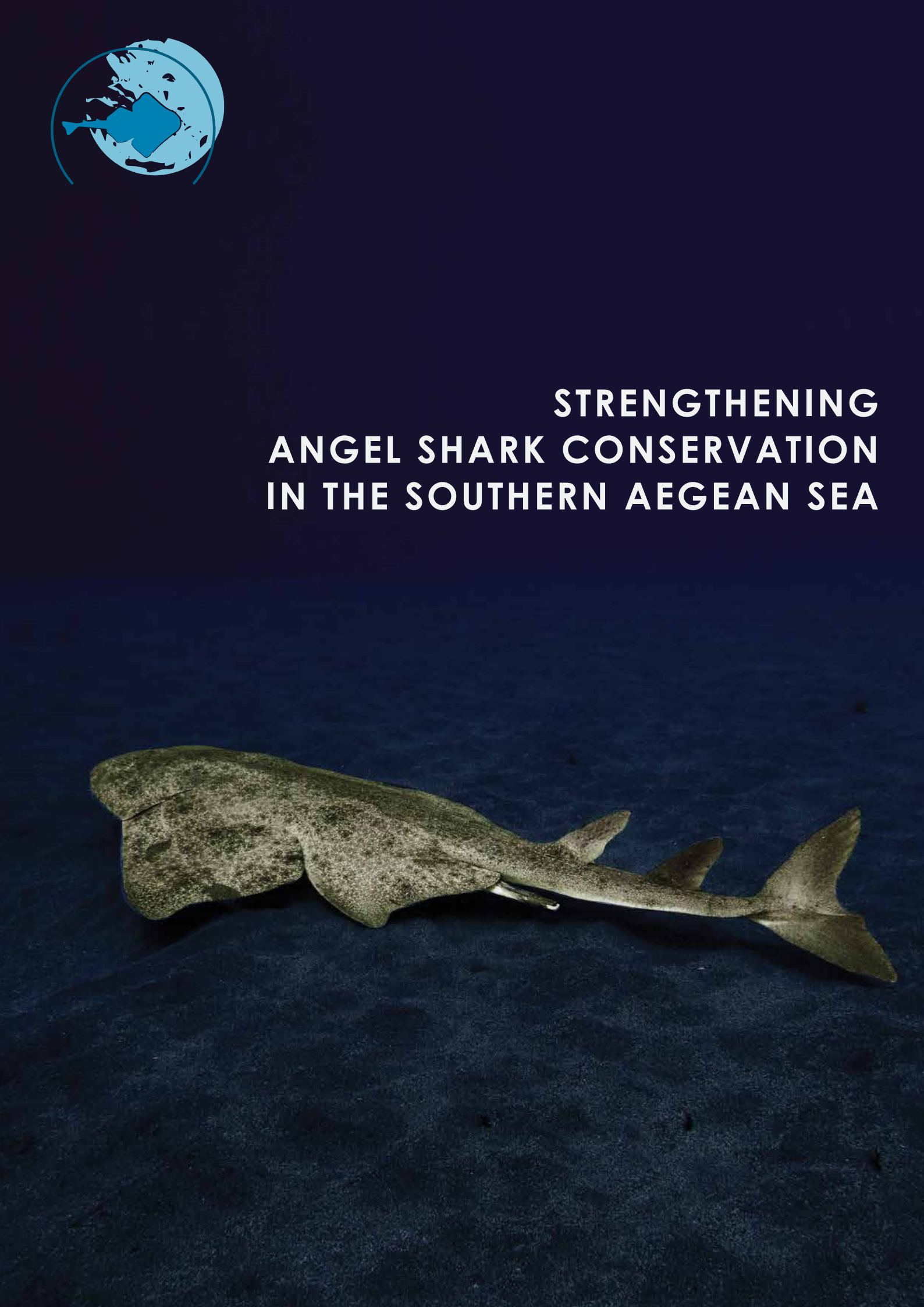
STRENGTHENING ANGEL SHARK CONSERVATION IN THE SOUTHERN AEGEAN SEA



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Foreword

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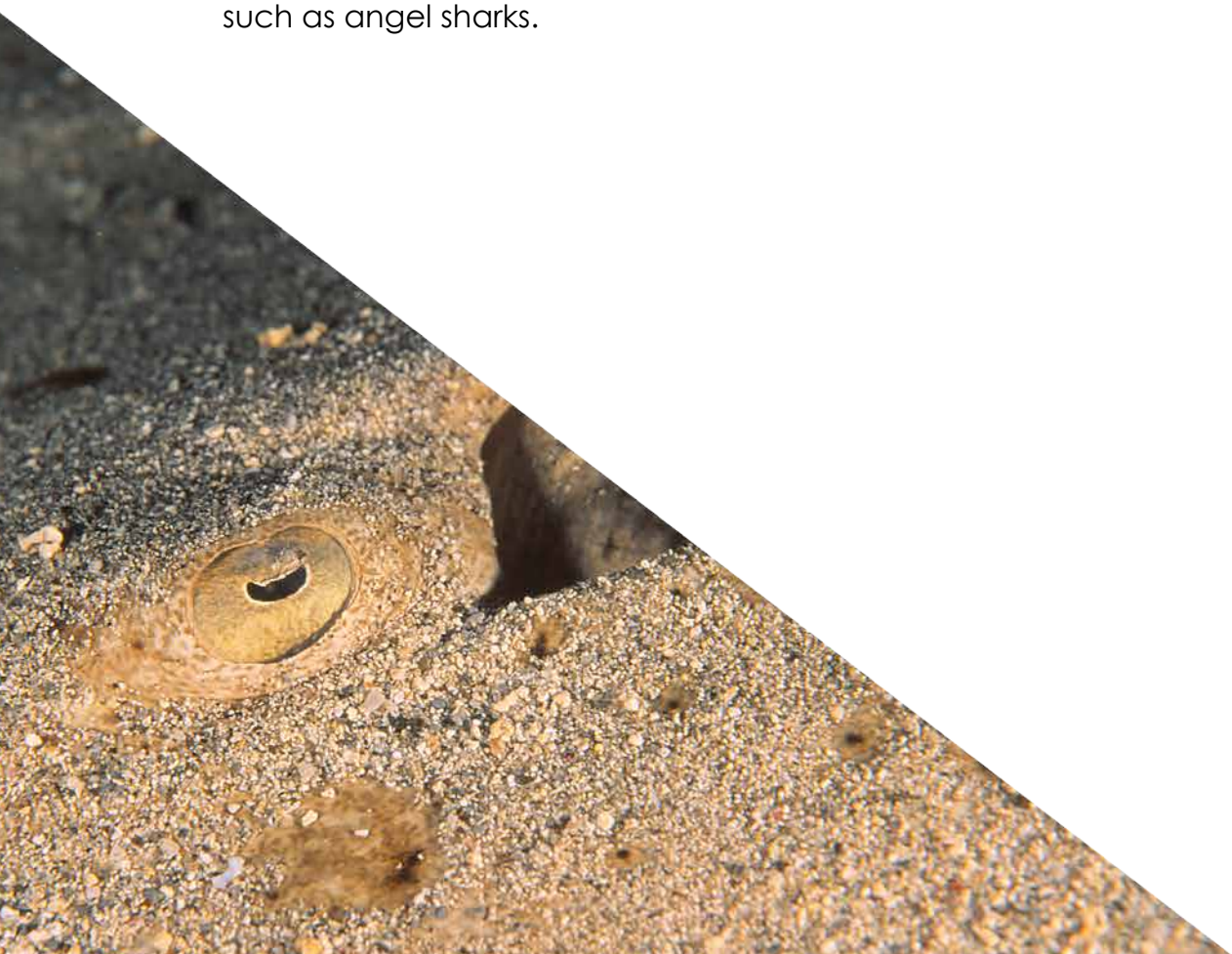
Co-Regional Vice Chairs of the IUCN Shark Specialist Group for the Mediterranean

The Mediterranean is a small semi-enclosed sea with peculiar physical characteristics, and it also contributes as much as 7% of chondrichthyans to global biodiversity. In this context, the seas of Greece play an important role by contributing to biodiversity with numerous species, including angel sharks. Some chondrichthyan species are vagrant and many other are resident on the continental shelf, an area where fishing effort is high, thus significantly negatively impacting chondrichthyans due to their morphological characteristics and their habitat preferences. Angel sharks are demersal species that suffer from overfishing, mainly by industrial bottom trawlers. Indeed, they require very different management solutions to bony fish. Certainly, we need a careful and uniform management approach throughout the Mediterranean, with a reduction in fishing effort and methods to mitigate bycatch.

There are over 20 countries and territories bordering the Mediterranean with very different cultures and religions. For sustainable fisheries, we must all agree on a general goal to protect the chondrichthyans thus there is a need to coordinate the numerous available approaches. However, before any other action is taken, it is necessary to have a clear understanding of the current state of their populations starting from basic knowledge on the biology and biogeography of chondrichthyan species such as angel sharks.



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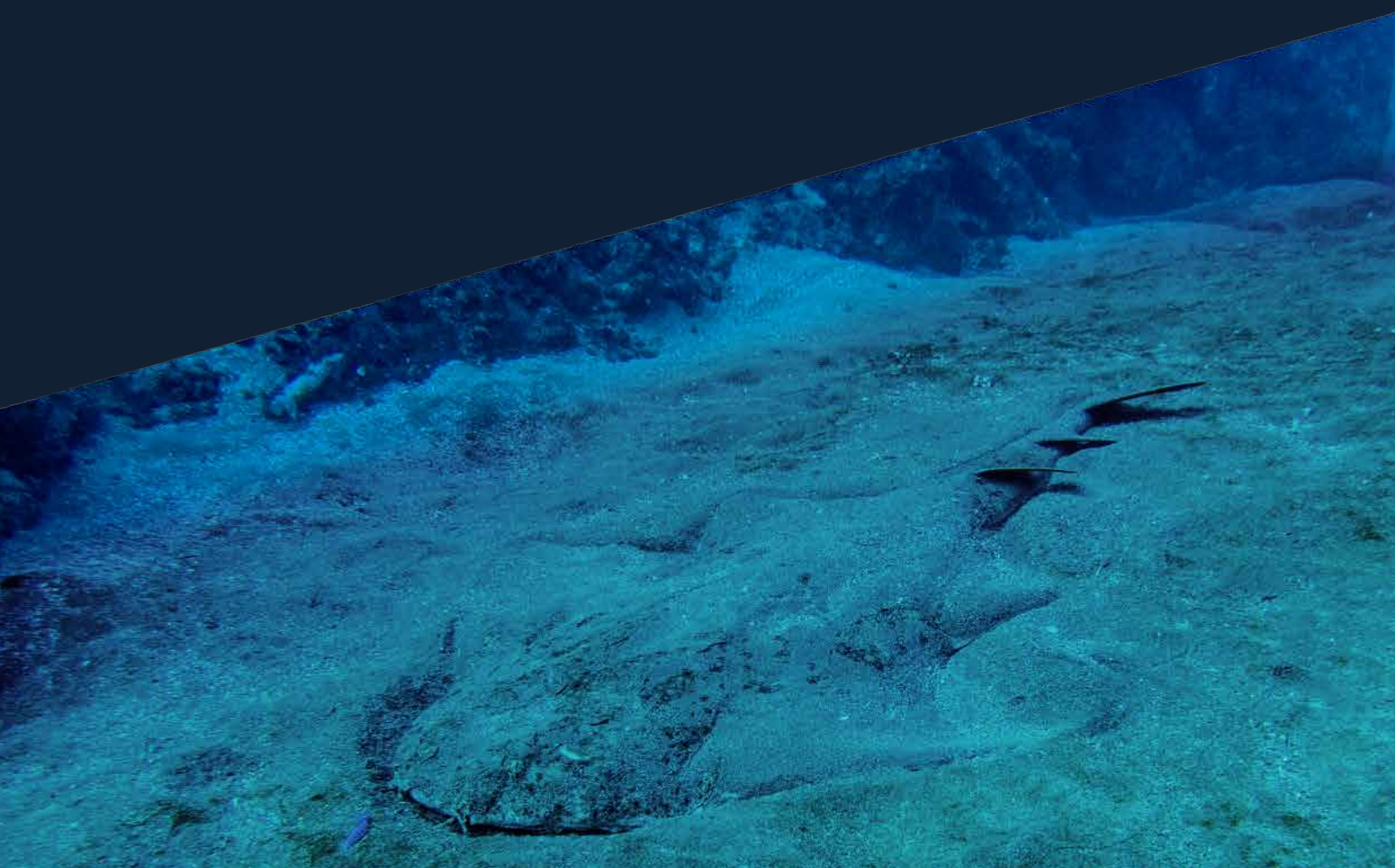


Glossary

Citizen science: the practice of public participation and collaboration in scientific research to increase scientific knowledge.

Chondrichthyans: a Class comprising cartilaginous fishes (sharks, skates, rays, chimaera).

Elasmobranchs: a subclass of Chondrichthyans comprising sharks, rays, skates.

Critical Angel Shark Areas: a specific geographic area that contains essential features necessary for the conservation of angel sharks. This may include an area that is not currently occupied by the species that will be needed for its recovery or conservation e.g. nursery, mating, aggregation, foraging areas.

IUCN Red List of Threatened Species: the most complete information source on the extinction risk status of species. It offers vital information on the range, population size, habitat and ecology, use and/or trade, threats, and conservation actions to inform conservation actions.

Local ecological knowledge: the knowledge that is relevant to the ecology that is acquired through personal observations and interactions with local ecosystems, and shared with local stakeholders.

Threat: a factor causing either a significant decline in numbers of a species' individuals, or an extensive contraction of the species' geographic range.

Abbreviations

CMS: Convention on the Conservation of Migratory Species of Wild Animals

DCF: Data Collection Framework

EU: European Union

GFCM: General Fisheries Commission for the Mediterranean

HELSTAT: Hellenic Statistical Authority

IUCN: International Union for Conservation of Nature

LEK: Local ecological knowledge

MPA: Marine Protected Area

RAP: Regional Action Plan

SubRAP: SubRegional Action Plan

Angel Sharks in the World

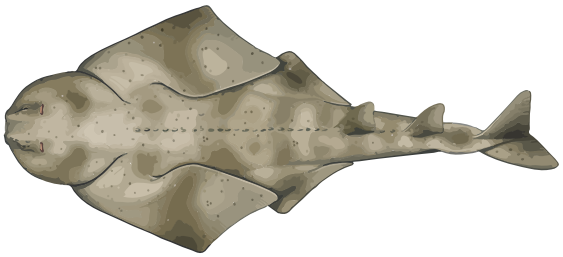
Angel sharks are **flat-bodied, moderately sized, coastal sharks** with broad pectoral fins, and dorsally located eyes and spiracles. Throughout the globe there are **22 species of angel sharks** [1]. Their distribution ranges from temperate to tropical marine waters and most of these species inhabit areas in the continental shelf and upper slopes down to 500 m [2].

Unfortunately, due to angel sharks' life characteristics, i.e. their slow growth, their low reproductive rate as well as their demersal nature which makes them susceptible to large-mesh gillnets, coupled with the **intensification of fisheries**, they have become **the third most threatened family of elasmobranchs** in the world, with many species in **urgent need of conservation** [3].

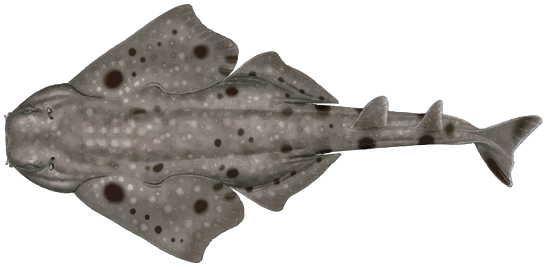
Angel Sharks in the Mediterranean

The Mediterranean Sea hosts three angel shark species:

- the Sawback Angelshark *(Squatina aculeata)*



- the Smoothback Angelshark *(Squatina oculata)*



- the Angelshark *(Squatina squatina)*

The Mediterranean populations of all these species are listed as **Critically Endangered** in the IUCN Red List of Threatened Species [4], a fact that means they are all facing an extremely **high risk of extinction**. Sawback Angelsharks, Smoothback Angelsharks, and Angelsharks have acquired this status because of a steep decline in their populations and local extinctions, as a result of **their historical and current overexploitation** by demersal fisheries and especially trawl fishing [5], [6], [7], [8], [9].

Presently, even though angel shark observations are extremely limited, it has been deduced that their distribution in the Mediterranean basin is scattered and that there are several local extinctions [6], [10], [11]. Apart from significant landings in Libya, there are no longer any targeted angel shark fisheries in the Mediterranean [6].

Against this backdrop, in 2019, **the Mediterranean Angel Sharks: Regional Action Plan (RAP)** was published [13] with the vision to restore Mediterranean angel sharks to robust populations capable to fulfill their ecological roles in healthy ecosystems; its primary aim was to provide a framework for conservation action for angel sharks in the basin. The Action Plan set three core goals which will help realize its vision:

1. **Minimisation of fisheries-based angel shark mortality** in the Mediterranean.

2. **Identification and protection of Critical Angel Shark Areas.**

3. **Establishment, implementation and enforcement of national legislation for angel sharks.**

Angel Sharks in Greece

In Greece, angel sharks, more commonly known as **Rina**, used to be a popular, high prised dish in the past. Currently, fishmongers, retailers, and restaurant owners use the common name 'Rina' to illegally sell Dasyatis spp. and Raja spp. in order to increase their profitability [14].

Greece has **no official reported angel shark landings**, according to data from HELSTAT (1967–2017) [15], however this can be attributed to the broadly aggregated elasmobranch landing categories. For this reason, **citizen science, social media reports and local ecological knowledge (LEK) have played a major role in information gathering;** between 2013 until 2020 they revealed the occurrence of more than 15 angel sharks in Greek waters, with 4 being marketed individuals.

Such recent evidence of the occurrence of all three angel shark species that are present in the Mediterranean has helped in the identification of the **Aegean and Cretan Seas** as priority regions for their conservation in the basin [16].

At the moment, the **priority threats** for angel sharks in these regions include the absence of species-specific landings, misidentification issues in both Small and Large-Scale Fisheries, Illegal, Unreported and Unregulated (IUU) fishing, negative effects of differing fishing gears, as well as lack of knowledge regarding their habitat preference and the impacts of anthropogenic disturbances [16].

In light of this situation, the **Mediterranean Angel Sharks: SubRegional Action Plan (SubRAP) GSAs 22/23 (Aegean Sea and Crete)** was developed [16], in line with the aim and goals of the RAP, to serve as a detailed roadmap for the regional Governments to use for protecting and preserving angel sharks.

Strengthening Angel Shark Conservation in the Aegean Sea

The recent discovery of several records of angel sharks in **Cyclades and Dodecanese Islands**, indicated that these areas are potentially **highly important** for Sawback Angelsharks, Smoothback Angelsharks, and Angelsharks. In this context, the project "Strengthening Angel Shark Conservation in the Southern Aegean Sea", implemented by iSea, with the support of the Shark Trust, the collaboration of the Angel Shark Project, and funded by the Shark Conservation Fund, aims at **improving and strengthening the conservation** of angel sharks in Greece, and in **advancing elasmobranch conservation** in the country.

Through this project further research will be conducted to support future conservation actions and policies, by **identifying** potential Critical Angel Shark Areas, **prioritizing conservation activities** at key areas that lack sufficient protection, **organizing capacity building workshops** on angel shark identification, good practices, and data collection tailored to the needs of competent authorities and local stakeholders, translating and distributing of **angel shark handling guides and identification plates**, and **meeting with the competent Ministries** to discuss the enhancement of current legislation to ensure the conservation of these species.

Angel Shark Habitats in the Aegean and priority areas for their conservation

For the production of the angel shark distribution maps all the available records from the Angel Shark Sightings Map of the Angel Shark Conservation Network were used. Additionally, data from the following projects were used:

1. The MECO (Mediterranean Elasmobranchs Citizen Observations) project

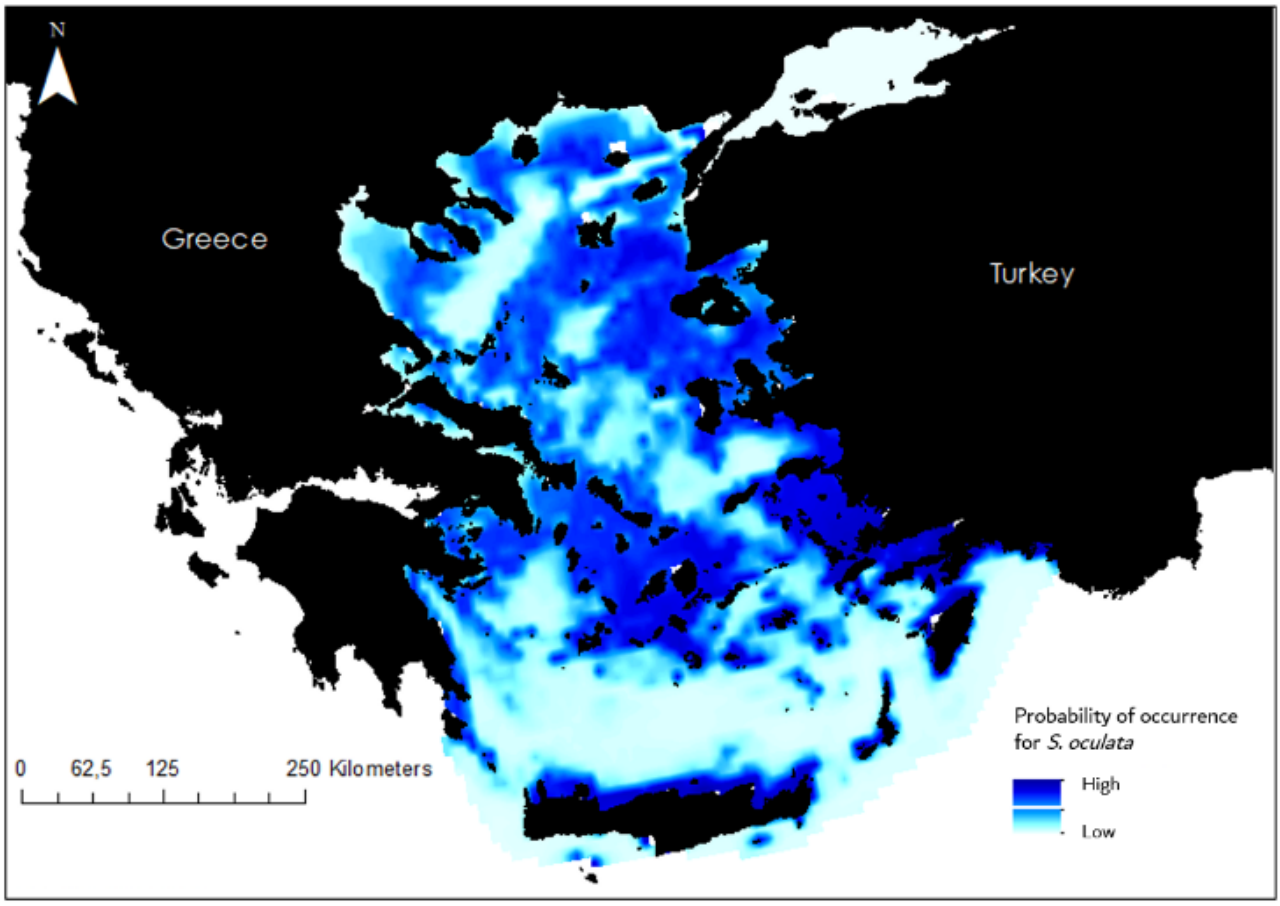
2. The Mediterranean Large Elasmobranchs Monitoring (MEDLEM) Species

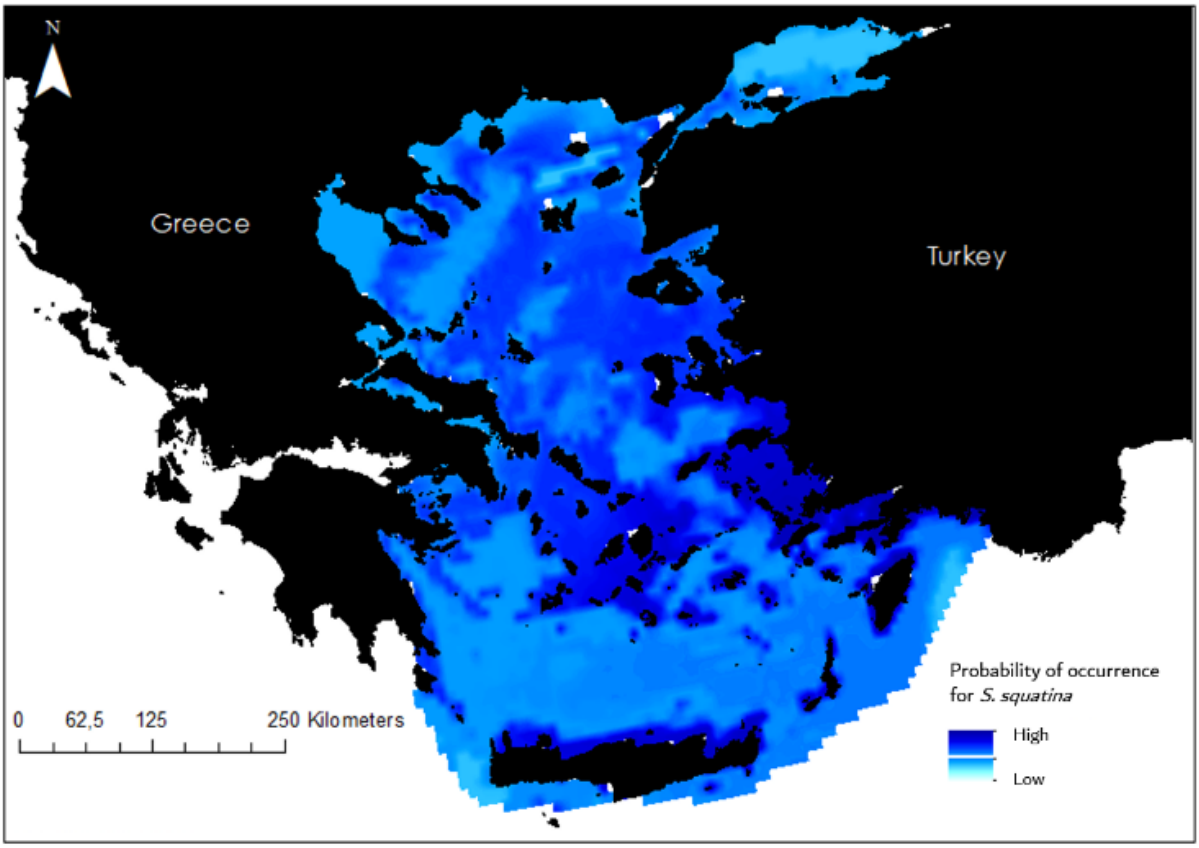
3. MARISCA: Maritime Spatial Planning for the protection and conservation of the biodiversity in the Aegean Sea

4. SharkPulse

5. By ElasmoCatch: monitoring elasmobranch fisheries in the North Aegean

Distribution Modelling was employed to **identify areas of high possibility of angel shark occurrence**, in the absence of extensive field data.





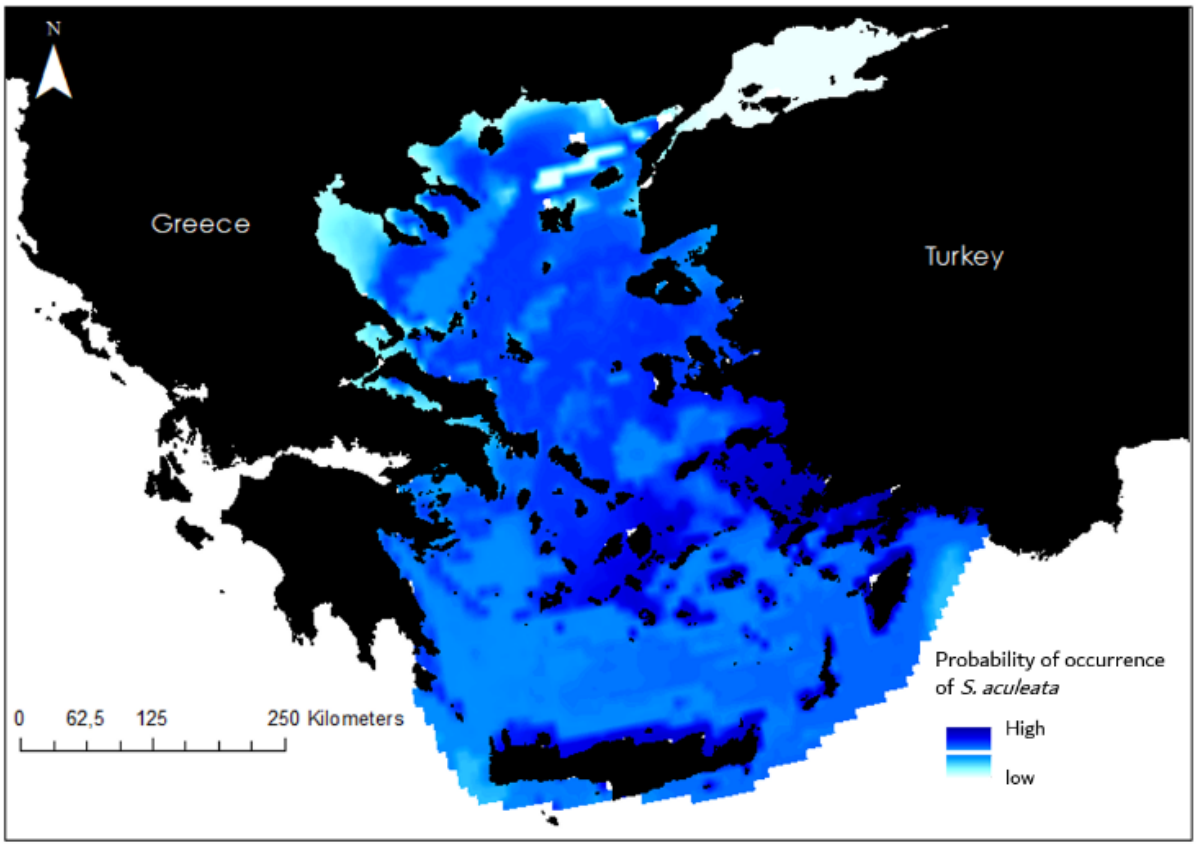


Figure 1: The potential distribution of the three angel shark species. Dark blue areas indicate a high probability of angel shark occurrence and light blue areas indicate a low probability of angel shark occurrence.

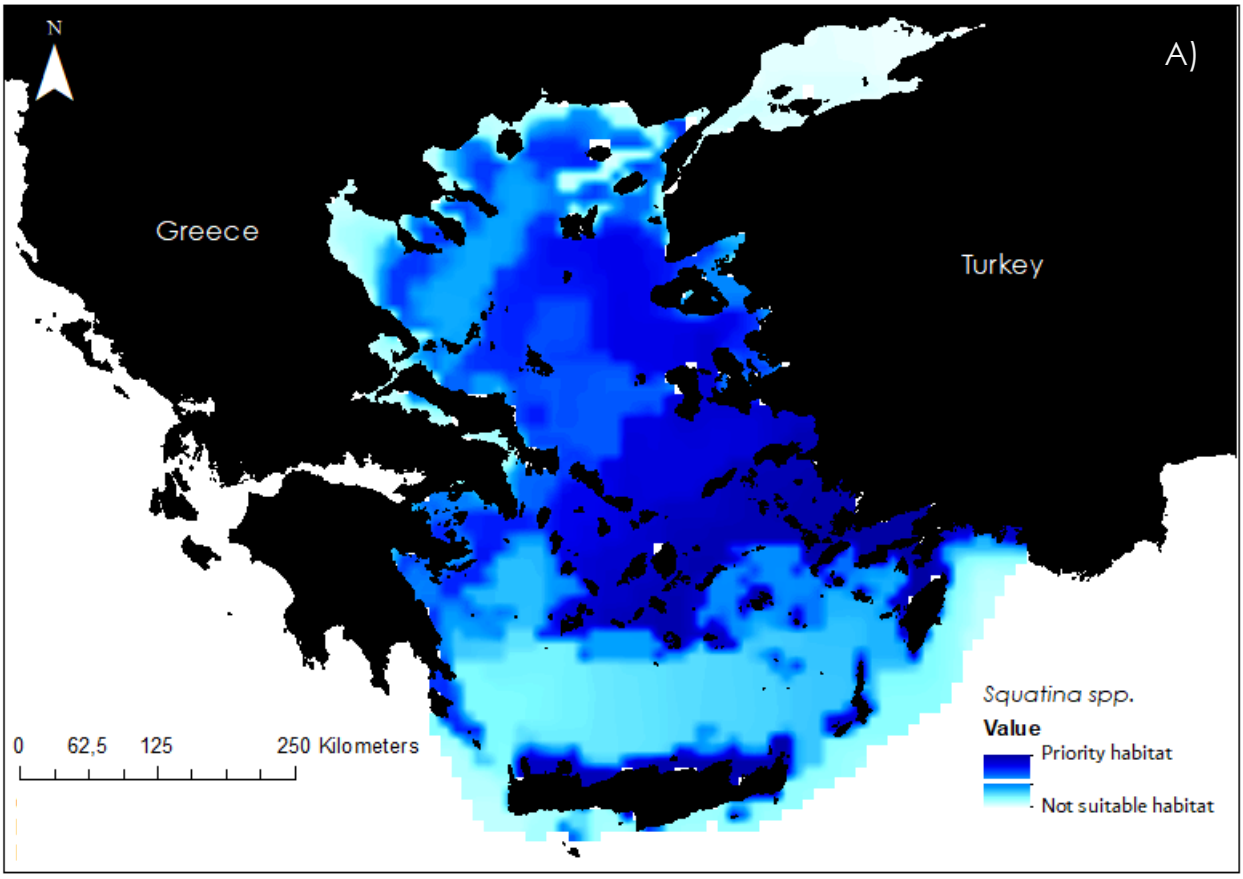
The results of the Distribution Modelling (Fig.1) were used for the **Spatial Prioritization modelling**, which aims to produce a spatial hierarchy of areas according to their conservation value. Specific areas were identified for targeted conservation activities that will benefit angel shark conservation in the region (Fig. 2).

Three areas seem to be more critical for all three analyzed species:

- **the region of the Cyclades islands,**
- **the southeastern eastern part of the Aegean and especially the zone between islands of Samos and Rhodes, and**
- **the northern coasts of Crete.**

These three regions capture more efficiently the spatial distribution of Smoothback Angelshark, to a lesser extent the distribution of Sawback Angelshark and to an even lesser extent that of Angelshark.

Existing marine protected area networks did not substantially overlap with the priority areas. However, given the low number of sighting records, which most likely mirrors the low population abundance of these species, **more effort should be put into monitoring angel sharks**, in order to facilitate a much deeper analysis.



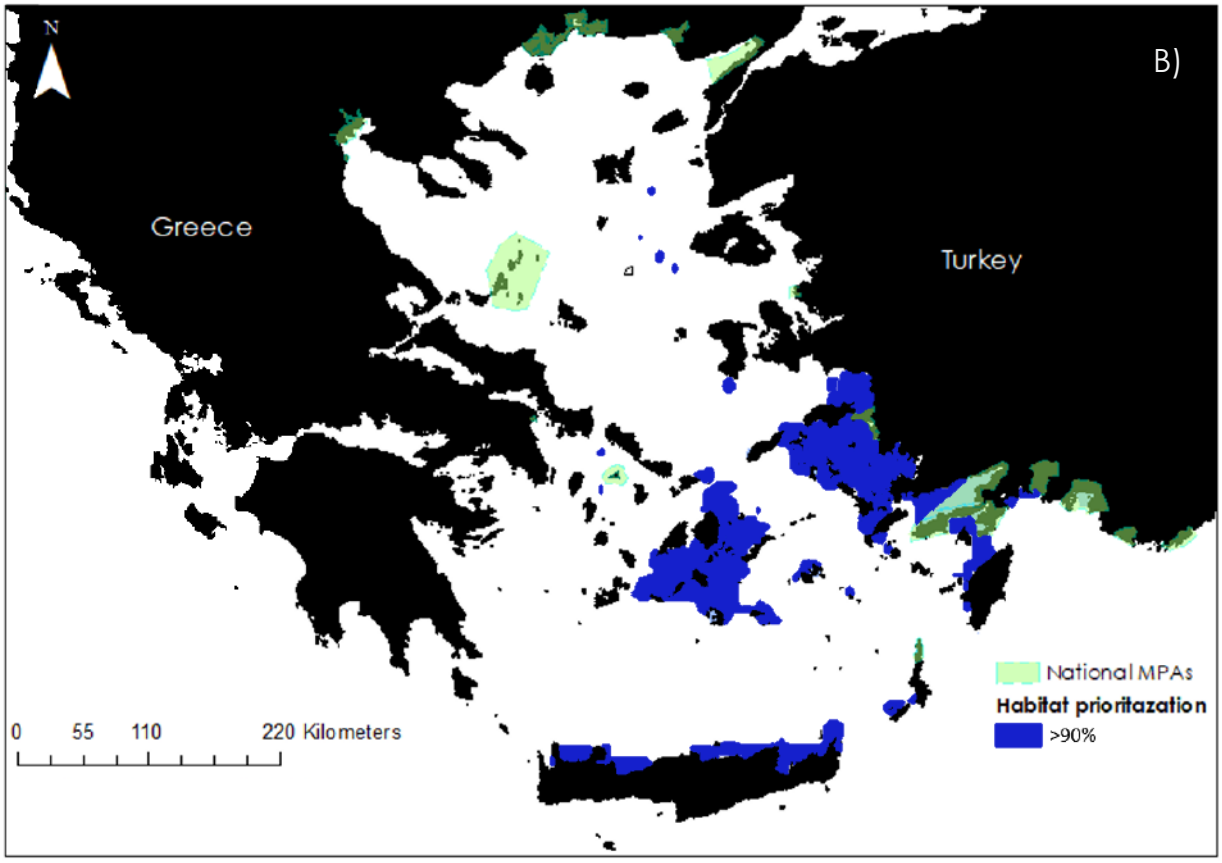


Figure 2: A) The prioritization map for the three angel shark species. High priority areas are indicated in dark blue and low priority areas in light blue. B) The map presents the critical areas (in blue) that ranked more than 90% in priority, overplayed with existing MPAs (in light green).

Legislation in force



	Sawback Angelshark *Squatina aculeata*	Smoothback Angelshark *Squatina oculata*	Angelshark *Squatina squatina*
Regulation (EU) 2015/2102	✓	✓	✓
Regulation (EU) 2019/1241			✓
Recommendation GFCM/36/2012/3, amended to Recommendation GFCM/42/2018/2	✓	✓	✓
Appendix I and II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS)[2]			✓
Appendix III of the Bern Convention - Convention on the Conservation of European Wildlife and Natural Habitats[3]			✓

In addition to the legislation mentioned above, the Action Plan for the Conservation of Cartilaginous Fishes (Chondrichthyans) in the Mediterranean Sea provides a framework for species conservation and habitat protection. The success of this Action Plan requires increasing cooperation between different jurisdictions and sectors at national, regional and international levels.

Since Greece is an EU Member State, it must enforce both Regulation (EU) 2015/2102 (for all three species) and Regulation (EU) 2019/1241 (for S. squatina). Additionally, the country is required to monitor all three angel shark species based on the Commission Delegated Decision (EU) 2019/910. Lastly, it is important to mention that **presently there is no action plan for the conservation of elasmobranchs in Greece.**

[2] Parties that are a Range State to a migratory species listed in Appendix I shall endeavour to strictly protect them by: prohibiting the taking of such species, with very restricted scope for exceptions; conserving and where appropriate restoring their habitats; preventing, removing or mitigating obstacles to their migration and controlling other factors that might endanger them.
[3] Appendix III – Protected fauna species

Future steps

Based on our findings we present the following recommendations to improve angel shark conservation in the Aegean Sea.

- Strengthen the enforcement of Regulation (EU) 2015/2102 and Recommendation GFCM/42/2018/2.

- Improve species identification through dedicated training for the monitoring authorities.

- Increase the landings resolution for facilitating compliance with the EU regulation.

- Engagement of the national data collection framework (DCF) to improve data quality and availability regarding angel sharks.

- Minimize illegal fishing and selling of angel sharks through engagement with the fishing community.

- Strengthen citizen science networks, for providing more records of the three species, to complement the national monitoring systems.

It is important to note that the current analysis shows low overlap between Greece's established marine protected areas and the distribution of the species. Thus, an increase in the existing MPA network, so as to include areas important for angel sharks, could be discussed.

Credits

We would like to offer our sincere thanks to Marc Dando, the wildlife and scientific illustrator, who contributed with the wonderful angel shark illustrations as well as to Luis Miguel Estevez for the angel shark photos. For the two historic records the credits belong to Mike Koubaros, Old Mykonos and Elounda Traditional Fishing Trips.

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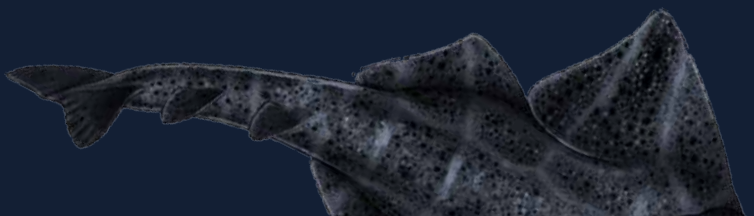

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