales, N.A. *Salas Y Gómez Expedition*; Final Project Report for Save Our Seas Foundation: Geneva, Switzerland, 2017.
1005. Wagner, D.; van der Meer, L.; Gorny, M.; Sellanes, J.; Gaymer, C.F.; Soto, E.H.; Easton, E.E.; Friedlander, A.M.; Lindsay, D.J.; Molodtsova, T.N.; et al. The Salas y Gómez and Nazca ridges: A review of the importance, opportunities and challenges for protecting a global diversity hotspot on the high seas. *Mar. Policy* **2021**, *126*, 104377. [[CrossRef](#)]
1006. Boteler, B.; Wagner, D.; Durussel, C.; Stokes, E.; Gaymer, C.F.; Friedlander, A.M.; Dunn, D.C.; Vargas, F.P.; Veliz, D.; Hazin, C. Borderless conservation: Integrating connectivity into high seas conservation efforts for the Salas y Gómez and Nazca ridges. *Front. Mar. Sci.* **2022**, *9*, 915983. [[CrossRef](#)]
1007. Gaymer, C.F.; Petit, I.; Canales, C.; Sanchez, N.; Sellanes, J.; Easton, E.E.; Chavez-Molina, V.; Friedlander, A.M.; Wagner, D. Salas y Gómez and Nazca ridges: The need for protection, with a minimum impact on fishing activities. *SSRN Prepr.* **2026**, 6478678, 1–35. [[CrossRef](#)]
1008. Sepúlveda, J.I. Peces de las islas oceánicas Chilenas. In *Islas Oceánicas Chilenas: Conocimiento Científico Y Necesidades de Investigaciones*; Castilla, J.C., Ed.; Ediciones Universidad Católica de Chile: Santiago, Chile, 1987; pp. 225–245. (In Spanish)
1009. Weijerman, M.; Grüss, A.; Dove, D.; Asher, J.; Williams, I.D.; Kelley, C.; Drazen, J.C. Shining a light on the composition and distribution patterns of mesophotic and subphotic fish communities in Hawai'i. *Ecol. Prog. Ser.* **2019**, *630*, 161–182. [[CrossRef](#)]
1010. Green, M.E.; Simpfendorfer, C.A.; Devloo-Delva, F. Chapter 16: Population structure and connectivity of chondrichthyans. In *Biology of Sharks and Their Relatives*, 3rd ed.; Carrier, J.C., Simpfendorfer, C.A., Heithaus, M.R., Yopak, K.E., Eds.; CRC Press: Boca Raton, FL, USA, 2022; pp. 523–543. [[CrossRef](#)]
1011. Tavera, J.; Beltrán-León, B.S.; Polanco, F.A.; Zapata, L.A.; Zapata, F.A.; Acero, P.A. Voucher-verified checklist of Colombian Pacific marine fishes with emphasis on material deposited in Colombian museums. *ZooKeys* **2026**, *1272*, 337–387. [[CrossRef](#)] [[PubMed](#)]
1012. Rastoin-Laplane, E.; McKinley, S.J.; Salinas-de-León, P.; Acuña-Marrero, D.; Goetze, J.; Saunders, B.J.; Ashe, H.; Cundy, M.; Harvey, E.S. Comparative Biogeography of Benthic and Mid-Water Coastal Fish Communities of the Galapagos: Stereo-BRUVs Surveys Support the Use of Bioregions for Management. *J. Biogeogr.* **2026**, *53*, e70196. [[CrossRef](#)]

1013. Clarke, L.; Collins, C.; Burns, P.; Chapel, L.; Curnick, D.J.; Doherty, P.D.; Goodchild, O.; Gollock, M.; Hussey, N.E.; Lomholt, E.; et al. A multi-method approach to characterising dynamic human–shark interactions at a remote oceanic island. *Sci. Rep.* **2026**, *16*, 13010. [[CrossRef](#)] [[PubMed](#)]
1014. Figueira, W.F.; Harianto, J. *Lord Howe Island Fishery Catch Report: 2004–2018*; New South Wales Department of Primary Industries: Sydney, Australia, 2022.
1015. Florida Museum. International Shark Attack File. 2026. Available online: <https://www.floridamuseum.ufl.edu/shark-attacks/> (accessed on 26 May 2026).

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