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Distribution of Chondrichthyans in the Greek Seas

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Abstract

The Greek seas have hosted a diversity of sharks and rays since antiquity, with Aristotle providing the earliest detailed descriptions in his History of Animals, while the first modern documented record dates back to 1858. Despite this long history of attention and the acceleration of research on elasmobranchs over the past two decades, information on their spatial distribution remains fragmented, with most studies focusing on biological and fisheries-related parameters at low taxonomic and/or spatial resolution. This is concerning given that over 50% of Mediterranean chondrichthyans are now threatened with extinction. The present study reconstructs the distribution of extant species in the Greek seas by integrating published literature, mass and social media, biodiversity platforms, citizen science programs, research projects, and national datasets. Although records were compiled from 1858 onwards, only those starting from 1942 contained sufficiently precise locality information to be georeferenced. The review yielded 5596 spatial presence records of initially 67 species; however, after data validation, 62 species were confirmed: 33 shark species, 28 batoid species, and 1 chimaera species, of which 54.8% were from research programs, 30.5% were from published research, and 14.4% were from citizen science and were previously unpublished. These records enrich knowledge of threatened and data-deficient taxa and may serve as a useful baseline for future analyses and distribution modeling, as well as for informing marine spatial planning and conservation prioritization efforts in the eastern Mediterranean.

Keywords: sharks; rays; chimaeras; Mediterranean Sea; Aegean Sea; Ionian Sea

Key Contributions: This study compiles 5596 records of 67 chondrichthyan species in the Greek seas, drawing on published literature, citizen science, research programs, and biodiversity databases. After data validation, 62 species were confirmed to be present in Greek waters: 33 shark species, 28 batoid species, and 1 chimaera species. Records are spatially allocated by GFCM sub-area to allow for transboundary use. The dataset has already informed the identification of Important Shark and Ray Areas and designation of new National Parks.

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1. Introduction

Chondrichthyans (sharks, rays, and chimaeras) are predominantly top predators to mesopredators and thus constitute cornerstone species within marine trophic webs. Through their ecological roles, they can strongly influence ecosystem structure and stability, often triggering cascading effects across trophic levels [1–3]. However, as with many taxa occupying high trophic positions, chondrichthyans are increasingly threatened with extinction [3,4]. They are now considered among the most threatened vertebrate groups globally, with more than one-third of species at risk of extinction, primarily due to overfishing [5].

From a life-history perspective, chondrichthyans are typical K-selected species, characterized by slow growth, late maturity, long gestation periods, and low fecundity [6,7]. These traits, combined with prolonged and intensive fishing pressure, have resulted in widespread population declines, extirpations, and, in some cases, collapses [8–10]. Recovery is often slow or uncertain, as the ecological and demographic conditions required for population rebuilding are rarely met [11]. The Mediterranean Sea hosts a relatively high diversity of chondrichthyans [12]; paradoxically, it is also considered one of the most at-risk regions for sharks and rays [13,14], with recent assessments indicating that more than half of its species are threatened with extinction [11].

In Greece, references to sharks and rays date to antiquity, with Aristotle providing detailed descriptions of several species that correspond to modern taxonomic entities [14,15]. Following the establishment of the modern Greek state in 1832, the first documented records of chondrichthyans in Greek waters appeared in a fish catalogue from the Cyclades [16]. Over subsequent decades, multiple species inventories were published. Apostolidés's foundational works on the fishes of Greece [17,18] informed later national checklists [19,20]. Regional investigations further contributed to this knowledge base, including studies from the Cyclades [21] and the Gulf of Izmir [22], the latter continuing to inform contemporary checklists in Turkey [23]. In addition, the General Statistical Service of Greece compiled fisheries landings data for selected taxa (i.e., *Galeorhinus galeus*, *Mustelus* spp., *Scyliorhinus* spp., *Raja* spp.) across 29 ports during 1928–1939 [24]. Despite this long history of observation, the resulting records were largely taxonomic inventories or fisheries accounts [24] and rarely provided the spatially explicit, species-level information required for distribution analysis or conservation planning.

According to [19], 67 chondrichthyan species, including 37 shark species, have been recorded in Greek waters. However, the updated national checklist [25] classified six species as having ambiguous occurrences. The most recent Greek Red List assessment confirmed the presence of 57 chondrichthyan species (31 shark species, 25 ray species, and 1 chimaera species) based on IUCN criteria [26].

Despite this long history of observation, accurately determining species richness and distribution patterns remains challenging. In Greece and, more broadly, in the eastern Mediterranean, research on chondrichthyans is substantially less extensive than in the western basin. Current knowledge relies on a limited number of studies, many of which are not based on systematic research. Available data are often derived from fisheries-dependent sources or specific monitoring programs, such as MEDITS [27], where taxonomic resolution is frequently not at the species level. Consequently, substantial gaps persist in our understanding of the ecology, biology, and conservation status of these species. Existing distributional studies are typically restricted either to individual species (e.g., the white shark, *Carcharodon carcharias* [28,29]) or to ecologically similar groups [30,31] and are largely fisheries-dependent. These knowledge gaps are further rooted in a historical perception of sharks as competitors or threats, which for much of the 20th century favored persecution over study and delayed the development of systematic monitoring [31].

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Previous studies have established that chondrichthyans occur in Greek waters and documented how threatened they are [25], while the Greek Red List has assessed their conservation status [26], and historical accounts have documented past shark occurrences based on archival sources [32]. To address the above-mentioned gaps, the present study builds upon the national checklist of [25] and the recent Greek Red List assessment [26] by (i) compiling and georeferencing, at the species level, all available occurrence records of chondrichthyans in Greek waters from heterogeneous sources, thereby establishing how many species can currently be confirmed as present; (ii) providing the first species-level distribution maps for these taxa, organized by GFCM geographical sub-area (hereafter GFCM-GSA) to enable transboundary application; (iii) characterizing the spatial and temporal structure of these records across the Greek seas and the extent to which observed patterns reflect genuine ecological signal versus uneven sampling effort; and (iv) discussing the relative contributions of different data sources. This study also aims to deliver a spatially explicit baseline that can support distribution modeling, marine spatial planning, and conservation prioritization for chondrichthyans in the eastern Mediterranean. This area is delineated according to the geographical sub-areas (GSAs) of the General Fisheries Commission for the Mediterranean (GFCM). This framework was adopted because it transcends national boundaries, which are ecologically irrelevant for many migratory and pelagic species, thereby enabling the integration of records from adjacent regions, including Turkish waters. Moreover, the use of GSAs aligns with fisheries management units, enhancing the applicability of the results for future research and management. By integrating multiple data sources, this study provides the most comprehensive assessment of chondrichthyan distributions in the study area to date.

2. Materials and Methods

2.1. Data Collection

The distribution of chondrichthyan species in Greek waters was compiled through integrative data mining [10] and included occurrence data from multiple sources, such as published literature, mass media, social media, biodiversity databases, citizen science initiatives, research programs, and national datasets from state bodies. All records were standardized and organized in a species-level database where possible. For each record, the following attributes were retained: (i) GFCM-GSA, (ii) date of observation, (iii) date of publication (where applicable), (iv) data source, and (v) geographic region. The data collection procedures for each source category are detailed below.

2.1.1. Published Literature

Occurrence data from the scientific and gray literature were compiled through a systematic review following the PRISMA framework [33], covering publications up to December 2024. Searches were conducted using Google Scholar and ResearchGate. Search strings combined taxonomic terms (“shark”, “elasmobranchs”, “cartilaginous fish”, “rays”, “skates”, “batoids”) with geographic descriptors (“Greece”, “Turkey”, “Aegean”, “Ionian”, “Crete”, “eastern Mediterranean”). Searches were performed in English and included the gray literature. Publications were screened and entered into the database as individual records per species occurrence. Each entry was annotated to indicate the nature of the source (e.g., primary data, bibliographic reference, or aggregated record), enabling subsequent evaluation of data quality and origin.

2.1.2. Mass Media

Occurrence records from mass media were retrieved using the Google Search platform. Searches employed both English and Greek vernacular terms for chondrichthyans (e.g., "shark", "dogfish", "ray", "vatos", "rina-fish", "keleri", "fox", "sapounas", "sbrilos"). To improve retrieval efficiency, searches were conducted across standard, image, and video categories, as visual content often provides additional unique records. In addition, historical records compiled by [32], covering the period 1900–1983 and derived from the Greek National Library and local newspapers, were incorporated. These data had already undergone duplicate removal. Where records overlapped with other sources (e.g., published literature or citizen science databases), the original validated source was retained to avoid redundancy and ensure consistency in taxonomic identification and data reliability.

2.1.3. Social Media

Social media platforms were systematically screened for occurrence records, including YouTube, Facebook, Instagram, and TikTok. Searches followed a similar strategy to mass media, combining taxonomic keywords with general descriptors (e.g., "fish") and geographic qualifiers (e.g., "Greece", "Aegean", "Ionian", "Crete"). Queries were conducted using both standard text and hashtags, including transliterations in Latin characters. All social media records were cross-checked against mass media and citizen science datasets to identify duplicates. When duplication was detected, the record was attributed to the most reliable primary source, thereby minimizing redundancy and maintaining consistency in taxonomic verification.

2.1.4. Biodiversity Databases

Two major biodiversity data infrastructures were used: the Global Biodiversity Information Facility (GBIF, https://www.gbif.org/citation-guidelines, accessed on 25 May 2026) and the Ocean Biodiversity Information System (OBIS, https://obis.org/, accessed on 25 May 2026). Species-specific queries were conducted for all target taxa, and records were filtered geographically to include only occurrences within Greek waters. GBIF aggregates data from multiple sources, including data from the citizen science platform iNaturalist; records originating from iNaturalist were cross-referenced and, where necessary, retrieved directly from the original platform to ensure consistency and avoid duplication.

2.1.5. Citizen Science Platforms

Citizen science has become an increasingly valuable tool for marine biodiversity monitoring, particularly for rare or data-deficient species [34]. Data from multiple citizen science initiatives were incorporated, including the M.E.C.O. project, iNaturalist, the Angel Shark Conservation Network, and the SEAlly© application (v.1.5.0).

The M.E.C.O. project, initiated in 2014, compiles records of sharks and rays from diver observations shared primarily via social media (www.facebook.com/pg/theMECOproject, accessed on 25 May 2026). Submitted records undergo verification using reverse image searches and expert taxonomic assessment. For each validated record, the key information retained includes the date of observation, number of individuals, species identification, and geographic coordinates. In Greece, the project is coordinated by iSea, which provided the dataset used in this study. The process of data collection and validation for the project is explained in [25].

Data from iNaturalist were collected on a species-by-species basis using spatial filtering via the platform's mapping interface. This approach was adopted to minimize duplication with other datasets (notably M.E.C.O.) and to exclude redundant records already incorporated in other programs (e.g., Shark Watch—https://www.inaturalist.org/projects/shark-watch, accessed on 25 May 2026). For consistency, the retained information included only the date, number of observed individuals, species identification, and coordinates.

Additional occurrence records were obtained from the SEAlly© application, developed by MEDASSET in collaboration with iSea within the framework of the project "Fishermen, Sea Turtles and Sharks: Alliance for Survival" and upgraded in the context of "Alliance for Symbiosis II", funded by the Greek Green Fund. These data were extracted and provided by iSea for inclusion in the present analysis.

2.1.6. Research Projects

Data from five research projects were incorporated: (i) ByElasmoCatch, (ii) Protecting the Rough Skate in the Thracean Sea, (iii) Angel Shark Project: Greece, (iv) Protecting Northeast Lemnos' habitats, and (v) MARISCA. The potential inclusion of MEDLEM [35] was evaluated; however, as the database contains non-original records and does not allow for the reliable identification and removal of duplicates, it was excluded.

The ByElasmoCatch project (https://isea.com.gr/by-elasmocatch/) (accessed on 25 May 2026), implemented in 2019 by iSea, focuses on fisheries–elasmobranch interactions in the North Aegean Sea and the Amvrakikos Gulf. It generates fisheries-dependent data through onboard observations and structured questionnaires at landing sites. The project "Protecting the Rough Skate in the Thracean Sea" (launched in 2024) targets *Raja radula* within the Thracean Sea Important Shark and Ray Area (IUCN SSC Shark Specialist Group, 2023), combining onboard observations with port-based surveys to collect occurrence and life-history data. "Angel Shark Project: Greece", part of the international Angel Shark Project, compiles occurrence records for angel shark species through direct collaboration with fishers. Since 2023, the project "Protecting Northeast Lemnos' habitats" has been investigating habitat–species relationships through onboard sampling and recording species composition alongside biometric data. Finally, the MARISCA project "Maritime Spatial Planning in the Aegean for the Conservation and Protection of Biodiversity" [36] collects shark occurrence data from multiple sources, including published studies [31,37,38], the National Fisheries Data Collection Program (199/2008/EC), independent research surveys, and MEDITS trawl surveys [27].

2.1.7. Data from Government Bodies

The inclusion of openly accessible data from national and international governmental sources was assessed but ultimately deemed unsuitable for this study. Fisheries data collected under the EU Common Fisheries Policy (CFP), including the National Fisheries Data Collection Program [39], provide extensive temporal coverage (2005–2021) but are typically aggregated at higher taxonomic levels (e.g., genus or family) and lack spatially explicit occurrence data. Similarly, datasets from the Hellenic Statistical Authority ([40]; 1964–present) and the General Fisheries Commission for the Mediterranean (GFCM) primarily report landings in biomass (kg), often with inconsistent taxonomic resolution and reporting practices across years. Due to these limitations, i.e., coarse taxonomic resolution, the absence of georeferenced records, and methodological inconsistencies, these datasets were excluded from the analysis.

2.2. Data Processing

The different sources used to compile the presence data necessitated a series of data processing steps: (a) the collection of geographic coordinates for observations with the highest possible accuracy, (b) the elimination of duplicate records and the identification of the original data source, (c) the organization of information in a common database (primary processing), and (d) the spatial processing and visualization of data on maps (secondary processing).

Spatial information was prioritized at the highest possible resolution. For sources lacking explicit coordinates (primarily published literature, mass media, and social

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media), location data were extracted where possible. When coordinates were not directly provided, spatial information was derived from maps or descriptive locality data. In cases where only approximate locations could be inferred (e.g., fishing grounds or landing sites), records were either georeferenced with reduced precision or excluded if spatial uncertainty was deemed excessive (e.g., market-based observations). For fisheries-dependent datasets reporting linear sampling effort (e.g., longlines, trawls) with start–end coordinates, midpoint locations were calculated to represent occurrence points. Depth of occurrence was not analyzed because this information was reported only sporadically and inconsistently across sources and could not be standardized; thus, records were georeferenced horizontally only. Early-fisheries records (before 1942) were retained in the database for historical reference, but excluded from the spatial analyses, because they were derived from broad areas lacking precise spatial information.

Duplicate removal was conducted iteratively throughout data compilation; later, an automatic removal procedure was also performed for records with the same coordinates and species. Duplicates were particularly prevalent in the scientific literature due to the reuse of primary datasets across multiple publications and citizen science platforms, where the same observation could appear in multiple databases (e.g., iNaturalist and M.E.C.O.; see also [25]). For literature-derived records, efforts were made to trace each occurrence back to its original source, often requiring cross-referencing multiple publications. Records were classified as either primary (original observations) or secondary (re-reported data), with only primary records retained where duplication was confirmed. For citizen science data, discrepancies (e.g., differing observation dates for the same record) were resolved by consulting the original posts on social or mass media platforms. In such cases, records validated through the M.E.C.O. project were prioritized due to its established verification and taxonomic identification protocols.

All validated records were compiled into a single database, with each occurrence represented as a unique entry. The database included the following fields: date of observation, date of publication, taxonomic identification (family and species), number of individuals, geographic coordinates, data source, GFCM sub-area, and source category. Only records identified to species level were retained, except for *Dasyatis* spp., which were grouped due to unresolved taxonomic issues. This is because species boundaries have been repeatedly revised (e.g., taxa formerly in *Dasyatis* have been reassigned to *Bathytoshia* and *Pteroplatytrygon*), *D. pastinaca* is frequently confused with *D. marmorata* and *D. tortonesei*, and *Bathytoshia lata* has been revised several times, having previously been identified as *D. centroura* (Mitchill 1815) and later as *B. centrura*, and was recently confirmed as the only species present in the Mediterranean [41]. Taxonomic classification and family-level analyses followed Eschmeyer's fish catalogue [42].

Spatial processing and visualization were conducted using QGIS. Data were imported as georeferenced point layers, and quality control procedures were applied to identify and correct erroneous coordinates. A final vector dataset (shapefile) was generated, preserving all associated metadata. Species-specific distribution maps were subsequently produced.

3. Results

The data compilation yielded a total of 5596 occurrence records, with a marked increase in reporting over the last decade (2015–2025) (Figure 1; Tables A1 and S1). Records of rays (N = 3287) outnumbered those of sharks (N = 2185), while chimaera records (N = 124) were rare throughout the dataset. The literature search identified 268 scientific articles and conference contributions. Of these, 54.8% were associated with research programs, 30.5% with independent published studies, and 14.4% with citizen science initiatives. Within the latter, the M.E.C.O. project accounted for 75.7% of records, followed by iNaturalist (24.2%). Searches of social media (Facebook, Instagram, YouTube) and mass media did not yield any additional unique records, as all relevant observations were already incorporated into the M.E.C.O. database. Historical media records (1948–1983) from Greek newspapers (e.g., Embros, Eleftheria, Macedonia, Rizospastis, Postman) were included via [33].

In total, 67 chondrichthyan species (35 shark species, 31 batoid species, and 1 chimaera species) have been reported in Greek waters; however, as noted in [24], the status of certain species remains uncertain despite historical records, whereas others, documented only sporadically, may have experienced local declines or extirpations. Therefore, in the context of this work, following [25] and [26], we consider *C. coelolepis*, *C. obscurus*, *Dipturus* cf. *batis*, *Leucoraja fullonica,* and *Rhinoptera marginata* not to be present in Greek waters. Additionally, we confirm that 62 shark, ray, and chimaera species are currently present in Greek waters, comprising 33 shark species, 28 ray species, and 1 chimaera species. The discrepancy between this work and [25] (here, 62 species; in [25], 61 species) is because solid evidence from morphometric and genetic analyses confirms that *D. tortonesei* exists in Greek waters (Ciprian et al., in prep.).

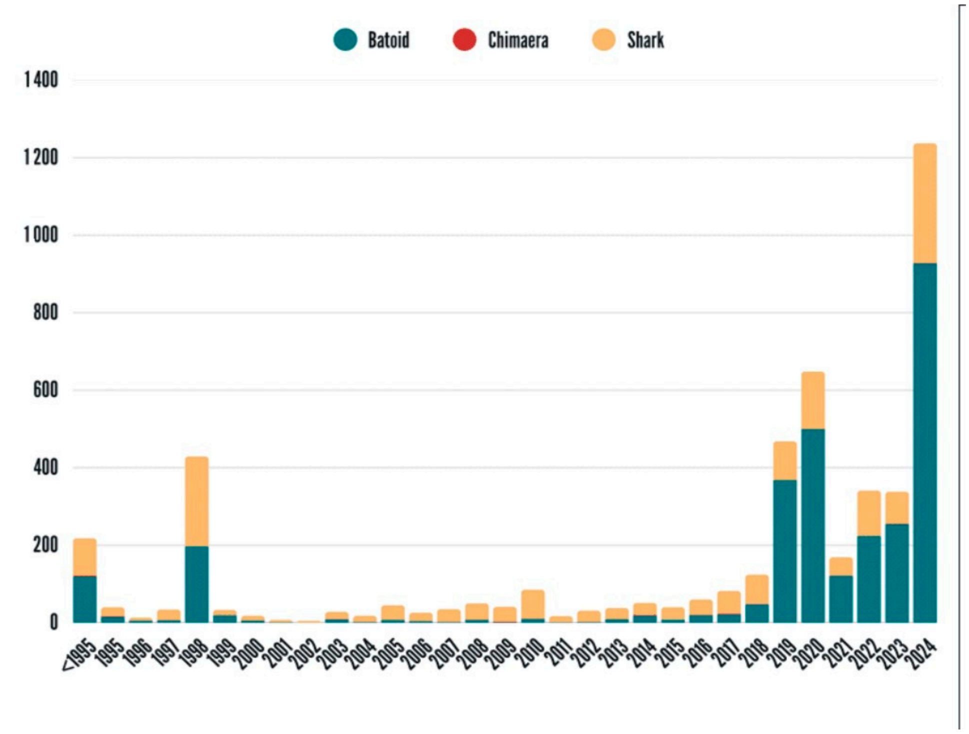
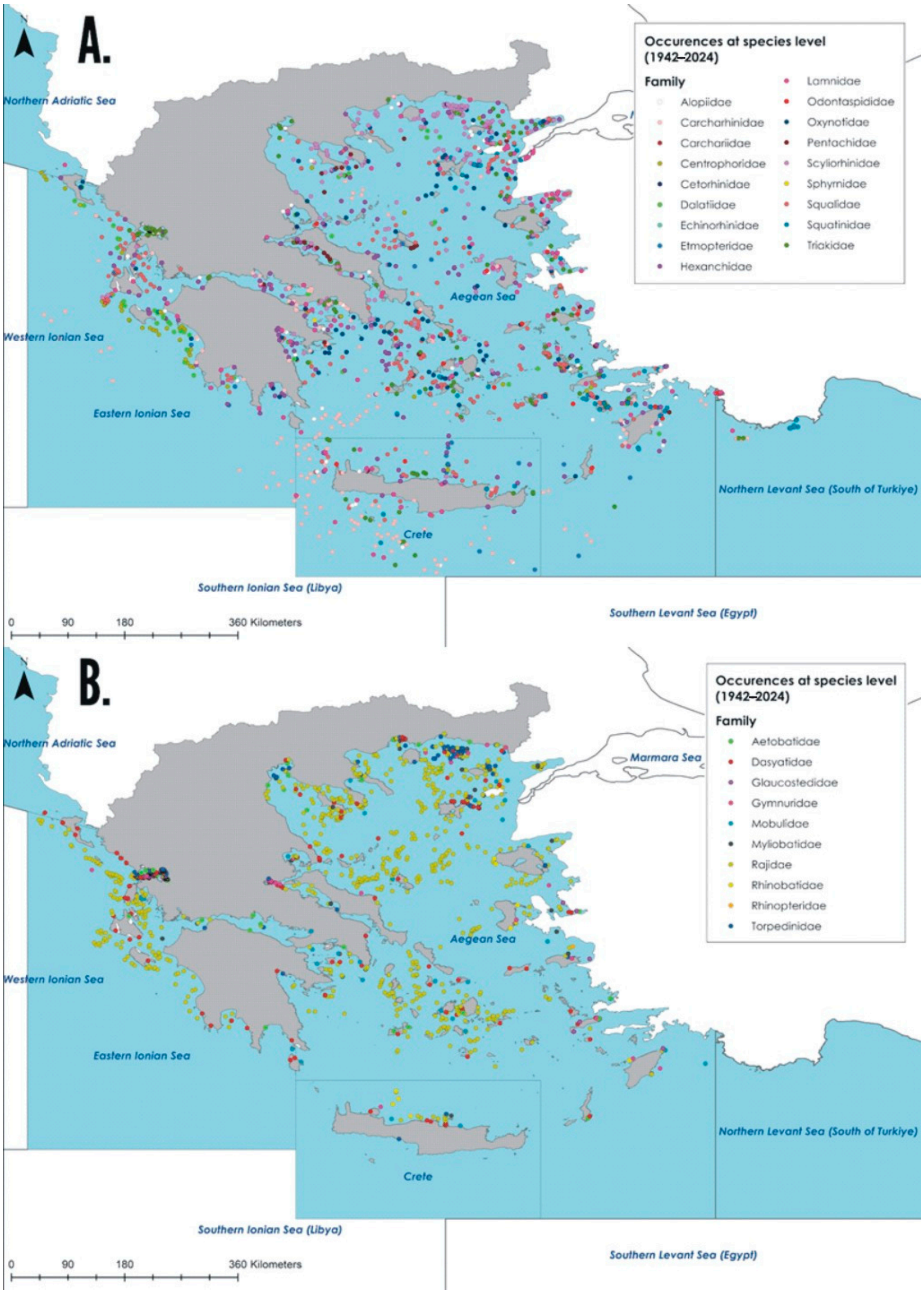


Figure 1. Number of records across years for batoids, sharks, and chimaeras during 1942–2025.

Spatially, most records originated from the Aegean Sea (67.7%), followed by the Ionian Sea (27.5%), with Cretan waters (GSA 23) accounting for 4.4% of records. The Levantine Sea and the southern Adriatic contributed less than 1% each (Figure 2). At the family level, Rajidae dominated the dataset (28.7%, N = 1606), followed by Torpedinidae (11.2%, N = 627) and Scyliorhinidae (7.8%, N = 438). A total of 67 species were reported, with *Raja radula* being the most frequently reported (13.6%, N = 761), followed by *Dipturus oxyrinchus* (7.0%, N = 389) and *Scyliorhinus canicula* (6.5%, N = 361) (Figure 2; Table A1).


A.
Occurences at species level
(1942–2024)
Family
Alopiidae
Carcharhinidae
Carchariidae
Centrophoridae
Cetorhinidae
Dalatiidae
Echinorhinidae
Etmopteridae
Hexanchidae
Lamnidae
Odontaspididae
Oxynotidae
Pentachidae
Scyliorhinidae
Sphyrnidae
Squalidae
Squatinidae
Triakidae
Northern Adriatic Sea
Western Ionian Sea
Eastern Ionian Sea
Aegean Sea
Northern Levant Sea (South of Turkiye)
Crete
Southern Ionian Sea (Libya)
Southern Levant Sea (Egypt)
0 90 180 360 Kilometers
B.
Occurences at species level
(1942–2024)
Family
Aetobatidae
Dasyatidae
Glaucostedidae
Gymnuridae
Mobulidae
Myliobatidae
Rajidae
Rhinobatidae
Rhinopteridae
Torpedinidae
Northern Adriatic Sea
Marmara Sea
Western Ionian Sea
Eastern Ionian Sea
Aegean Sea
Northern Levant Sea (South of Turkiye)
Crete
Southern Ionian Sea (Libya)
Southern Levant Sea (Egypt)
0 90 180 360 Kilometers

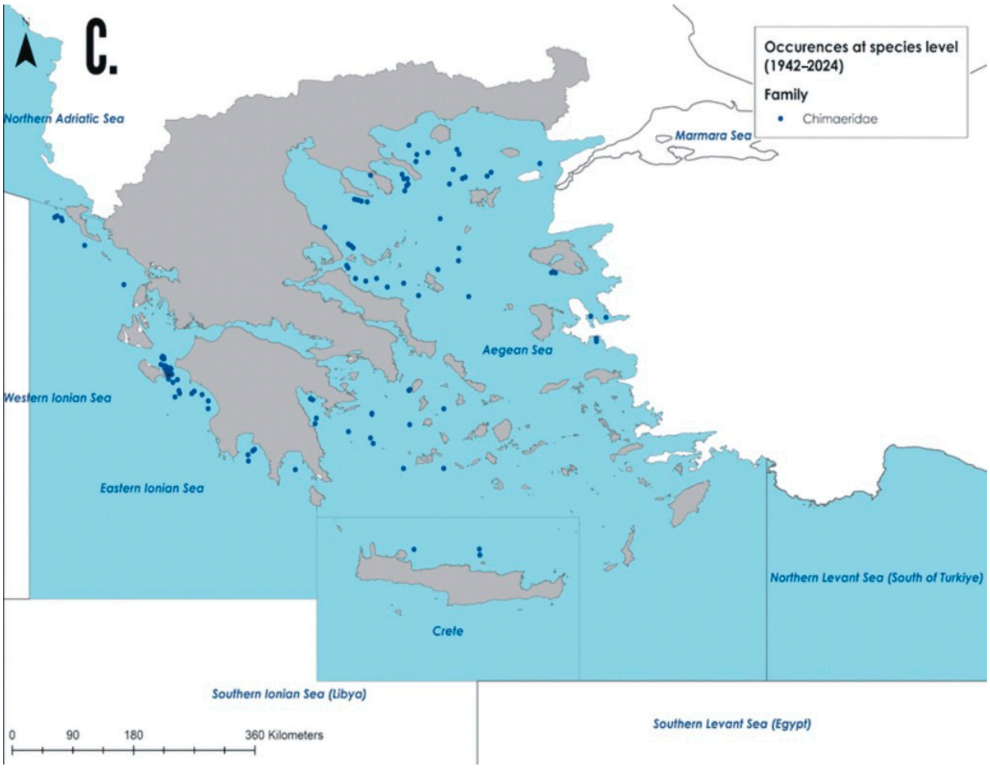
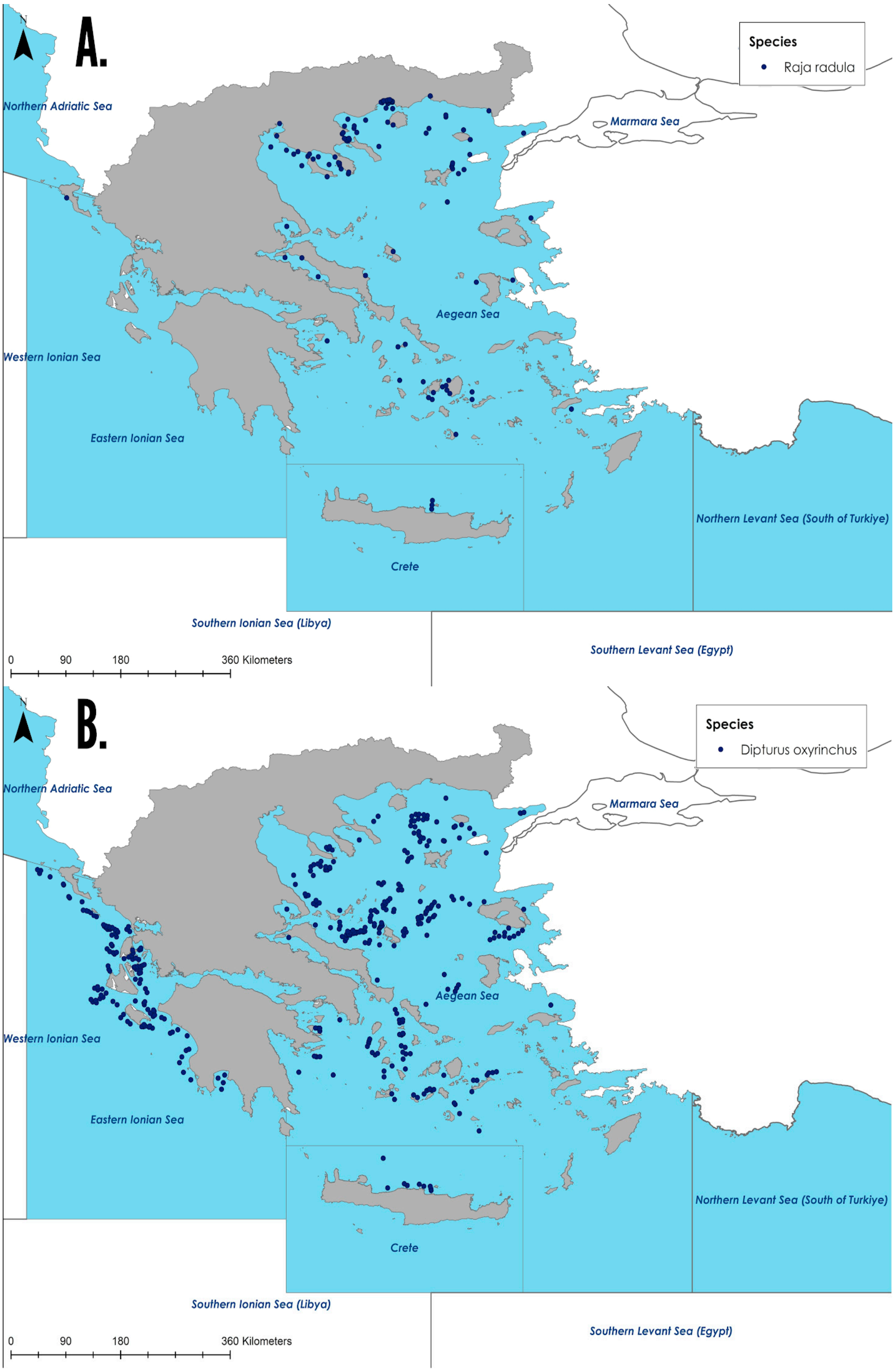
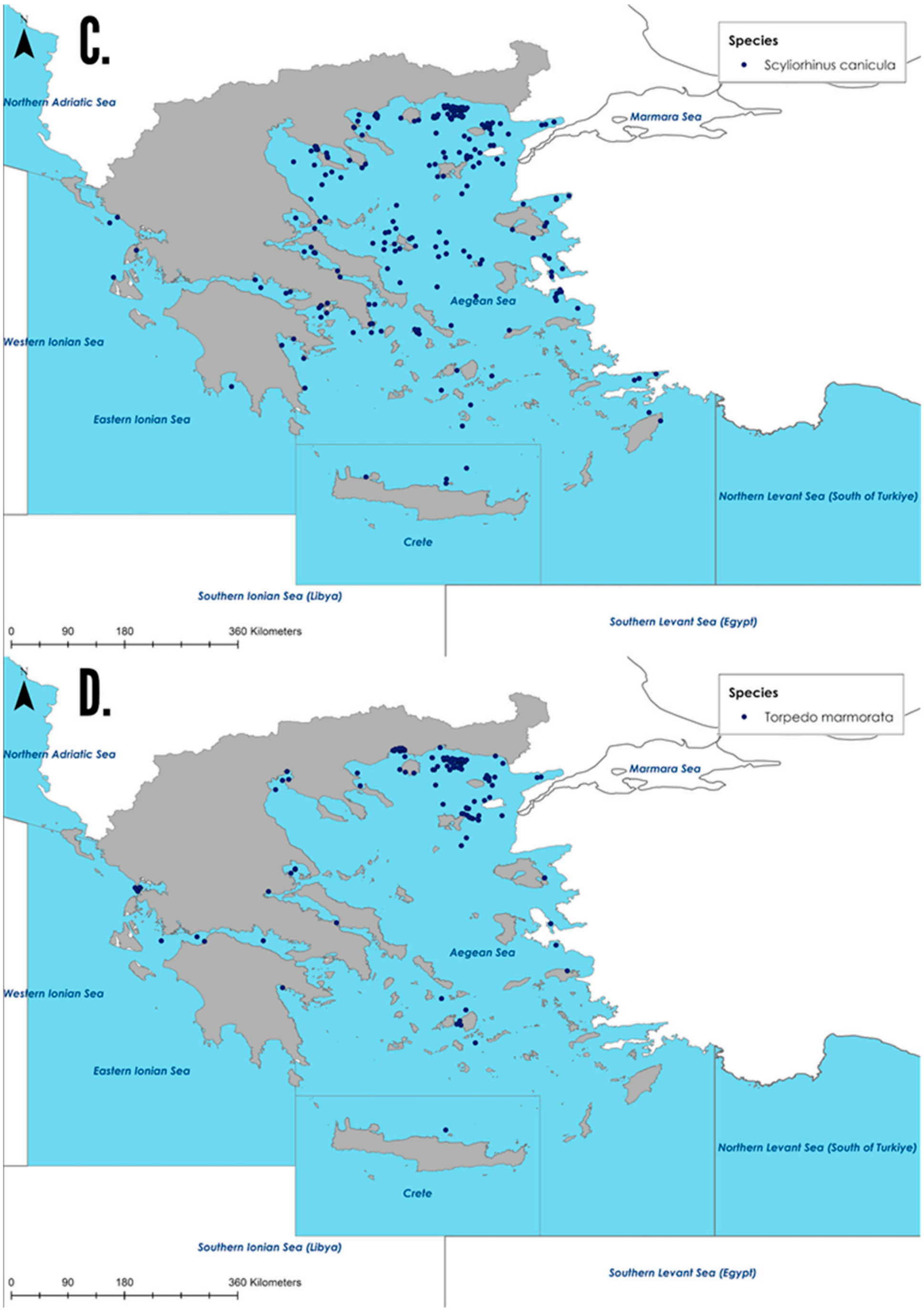


Figure 2. Spatial distribution of (**A**) shark species, (**B**) ray species, and (**C**) chimaera species occurrences (1942–2025), categorized by family. Although records dating back to 1858 were compiled in this study, only those from 1942 onward contained sufficiently precise locality information to be georeferenced. Earlier records typically referred to fish markets or consisted of species inventories for broader areas, lacking specific geospatial data.

In the Aegean Sea, *Raja radula* was the most frequently recorded species (N = 757), followed by *Scyliorhinus canicula* (*N* = 341) and *Torpedo marmorata* (*N* = 332). In the Ionian Sea, *Torpedo torpedo* (*N* = 275), *Mustelus mustelus* (*N* = 173), and *Gymnura altavela* (*N* = 166) were the most frequently reported species. However, this pattern is strongly influenced by intensive monitoring in the Amvrakikos Gulf (iSea). When this localized sampling effort is excluded, the most frequently reported species in the Ionian Sea are *Dipturus oxyrinchus* (*N* = 123), *Chimaera monstrosa* (*N* = 54), and *Prionace glauca* (*N* = 43) (Figure 3). *Carcharodon carcharias* and *Rostroraja alba*, both considered rare in the eastern Mediterranean [12], were recorded primarily in the northeastern Aegean and, to a lesser extent, on the Cyclades Plateau (Figure 4).


A.
Species
Raja radula
Northern Adriatic Sea
Marmara Sea
Aegean Sea
Western Ionian Sea
Eastern Ionian Sea
Northern Levant Sea (South of Turkiye)
Crete
Southern Ionian Sea (Libya)
Southern Levant Sea (Egypt)
0 90 180 360 Kilometers
B.
Species
Dipturus oxyrinchus
Northern Adriatic Sea
Marmara Sea
Aegean Sea
Western Ionian Sea
Eastern Ionian Sea
Northern Levant Sea (South of Turkiye)
Crete
Southern Ionian Sea (Libya)
Southern Levant Sea (Egypt)
0 90 180 360 Kilometers


C.
Species
Scyliorhinus canicula
Northern Adriatic Sea
Marmara Sea
Western Ionian Sea
Aegean Sea
Eastern Ionian Sea
Northern Levant Sea (South of Turkiye)
Crete
Southern Ionian Sea (Libya)
Southern Levant Sea (Egypt)
0 90 180 360 Kilometers
D.
Species
Torpedo marmorata
Northern Adriatic Sea
Marmara Sea
Western Ionian Sea
Aegean Sea
Eastern Ionian Sea
Northern Levant Sea (South of Turkiye)
Crete
Southern Ionian Sea (Libya)
Southern Levant Sea (Egypt)
0 90 180 360 Kilometers

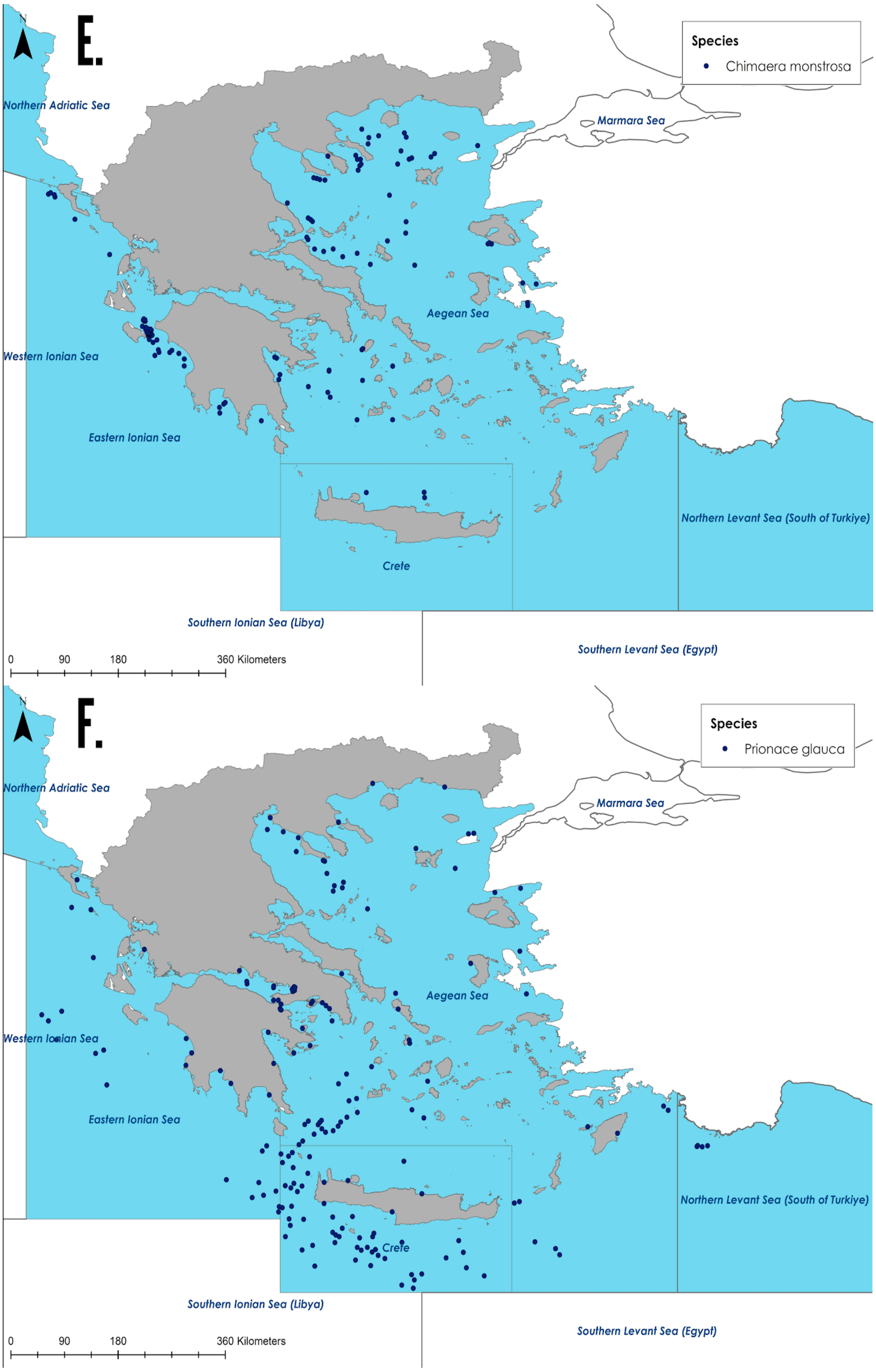


Figure 3. Occurrences of the most frequently reported chondrichthyans in Greek waters. (**A**) *Raja radula* (13.60%, *N* = 761); (**B**) *Dipturus oxyrinchus* (6.95%, *N* = 389); (**C**) *Scyliorhinus canicula* (6.45%, *N* = 361); (**D**) *Torpedo marmorata* (6.17%, *N* = 345); (**E**) *Chimaera monstrosa* (2.22%, *N* = 54); and (**F**) *Prionace glauca* (3.36%, *N* = 43).

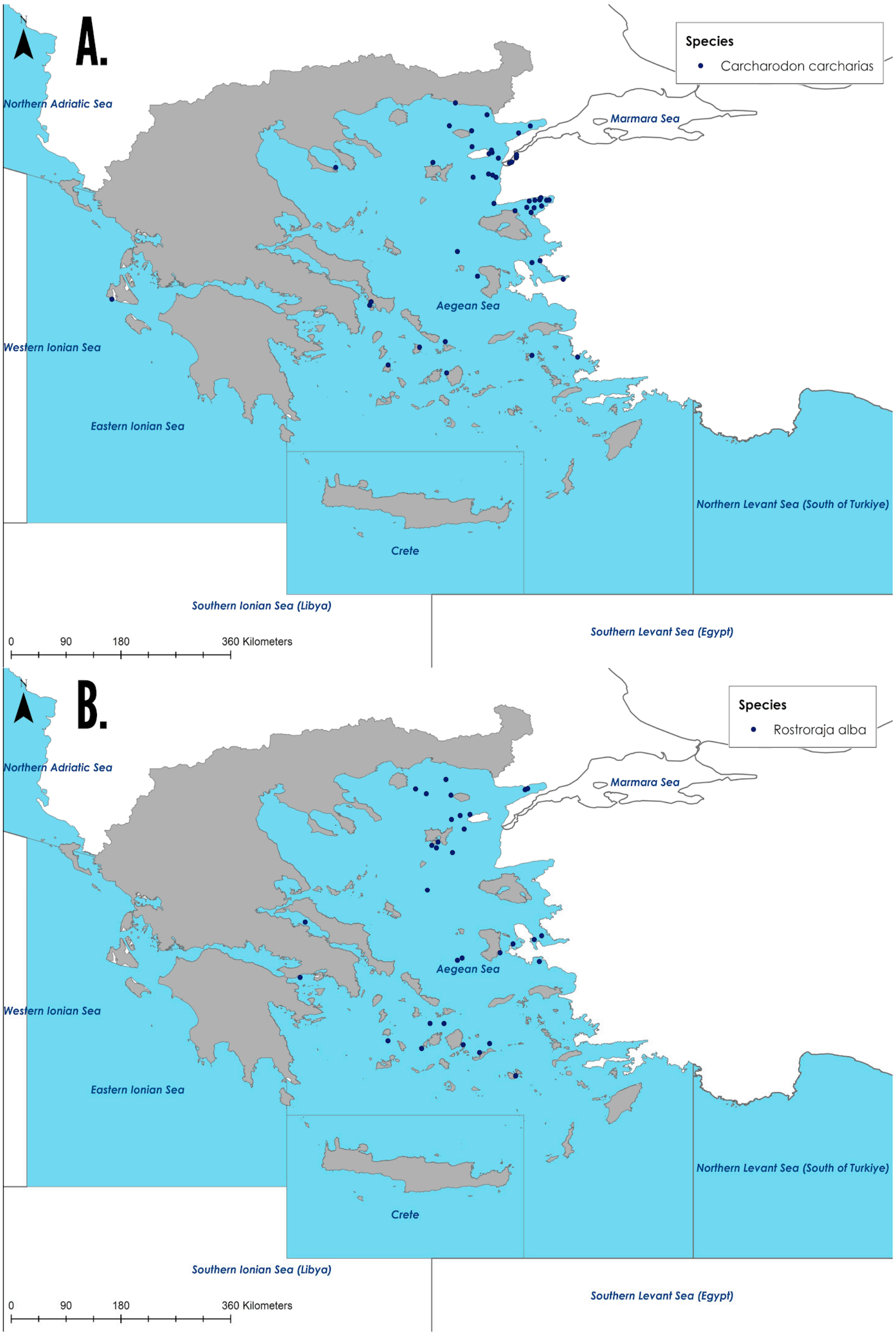


Figure 4. Occurrences of (**A**) *Carcharodon carcharias* (0.89%; $N = 50$) and (**B**) *Rostroraja alba* (1.16%; $N = 65$) in Greek waters.

4. Discussion

The present study advances the spatial and temporal understanding of chondrichthyan distribution in Greek waters by integrating heterogeneous data sources, combining the scientific literature, citizen science initiatives, biodiversity databases, and fisheries-dependent datasets. The presence of 62 species of shark, ray, and chimaera (33 shark species, 28 ray species, and 1 chimaera species) were confirmed in Greek waters. Such integrative approaches are increasingly recognized as essential for improving species distribution assessments and supporting evidence-based conservation planning (e.g., [43–45]), particularly in data-limited systems for enabling adaptive, ecosystem-based management.

The integrated dataset allowed the spatial structure of chondrichthyan occurrence in Greek waters to be examined in detail, particularly the pronounced concentration of records in the Aegean Sea, which likely reflects both ecological patterns and uneven sampling effort. This region has historically received greater research attention and hosts multiple monitoring initiatives [25], which increases detection probability. At the same time, the Aegean is recognized as a Mediterranean biodiversity hotspot, characterized by complex bathymetry, pronounced habitat heterogeneity, and dynamic oceanographic conditions [36,46]. The Aegean's hydrography, including Black Sea water inflow through the Dardanelles, Levantine Intermediate Water intrusion, and persistent fronts and gyres, enhancing localized productivity that support elevated taxonomic and functional diversity, particularly for mobile predators such as chondrichthyans [38,46]. Thus, the Aegean Sea likely represents not only an area of high diversity but also a critical zone for key ecological processes, reinforcing its importance for regional conservation prioritization. Consequently, this area offers elasmobranchs foraging, nursery, and refuge opportunities and might support greater taxonomic and functional diversity than more uniform areas such as the southern Greek seas [12,46]. For instance, the concentration of *Carcharodon carcharias* and *Rostroraja alba* records in the northeastern Aegean and on the Cyclades Plateau is consistent with both species' habitat requirements, including extensive continental-shelf and shallow-plateau habitats, soft substrata, and elevated productivity. In contrast, the relatively low number of records from Cretan and Levantine waters highlights the need for more targeted and systematic research in these understudied areas. These patterns are consistent with broader Mediterranean trends, where data scarcity often reflects limited sampling effort rather than true species absence (e.g., [47]). Such gaps can bias conservation planning by underrepresenting ecologically significant areas. The use of GFCM-GSAs partially mitigates this issue by providing a transboundary framework aligned with ecological processes, acknowledging that many chondrichthyan species exhibit wide-ranging and migratory behavior [12]. This supports the need for coordinated, basin-scale conservation strategies and spatial planning tools that operate across ecological, rather than political, boundaries.

Interpreting these spatial patterns requires an understanding of how the underlying records were assembled, and here, citizen science has received a central role. Citizen science has emerged as an important contributor to data availability, particularly for rare, elusive, or seasonally occurring species. Initiatives such as the M.E.C.O. project and iNaturalist enhance spatial and temporal coverage, complementing conventional survey approaches. Recent studies further demonstrate that, when supported by robust validation protocols, citizen-derived data can achieve high levels of reliability and are increasingly integrated into conservation science [45,48]. Our results also clarify that independent searches of social and mass media provide no additional unique records, all of which had already been incorporated and validated within M.E.C.O. This indicates that citizen science resides in the curation and taxonomic-validation layer that consolidates scattered records into a single, de-duplicated repository. This empirically substantiates the more general case made in previous work [48], demonstrating that unstructured media mining adds no information beyond that captured by a structured platform. Citizen science records have been instrumental in documenting rare and threatened taxa, including *Carcharodon carcharias* and *Rostroraja alba*, and have contributed directly to ISRA identification and Special Environmental Studies supporting the designation of new National Parks. Therefore, citizen-derived data achieve high reliability [45,48] and offer an efficient, conservation-relevant foundation for future monitoring in under-sampled regions such as the eastern Mediterranean. The absence of additional records from independent social and mass media searches in this study further highlights the central role of citizen science platforms, which consolidate opportunistic observations into a single repository with duplicates removed and identifications expertly verified. Such efforts could provide an efficient means for future biodiversity monitoring in data-limited regions such as the eastern Mediterranean.

Alongside these spatial and methodological considerations, the dataset also reveals a clear temporal signal. The temporal increase in occurrence records, particularly for batoids, likely reflects both improved data availability and growing scientific and public interest. This trend aligns with broader developments in marine biodiversity monitoring, driven by technological advances, increased stakeholder engagement, and enhanced data-sharing practices. Improved distributional knowledge has direct conservation implications, informing spatial management measures, such as the designation of Marine Protected Areas, and targeted conservation actions. In this context, frameworks such as Important Shark and Ray Areas (ISRAs) rely on robust, spatially explicit datasets to support transparent prioritization. Importantly, the data compiled here have already contributed to the identification of ISRAs in Greek waters and to Special Environmental Studies supporting the designation of new National Parks, i.e., the Ionian National Park. This represents a notable shift toward the explicit inclusion of chondrichthyans in marine spatial planning in Greece, consistent with ecosystem-based management approaches that recognize their ecological significance.

Several limitations relating to data availability, data quality, and sampling effort should be considered when interpreting these findings. Variability in taxonomic resolution, uneven sampling effort, and reporting biases can influence observed distribution patterns [12]. Fisheries-dependent data, while valuable, are inherently shaped by gear selectivity, spatial effort, and inconsistencies in species identification, potentially introducing systematic bias. The absence of depth- and habitat-related data further biases interpretation. This is because the bathymetric representation of the dataset is determined by the uneven depth coverage of its sources, which should be considered when interpreting distribution patterns. With respect to habitat, citizen science and media observations concentrate on shallow, accessible habitats and are biased toward coastal and near-surface taxa, leaving the open sea sampled only opportunistically. Consequently, pelagic and oceanic species are likely underrepresented relative to coastal taxa, and observed diversity and distribution patterns should be interpreted as partly reflecting differential habitat accessibility rather than true ecological distribution alone. These constraints highlight the need for continued expert validation and the integration of complementary methodologies, including fisheries-independent surveys (e.g., baited remote underwater video systems) and emerging molecular approaches such as environmental DNA, which can improve detection probabilities and resolve cryptic diversity. eDNA data integrated with the georeferenced baseline and other fisheries-independent methods [49] could complement future monitoring by detecting rare chondrichthyans, resolving taxonomically ambiguous taxa, and extending coverage into the under-sampled deep and offshore habitats identified in this study. Discrepancies were also observed between recorded species richness and assessed taxa, indicating that knowledge gaps remain. As noted in [25], the occurrence of some species remains uncertain, while others may have undergone local declines or extirpations. Data deficiency continues to constrain effective conservation, particularly for elasmobranchs, where life-history traits exacerbate vulnerability and limit recovery potential. These uncertainties necessitate cautious interpretation of distribution patterns and highlight the importance of sustained, systematic research efforts.

Future research should prioritize the development of species distribution models for taxa with sufficient occurrence data, as these approaches can help correct for sampling bias and improve predictive accuracy (e.g., [50]). Integrating environmental predictors with occurrence datasets can refine habitat suitability assessments and support scenariobased systematic conservation planning [51]. In parallel, the establishment of standardized, long-term monitoring programs across Greek seas is essential, alongside strengthened regional collaboration in the eastern Mediterranean. Within the European Union framework, Greece participates in the Data Collection Framework and MEDITS surveys. Enhancing data transparency, coupled with continued methodological integration, will be essential for improving the conservation assessment and management of chondrichthyan species in this ecologically important yet still understudied region.

5. Conclusions

The present study provided the first spatially explicit, species-level synthesis of chondrichthyan occurrence in the Greek seas, integrating published literature, citizen science, research programs, and biodiversity databases into a single georeferenced baseline. Its principal contribution was to convert a long but fragmented history of observations into a coherent distributional context, organized by GFCM geographical sub-areas. The study also clarified which species can be confirmed as present in Greek waters and where the principal spatial gaps exist, most notably in the comparatively under-sampled Cretan and Levantine waters, where the scarcity of records reflects limited sampling effort rather than true absence. The records compiled in this study have already contributed to the identification of Important Shark and Ray Areas in Greek waters and to Special Environmental Studies prepared for the designation of the Ionian National Park. Important gaps remain for rare and data-deficient taxa, and better access to fisheries data collected under the EU Data Collection Framework will be needed to build on the baseline presented. The dataset thus offers a foundation for future distribution modeling and conservation prioritization across the eastern Mediterranean.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/fishes11080492/s1, Table S1: Raw data of Chondrichthyan distribution in the Greek Seas [52–228].

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Appendix A

Table A1. Total occurrence records per family and species per GSA. * *Dasyatis* spp. represents a mixture of stingray species: *D. pastinaca*, *D. marmorata*, and *D. tortonesei*. + entries considered not present.

Taxa	Aegean Sea	Crete	Eastern Ionian Sea	Southern Adriatic Sea	Northern Levant Sea	Total
Sharks	1522	201	435	2	25	2185
Hexanchidae Gray, 1851	183	20	38			241
Heptranchias perlo	66	4	3			73
Hexanchus griseus	112	15	33			160
Hexanchus nakamurai	5	1	2			8
Carchariidae Müller & Henle, 1838	1					1
Carcharias taurus	1					1
Odontaspididae Müller & Henle, 1841	19	3			1	23
Odontaspis ferox	19	3			1	23
Lamnidae Müller & Henle, 1838	105	18	17	1	6	147
Carcharodon carcharias	49		1			50
Isurus oxyrinchus	54	18	16	1	6	95
Lamna nasus	2					2
Cetorhinidae Gill, 1861	16		2			18
Cetorhinus maximus	16		2			18
Alopiidae, Bonaparte, 1838	57	9	7		1	74
Alopias superciliosus	22	3	5		1	31
Alopias vulpinus	35	6	2			43
Pentanchidae Smith, 1912	39	12	1			52
Galeus melastomus	39	12	1			52
Scyliorhinidae Gill, 1862	416	5	17			438
Scyliorhinus canicula	341	5	15			361
Scyliorhinus stellaris	75		2			77
Triakidae Gray, 1851	136	22	175		2	335
Mustelus asterias	11					11
Mustelus mustelus	92	4	173			269
Mustelus punctulatus	7		2			9
Galeorhinus galeus	26	18			2	46
Carcharhinidae Jordan & Evermann, 1896	100	61	49		4	214
Carcharhinus brevipinna	1					1
+ *Carcharhinus obscurus*	1					1

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Carcharhinus plumbeus	14	4	6			24
Prionace glauca	84	57	43		4	188
Sphyrnidae Gill, 1872	3					3
Sphyrna zygaena	3					3
Dalatiidae Gray, 1851	23	1	24			48
Dalatias licha	23	1	24			48
Etmopteridae Fowler, 1934	36	18	6			60
Etmopterus spinax	36	18	6			60
Somniosidae Jordan, 1888						
+ *Centroscymnus coelolepis*						
Somniosus rostratus						
Oxynotidae Rafinesque, 1810	107	1	4	1		113
Oxynotus centrina	107	1	4	1		113
Centrophoridae Bleeker, 1859	12	3	37			52
Centrophorus uyato	12	3	37			52
Squalidae Bonaparte, 1834	193	25	58			276
Squalus acanthias	117	20	35			172
Squalus blainvillei	76	5	23			104
Echinorhinidae Gill, 1862	3					3
Echinorhinus brucus	3					3
Squatinidae Bonaparte, 1838	73	3			11	87
Squatina aculeata	23	2				25
Squatina oculata	15	1			11	27
Squatina squatina	35					35
Batoids	2201	38	1047	1		3287
Torpedinidae Bonaparte, 1838	336	2	289			627
Tetronarce nobiliana	4	1	2			7
Torpedo marmorata	332	1	12			345
Torpedo torpedo			275			275
Rhinobatidae Müller & Henle, 1837	5	4				9
Rhinobatos rhinobatos	5	4				9
Glaucostegidae Bonaparte, 1835	10					10
Glaucostegus cemiculus	10					10
Rajidae de Blainville, 1816	1445	20	141			1606
+ *Dipturus* cf. *batis*	5		1			6
Dipturus oxyrinchus	257	9	123			389
Leucoraja circularis	30					30

+ *Leucoraja fullonica*	3					3
Leucoraja melitensis	53					53
Leucoraja naevus	8	1				9
Raja asterias	11		2			13
Raja brachyura	4					4
Raja clavata	118	3	10			131
Raja miraletus	118	3	4			125
Raja montagui	4					4
Raja polystigma	11	1				12
Raja radula	757	3	1			761
Raja undulata	1					1
Rostroraja alba	65					65
Dasyatidae Jordan & Gilbert, 1879	189	7	229	1		426
Bathytoshia lata	5		5			10
Dasyatis marmorata	2		60			62
Dasyatis pastinaca	71	7	51	1		130
* *Dasyatis* spp.	85		49			134
Dasyatis tortonesei	4		57			61
Pteroplatytrygon violacea	22		7			29
Gymnuridae Fowler, 1934	67	1	166			234
Gymnura altavela	67	1	166			234
Myliobatidae Bonaparte, 1835	54	2	73			129
Aetomylaeus bovinus	66		145			211
Myliobatis aquila	54	2	73			129
Rhinopteridae Jordan & Evermann, 1896	2					2
+ *Rhinoptera marginata*	2					2
Mobulidae Gill, 1893	27	2	4			33
Mobula mobular	27	2	4			33
Chimaeras	65	5	54			124
Chimaeridae Rafinesque, 1815	65	5	54			124
Chimaera monstrosa	65	5	54			124
Total occurrence records per GSA	3788	244	1536	3	25	5596

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