CRITICAL HABITATS FOR ANGEL SHARKS IN CYPRUS

THESSALONIKI, 2025

REFERENCE

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SPECIES DISTRIBUTION MODELLING

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SPATIAL PRIORITIZATION

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REALISTIC SPECIES ILLUSTRATIONS

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GLOSSARY/ACRONYMS

ABF: Additive-Benefit Function

ASCN: Angel Shark Conservation Network

AUC: Area Under the Curve

BLP: Boundary Length Penalty

Bycatch: is the part of the catch that is unintentionally captured during a fishing operation in addition to the target species. It may refer to the catch of other commercial species that are landed, commercial species that cannot be landed, and non-commercial species.

CBI: Continuous Boyce Index

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

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

COP: Conference of the Parties

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

EBSA: Ecologically or Biologically Significant Marine Areas.

EEZ: Exclusive Economic Zone

Elasmobranchs: Sharks, rays and skates

EU: European Union

FRA: Fisheries Restricted Area

GFCM: General Fisheries Commission for the Mediterranean

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GLOSSARY/ACRONYMS

ISRA: Important Shark and Ray Area

IUCN: International Union for Conservation of Nature

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 and threats to inform conservation actions

KBA: Key Biodiversity Area

Local Ecological Knowledge (LEK): the knowledge that is relevant to the ecology that is acquired through personal observations and interactions with local ecosystems, and shared with local stakeholders.

MAPAMED: MArine Protected Areas in the MEDiterranean

MPA: Marine Protected Area

RAP: Regional Action Plan

SCP: Systematic Conservation Planning

SDM: Species Distribution Modelling

SPAMI: Specially Protected Areas of Mediterranean Importance

SubRAP: Sub-Regional Action Plan

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

SYMBOLS

Conservation Status according to the IUCN Red List of Threatened Species

CR	EN	VU	NT	LC	DD	NE
CRITICALLY ENDANGERED	ENDANGERED	VULNE RABLE	NEAR THREATEND	LEAST CONCERN	DATA DEFICIENT	NOT EVALUATED

Protection status

"This symbol indicates that the species is strictly protected species. These species must not be caught, retained on board, transshipped, landed, or sold. In case of accidental capture, they must be released immediately without causing any harm to the individuals."

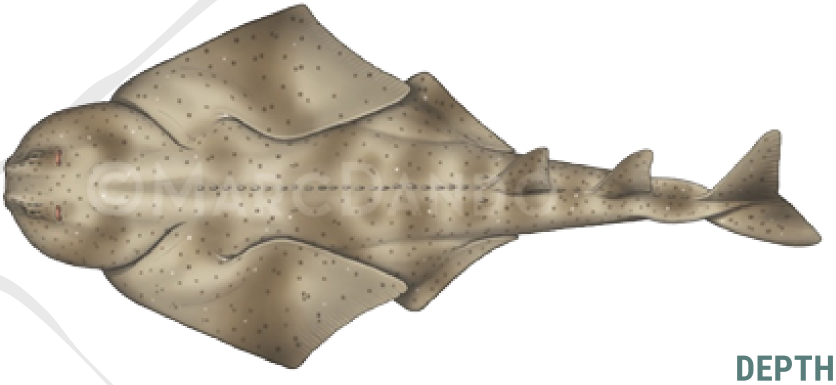
ANGEL SHARKS IN THE WORLD

Angel sharks are flat and large-bodied coastal sharks. Throughout the globe, there are 24 species of angel sharks, all belonging to one genus (Squatina) (Weigmann et al., 2023). Due to their unique life history traits, such as slow growth, late maturity, and low reproductive rates, angel sharks are especially susceptible to population declines, primarily driven by human activities like overfishing and habitat degradation. For this reason, they face a high risk of extinction with 13 of the 24 species classified as threatened on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (8 Critically Endangered, 4 Endangered, 1 Vulnerable) (Lawson et al. 2020; Dulvy et al. 2014; Gordon 2022).

ANGEL SHARKS IN THE MEDITERRANEAN SEA AND CYPRUS

In the Mediterranean Sea, three species of angel sharks are present, with overlapping ranges: the Sawback Angelshark *Squatina aculeata* Cuvier, 1829, the Smoothback Angelshark *S. oculata* Bonaparte, 1840, and the Angelshark *S. squatina* (Linnaeus, 1758). All three species are classified as Critically Endangered by the IUCN (Ferretti et al., 2016a,b; Soldo and Bariche, 2016), indicating they face a high risk of extinction. The presence of all three species has recently been confirmed in Cyprus, highlighting the area's importance to angel sharks. It is important to focus the research efforts on better understanding important areas for angel sharks; ensuring their protection and the effective management of all three species (Giovos et al. 2021; Gordon et al. 2017).

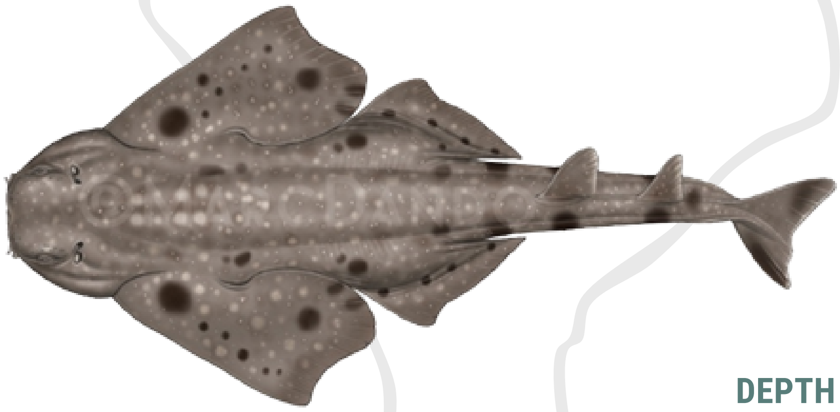
Sawback Angelshark (*Squatina aculeata*)



CR

DEPTH RANGE 30-500 m.

Smoothback Angelshark (*Squatina oculata*)



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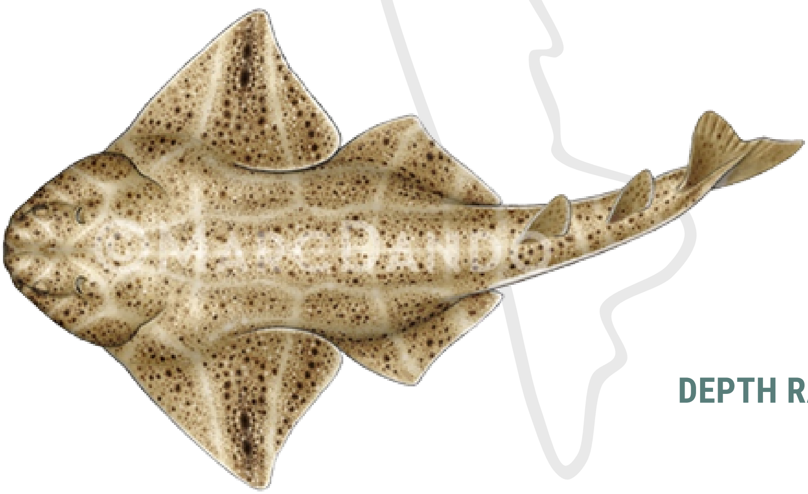
DEPTH RANGE 20-500 m.

Angelshark (*Squatina squatina*)



CR

DEPTH RANGE 0-150 m.

MEDITERRANEAN ANGEL SHARKS: SUBREGIONAL ACTION PLAN (SUBRAP)

The Eastern Atlantic and Mediterranean Angel Shark Conservation Strategy was developed by the Angel Shark Conservation Network (ASCN) and published in 2017 (Gordon et al., 2017). The Mediterranean Sea was identified as a priority region, and the following priorities were outlined: 1) enhance understanding of species distribution, 2) quantify incidental catch, and 3) enforce existing management measures. In this context, the Mediterranean Angel Sharks: Regional Action Plan (MedRAP) was published in 2019, with the vision of restoring Mediterranean angel sharks to robust populations, able to fulfil their ecological roles in a healthy ecosystem (Gordon et al., 2019). As an Annex to the MedRAP, a SubRegional Action Plan (SubRAP) was produced for Cyprus in 2021 (Giovos et al., 2021(b); Bengil et al., 2021). The Cypriot SubRAP boundaries align with the General Fisheries Commission for the Mediterranean Sea (GFCM) Geographic Subarea (GSA) 25, which as a result has been identified as a priority region for angel sharks, given the occurrence of all three species of *Squatina* known in the Mediterranean. Within the Cyprus SubRAP, three goals are set:

GOAL 1 | **GOAL 2** | **GOAL 3**

GOAL 1: Fisheries-based angel shark mortality is minimised

GOAL 2: Angel shark habitat is identified and protected

GOAL 3: National legislation for angel sharks is established, implemented and enforced

EXISTING AND COMPLETED REGIONAL PROJECTS AND INITIATIVES

Key projects already established in GSA 25 are the following:

1. **Mediterranean Elasmobranchs Citizen Observations, M.E.C.O** – as part of the broader Mediterranean initiative, sightings data are collected and shared between a network of organisations to better understand the occurrence, seasonality, and distribution of elasmobranchs in the region. The project in Cyprus is coordinated by Marine and Environmental Research Lab together with iSea.

2. **LIFE PROMETHEUS (LIFE23 NAT/IT/101148295 LIFE PROMETHEUS)** – as part of a wider European project involving Italy, Spain, France, Cyprus, and Greece, the project aims to improve the conservation of different elasmobranch species classified as Critically Endangered and Endangered by the IUCN Red List. This will be achieved by reducing their bycatch and promoting regulated tourism in their aggregation sites. Moreover, the project will act on some Invasive Alien Species by promoting their sustainable fishery as an alternative to elasmobranch fisheries, thus mitigating their impact.

3. **The Cyprus Bycatch Project** (Birdlife International, Birdlife Cyprus, Enalia Physis Environmental Research Centre (Enalia Physis), Society for the Protection of Turtles (SPOT)) assessed and monitored the issue of fisheries bycatch in Cyprus. Observers and collaborating fishers collected species data through onboard observations, at-port questionnaires, and fishers' logbooks. Through data collection and workshop outputs, mitigation measures were examined, focusing on advocating for and implementing practice changes and updating national legislation and conservation areas.

EXISTING AND COMPLETED REGIONAL PROJECTS AND INITIATIVES

4

Cyprus Elasmobranch Research and Conservation Network (CERECON) (Enalia Physis and SPOT) aimed to understand better the diversity and ecology of threatened and data-deficient elasmobranchs in Cyprus to manage populations better. Angel sharks encountered through targeted and casual observations were measured, analysed, and sampled for genetic testing with the objective of feeding additional knowledge into bycatch management plans and proposing conservation measures.

5

The Angel Shark Conservation Network (ASCN) represents a community working to protect angel sharks better. The Angel Shark Sightings Map is an interactive tool developed by the ASCN to collect and visualise public reports of angel shark encounters. It allows divers, fishers, and coastal communities to contribute sightings data, which helps researchers track the distribution and abundance of angel sharks. This information is critical for identifying key habitats, monitoring population trends, and guiding conservation efforts. The map also raises awareness about the presence of angel sharks in specific regions, encouraging public involvement in their protection.

6

Cyprus Work Plans for Data Collection in the fisheries and aquaculture sectors, based on Data Collection Framework (DCF) Regulation (EU) 2017/1004. Data Collection under EU Regulations is performed since 2005 by the Department of Fisheries and Marine Research (DFMR), with the current Work Plan covering the period 2025-2027. The work plans include, among other activities, the collection of data on incidental catches of vulnerable species from onboard and onshore observations, which are transmitted to the relevant Regional Fisheries Management Organisations (RFMOs), advisory bodies, and other end users. Annual reports are produced on the implementation of the Data Collection Framework, and are available at the following webpage: https://dcf.ec.europa.eu/wps-and-ars/annual-reports_en.

EXISTING AND COMPLETED REGIONAL PROJECTS AND INITIATIVES

7

CIESM SHARKnowledge initiative. This participatory science project is being conducted in Algeria, Cyprus, Egypt, Italy, Libya, Tunisia, and Türkiye, where national experts engage local fishers through structured interviews and sightings mapping according to a Local Ecological Knowledge (LEK) approach. Data are being collected in 2025 and will be used to reconstruct historical trends, identify critical habitats (hotspots, nurseries), and assess the perceptions and socio-economic impact of sharks in coastal communities, including Angel Sharks. The DFMR is responsible for the implementation of this project in Cyprus.

SPECIES MANAGEMENT

All three *Squatina* species are protected in the Mediterranean under the binding Recommendation GFCM/42/2018/2 (amending GFCM/36/2012/3) adopted by the 23 Parties to the GFCM. This Recommendation prohibits the retention and sale of elasmobranchs listed in Annex II of the Barcelona Convention.

The European Union (EU) transposed the provisions of GFCM Recommendation into EU Regulation (EU) 2023/2124), thereby as an EU Member State, this regulation is applicable through Cyprus. Also, *S. squatina* is a Prohibited species under the Technical Measure, Regulation (EU) 2019/1241, which applies to the EU fleet in the Mediterranean and third-country vessels fishing in Union waters.

Squatina squatina is also listed in Appendix I and II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS), Annex 1 of the CMS Sharks Memorandum of Understanding for the Conservation of Migratory Sharks (CMS Sharks MOU) and Appendix III of the Bern Convention, Convention of the European Wildlife and Natural Habitat.

FIND THE REPORT

THE GOAL OF THIS WORK

This study aims to explore and deliver the most comprehensive and accurate information on the spatial distribution of the three species of angel sharks in Cyprus, located in the Eastern Mediterranean. The application of ecological modelling and spatial prioritisation will allow us to provide science-based recommendations to policymakers to improve their spatial conservation in Cyprus.

SPECIES DISTRIBUTION MODELLING (SDM)

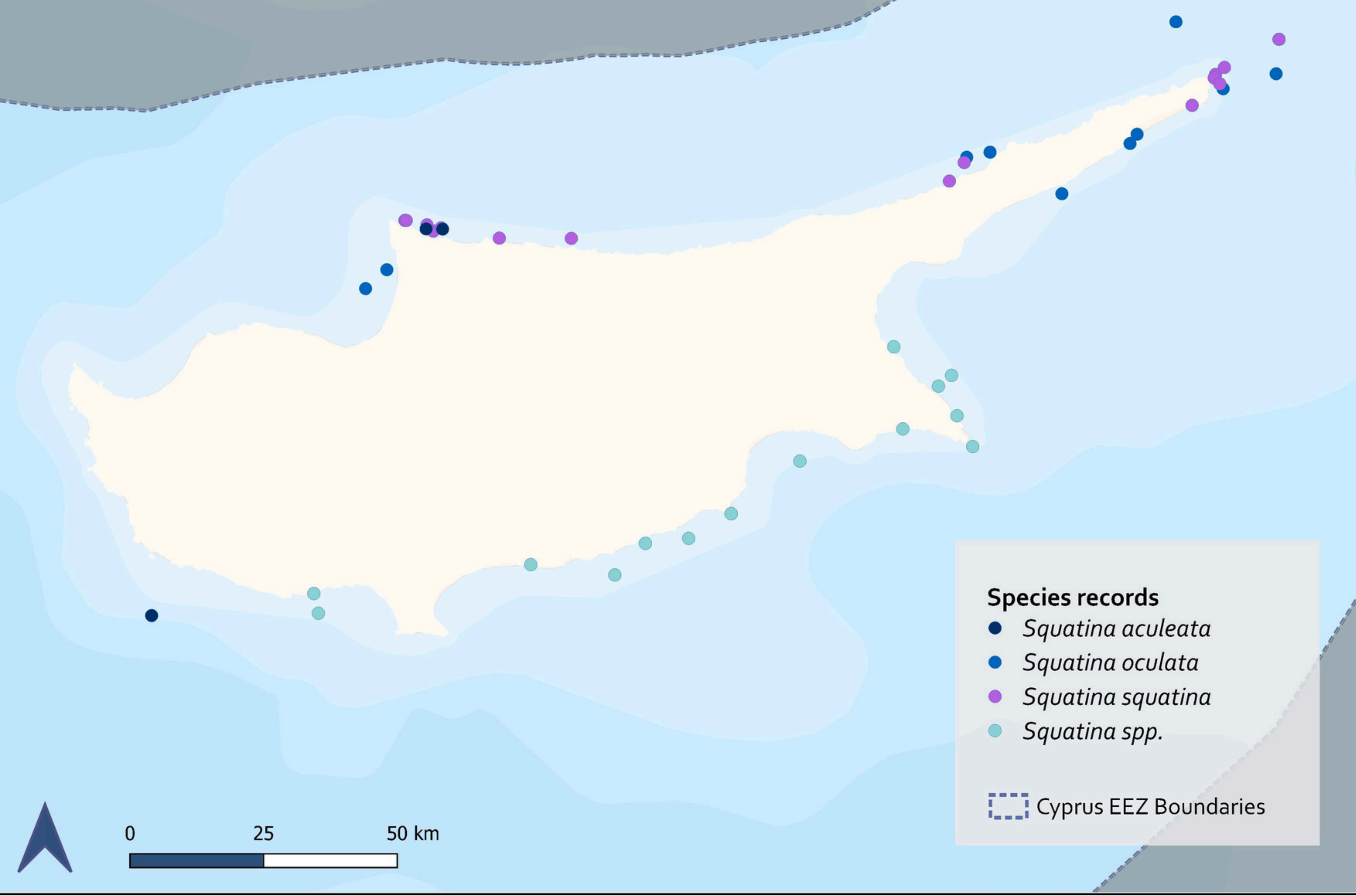
Within the SubRAP for Cyprus, Goal 2 focuses on the identification and protection of angel shark habitats. From this perspective, Species Distribution Modelling (SDM) was developed to spatially predict suitable areas for the species of the genus *Squatina*, based on available spatial data and carefully selected environmental data. The results of the SDM were utilised in the Zonation software within the methodological framework of Systematic Conservation Planning (SCP) to identify areas of high conservation value for these species.

Occurrence data and SDM setup

The SDM setup followed the methodology presented by Giovos et al., 2022. All available records (N = 50) from the existing literature and the aforementioned projects were collected (Figure 1). This is the most exhaustive collection of observations of the species in the area (Appendix 1). The available dataset consisted of historical records (2 records), as well as of more recent records spanning from 2000 to present. It also included Local Ecological Knowledge reports and instances where the animals were caught as bycatch, as detailed in Appendix 1.

The distribution of occurrence records across the project area was uneven. Additionally, not all species had a sufficient number of records (Table 1) to be included in the SDM methodological framework, since the analysis requires a minimum of 10 records per species for a full analysis and at least five records for exploratory analysis (van Proosdij et al., 2016; Støa et al., 2019). The limited sample size also impacts the model evaluation, as it restricts the number of data points available for critical validation steps (Gaul et al., 2020; Collart & Guisan, 2023). To ensure data quality, pre-processing included occurrence records verification, data cleaning (e.g. removal of duplicate coordinates), and clarification of the species considered for analysis (Table 1).

Figure 1: Records of angel sharks in Cyprus.



The final selection of records utilized for the analysis included most of the existing records (N = 44), while the analysis separately for *Squatina aculeata* was impossible due to the restricted number of records (3). Given the low number of species-specific records, we also applied a model at the level of genus, pooling all the available data (N=44, Squatina aculeata included) to provide a more comprehensive perspective of their total distribution in Cypriot waters.

Table 1: The number of species records after the preprocessing used in the analysis

	Number of records	SDM
Squatina aculeata	3	No
Squatina oculata	11	Yes
Squatina squatina	16	Yes
Squatina spp.	14	Yes
Squatina Genus	44	Yes

For the SDM workflow, the Wallace R package (Kass et al., 2023) was selected as a transparent methodological approach, with the MaxEnt algorithm being efficiently tuned, utilising several pre-processing settings essential for high-quality modelling of small sample datasets (Wisz et al., 2008). The Jackknife approach (n-1), a non-spatial partitioning method for modelling, was explicitly implemented due to the limited number of occurrences (Shcheglovitova and Anderson, 2013).

Environmental predictors

As environmental predictors, two EMODnet factor layers of 1/16 arcmin resolution were selected, which is approximately 95 meters in Cyprus:

- the EMODnet Bathymetry DTM (EMODnet, 2022);
- the EMODnet Seabed Habitats, the broad-scale seabed habitat map for Europe (EUSeaMap) (EMODnet, 2023).

The selection of environmental predictors was based on methodologies described in Barket et al. (2022) and Bisch (2020).

Evaluation criteria

The Area Under the Curve (AUC) was used to evaluate model performance, as it provides a robust metric even with small sample sizes (Shcheglovitova and Anderson 2013). The Continuous Boyce Index (CBI) metric was also investigated for model selection. It is defined as the Spearman rank correlation between the observed proportion of presences in each prediction class and the expected proportion of predictions, based on the proportion of the landscape in each class. The index ranges from -1 to 1. Values > 0 indicate that the model's output positively correlates with the true probability of presence. Values < 0 indicate it negatively correlates with the true probability of presence (CBI, Boyce et al., 2002). For the modelled species, Table 2 provides an overview of the model performance based on the modelling metrics of Area Under the Curve (AUC) and Continuous Boyce Index (CBI).

Table 2: Model performance based on the modelling metrics of Area Under the Curve (AUC) and Continuous Boyce Index (CBI).

	auc.val.avg	cbi.val.avg
Squatina oculata	0.89	0.36
Squatina squatina	0.97	0.47
***Squatina* spp.**	0.95	0.56
***Squatina* Genus**	0.96	0.68

For all models, the mean depth is the most impactful predictor, with the habitats playing a minor, non-significant role. As depicted in all maps of Figure 2, the high probability of the species occurrence in the shallow continental shelf waters overlaps spatially with the records used. The probability is much higher in the coastal zone than in deeper waters. Furthermore, it is noticed that the fragmentation among habitat types has resulted in the creation of several fragmented shapes of different probabilities of occurrence along the study area.

Mean AUC value for the validation part (auc.val.avg) was around 0.92 for all species, which is considered good, while the mean Continuous Boyce Index (cbi.val.avg) was around 0.63, which is also considered good.

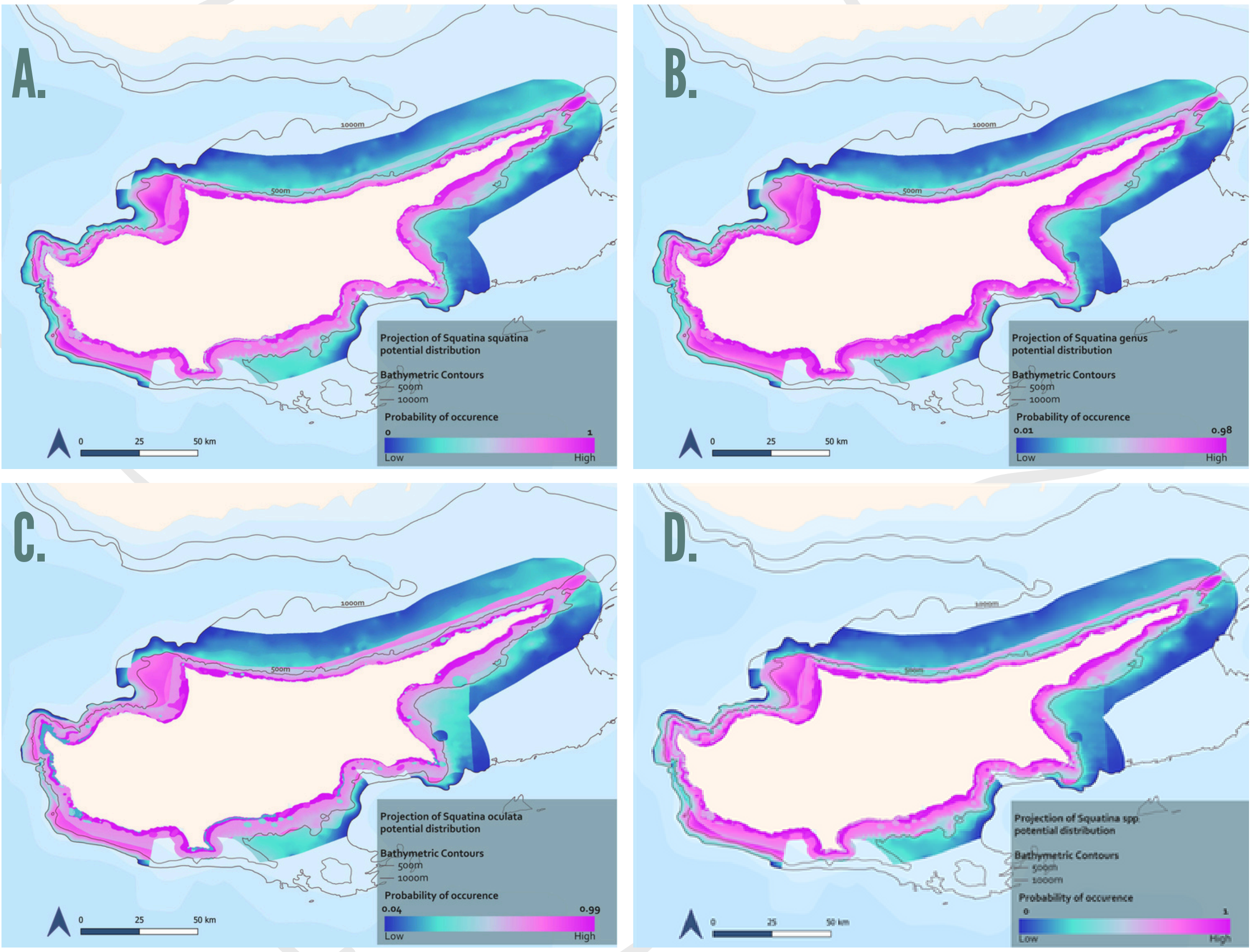


Figure 2: Projections of Potential Distribution Maps based on the probability of occurrence for A. *Squatina oculata*, B. *Squatina squatina*, C. *Squatina* genus, D. *Squatina* spp. Higher-quality images of the maps can be found in the Appendix.

SPATIAL PRIORITISATION ANALYSIS

As Zonation software offers the possibility of synthesising different biodiversity features (Moilanen et al., 2014), the potential distributions in the present for multiple angel shark species based on the available data were selected as biodiversity features, as they emerged from a previous stage of the analysis.

In more detail, the layers for *Squatina squatina* and *Squatina oculata*, as well as the one derived from the presence records of individuals identified at the genus level (*Squatina* spp.), were included. Since the potential distribution of *Squatina aculeata* was not predicted due to the low number of presence records, it was not included in the spatial prioritisation analysis. Initially, the layers were adjusted to the exact spatial resolution in QGIS and then included in the zonation setup without assigning different weights to each layer.

More specifically, the zonation algorithm generates a prioritisation ranking of the landscape through iterative cycles of cell comparison according to the features they include, which results in their removal (e.g., species habitat presence, habitat type, etc.). The goal of each removal cycle is to minimise the loss of conservation value, removing cells with lower values first and retaining the most important ones until the end. The removal process is guided by a selected cell-removal rule, which, in this case, is the "Additive-Benefit Function (ABF)". The ABF rule prioritizes cells with many biodiversity characters. At the same time, it accounts for the complementarity of the biodiversity features across the landscape, ensuring the representation of all of them in the final solution (Moilanen et al., 2014).

"Boundary Length Penalty (BLP)" was chosen as the aggregation method applied to the cell removal rule to ensure the desired landscape connectivity through the spatial coherence of high-priority areas. Although BLP does not reflect the real fragmentation of the landscape, it is widely used to achieve coherent solutions (Moilanen and Wintle, 2007). Numerous simulations were performed using different values of the BLP: 0.1, 0.2, 0.3, 0.5. The warp factor defines the number of cells that are removed by the cell removal rule at each iteration. Due to the choice of BLP as the aggregation method, the analysis warp factor was set to 1, as proposed in the bibliography, while a low value leads to a finer solution (Moilanen et al., 2014).

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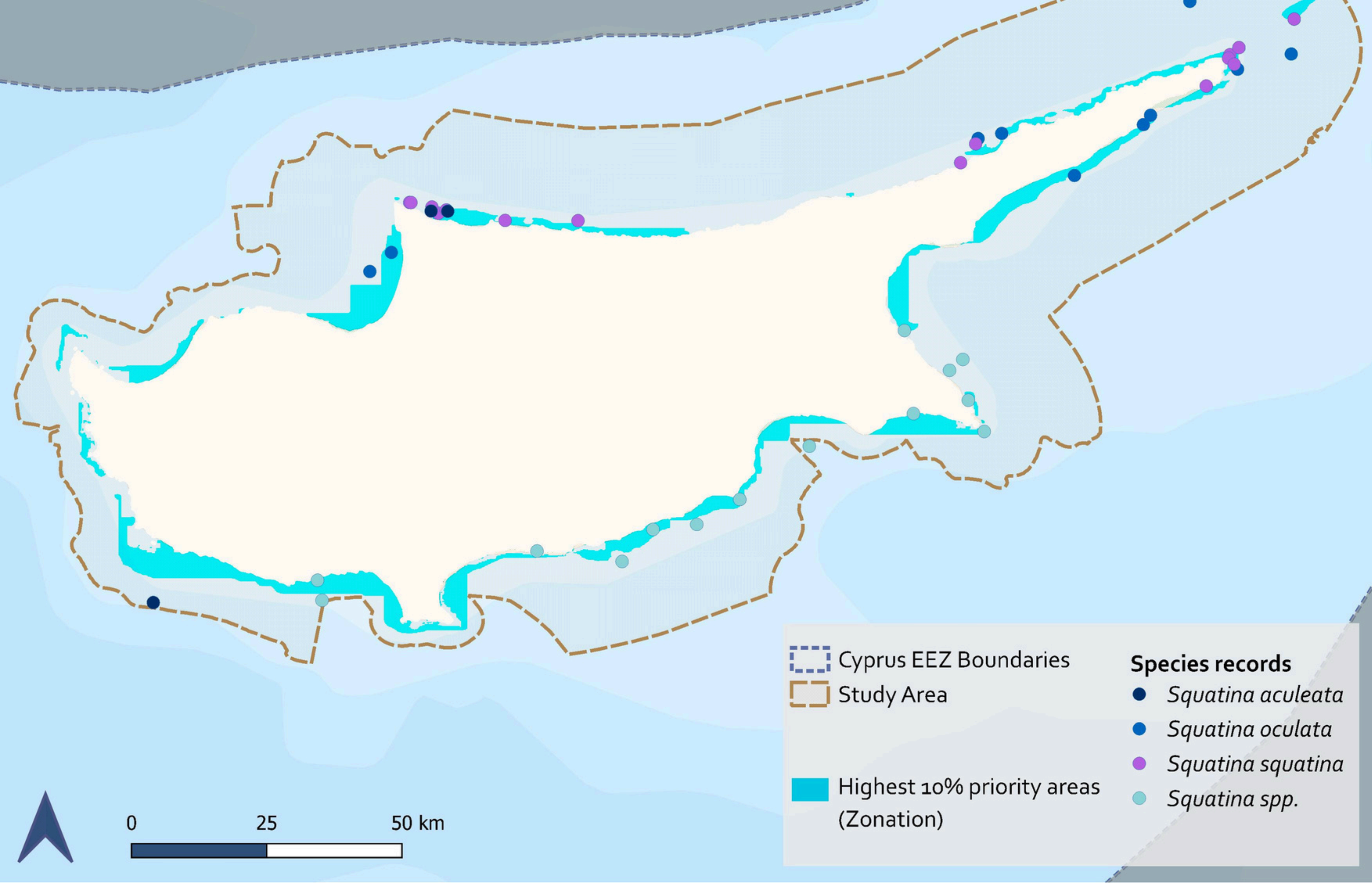

Figure 3: The highest 10% fraction defining top priority areas for angel sharks in Cyprus based on the SDM applied in the context of this work.

FINDINGS

Angel Sharks are among the most threatened marine species in the Mediterranean, and their survival hinges on law enforcement and precise, science-based conservation strategies. In the Mediterranean, the coastal waters of Cyprus have recently emerged as critical areas for these species and as one of the last refuges where all three species are present (Giovos et al., 2021a), underscoring the need for targeted conservation efforts. Several interconnected approaches, including SDM adaptive management practices, legislative analysis and development, and collaborative initiatives, can provide a robust framework for safeguarding angel sharks in the region. A preliminary analysis of the prioritization for angel sharks reveals that the coastal areas of Cyprus are key to conservation efforts (Figure 3). However, it is imperative to recognise that these findings serve as preliminary guiding principles and that further systematic data collection is urgently needed, including in deeper areas, to provide a more targeted prioritisation of conservation areas.

Although fisheries legislation and its enforcement are imperative for the protection of these species, fisheries legislation could be effectively bolstered by spatial conservation measures, including spatiotemporal fisheries restrictions, environmental legislation and specifically the creation of MPAs. In the Kunming-Montreal Global Biodiversity Framework context, establishing an effectively managed MPA network by 2030 and protecting 30% of the oceans (the 30x30 initiative) is a significant tool for marine conservation, particularly for angel shark conservation. This approach is highlighted in the Mediterranean Regional Action Plan (RAP) for the three species (GOAL 2 - Angel shark habitat is identified and protected) (Gordon et al., 2019) but also in the SubRegional Action Plan for GSA 25 (Cyprus) (GOAL 2 - Angel shark habitat is identified and protected) (Giovos et al., 2021b). Angel sharks are heavily overlooked when creating MPAs or other unofficial delineations like the Key Biodiversity or Ecologically and Biologically Important Areas. Therefore, tools like the SDM are pivotal. An additional tool available in the Mediterranean are the Important Shark and Ray Areas (ISRAs), which are based on scientific evidence combined with expert knowledge to identify key areas for sharks and rays.

Following the framework of Systematic Conservation Planning (SCP) to highlight areas of conservation value

The methodological framework of Systematic Conservation Planning (SCP) by incorporating SDM projections as inputs, serves as the most integrated approach for targeting areas of high conservation value. By analysing environmental and spatial data, using the most updated dataset of angel shark observations in Cyprus, SDM allowed the identification of potential suitable areas for angel shark species, despite the limitations of available data and restricted knowledge.

Also, this approach provided a better understanding Cyprus's potential as a critical area for angel sharks. The coastal regions of Cyprus were prioritised through the spatial analysis, indicating their importance for the conservation of angel sharks, while potentially shedding light on the past distribution of angel sharks in Cyprus and all the Mediterranean. These waters could serve as potential strongholds for the species, laying the foundation for the conservation of their populations. The significance of this study is further amplified by its status as the first of its kind for Cyprus, where limited available information regarding the species' ecology and habitat preferences necessitates innovative approaches to conservation planning.

Still, the available data were insufficient to understand differences among the projections of the potential distributions of the species and not enough to produce results for *Squatina aculeata*, which was only recently reported again after almost 50 years. Data collection efforts must continue to inform and improve the model, designing an adaptive modelling framework that will enable us to better understand the distribution differences between species, as well as to more precisely investigate top-priority areas.

Until more data are available, we suggest the following:

1. Further research is required to understand the overlap between the prioritised areas and the Marine Protected Areas network in Cyprus.
2. Continue training primarily small-scale fishers on species identification, safe handling and releasing
3. The preliminary findings of this work must be taken into account on the next expansion of MPAs in Cyprus.

Given the preliminary nature of these results, ongoing research aimed at their validation and refinement is imperative. Rigorous field studies, developed SDMs, and more comprehensive spatial prioritization analyses will provide a more holistic understanding of habitat preferences and threats, enabling the development of effective, evidence-based conservation strategies.

Fostering Collaborative Conservation Efforts

Collaborative initiatives integrating scientific research, citizen science programs, and policy development are essential for addressing the multifaceted threats to angel sharks. Citizen science holds promise for augmenting data collection efforts, empowering local communities, and fostering public engagement. The dataset used in the SDM primarily results from citizen science initiatives and Local Ecological Knowledge (LEK) surveys from fishers. These two sources can provide significant data, especially for scarce species like angel sharks (Giovos et al., 2019).

In addition, angel shark conservation requires a concerted effort across local, national, and international levels. Towards this direction, the data of this work were included in the Mediterranean analysis ''Advice for Spatial Management of Angel Sharks in the Mediterranean Sea'', a guidance document for the CMS Parties that are Range States to angel sharks in the Mediterranean Sea and participate in the implementation of the CMS SSAP Angelshark Med.

Additionally, the Angel Shark Conservation Network (ASCN) has collaborated with several partners to ensure the most accurate interpretation of results and alignment with global efforts. Moreover, government representatives and national experts were involved to validate the findings. We further suggest that local authorities actively engage and participate in the implementation of the CMS SSAP Angelshark Med, which will ensure alignment with the global community working actively on angel shark conservation.

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APPENDIX

Appendix 1: Reports of angel sharks in Cyprus collected from all sources and used in the context of this work.

#	Species	Date of sighting	No Individuals	Source	Type of report
1	*Squatina aculeata*	04/01/2018-19/06/2023	1	SPOT (O'Keefe et al. (2023))	Bycatch
2	*Squatina aculeata*	04/01/2018-19/06/2023	1	SPOT (O'Keefe et al. (2023))	Bycatch
3	*Squatina oculata*	04/01/2018-19/06/2023	1	SPOT (O'Keefe et al. (2023))	Bycatch
4	*Squatina oculata*	04/01/2018-19/06/2023	1	SPOT (O'Keefe et al. (2023))	Bycatch
5	*Squatina oculata*	04/01/2018-19/06/2023	1	SPOT (O'Keefe et al. (2023))	Bycatch
6	*Squatina squatina*	04/01/2018-19/06/2023	1	SPOT (O'Keefe et al. (2023))	Bycatch
7	*Squatina squatina*	04/01/2018-19/06/2023	1	SPOT (O'Keefe et al. (2023))	Bycatch
8	*Squatina squatina*	04/01/2018-19/06/2023	1	SPOT (O'Keefe et al. (2023))	Bycatch
9	*Squatina squatina*	04/01/2018-19/06/2023	1	SPOT (O'Keefe et al. (2023))	Bycatch
10	*Squatina squatina*	04/01/2018-19/06/2023	1	SPOT (O'Keefe et al. (2023))	Bycatch

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Appendix 1: The reports of angel sharks in Cyprus collected from all sources and used in the context of this work.

#	Species	Date of sighting	No Individuals	Source	Type of report
11	*Squatina squatina*	04/01/2018-19/06/2023	1	SPOT (O'Keefe et al. (2023))	Bycatch
12	*Squatina aculeata*	02/10/2020	1	The M.E.C.O Project	Bycatch
13	*Squatina* spp.	22/06/2000	1	The M.E.C.O Project	Bycatch
14	*Squatina* spp.	40 years ago	1	Enalia Physis	LEK
15	*Squatina* spp.	2019	1	Enalia Physis	LEK
16	*Squatina* spp.	10 years ago	1	Enalia Physis	LEK
17	*Squatina* spp.	2017	1	Enalia Physis	LEK
18	*Squatina* spp.	2014	1	Enalia Physis	LEK
19	*Squatina* spp.	2005	1	Enalia Physis	LEK
20	*Squatina* spp.	2000	1	Enalia Physis	LEK
21	*Squatina* spp.	2015	1	Enalia Physis	LEK
22	*Squatina* spp.	2015	1	Enalia Physis	LEK
23	*Squatina* spp.	2015	1	Enalia Physis	LEK
24	*Squatina* spp.	2013	1	Enalia Physis	LEK
25	*Squatina* spp.	2019	1	Enalia Physis	LEK
26	*Squatina* spp.	2014	1	Enalia Physis	LEK

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Appendix 1: The reports of angel sharks in Cyprus collected from all sources and used in the context of this work.

#	Species	Date of sighting	No Individuals	Source	Type of report
27	*Squatina oculata*	27/03/2023	1	SPOT	Bycatch
28	*Squatina squatina*	27/04/2023	1	SPOT	Bycatch
29	*Squatina oculata*	29/04/2023	1	SPOT	Bycatch
30	*Squatina squatina*	30/04/2023	1	SPOT	Bycatch
31	*Squatina squatina*	01/05/2023	1	SPOT	Bycatch
32	*Squatina squatina*	03/05/2023	1	SPOT	Bycatch
33	*Squatina squatina*	15/05/2023	1	SPOT	Bycatch
34	*Squatina oculata*	09/05/2023	1	SPOT	Bycatch
35	*Squatina oculata*	15/05/2023	1	SPOT	Bycatch
36	*Squatina squatina*	16/05/2023	1	SPOT	Bycatch
37	*Squatina squatina*	04/06/2022	1	SPOT	Bycatch
38	*Squatina aculeata*	03/06/2022	1	SPOT	Bycatch
39	*Squatina squatina*	03/06/2022	1	SPOT	Bycatch
40	*Squatina squatina*	27/05/2022	1	SPOT	Bycatch

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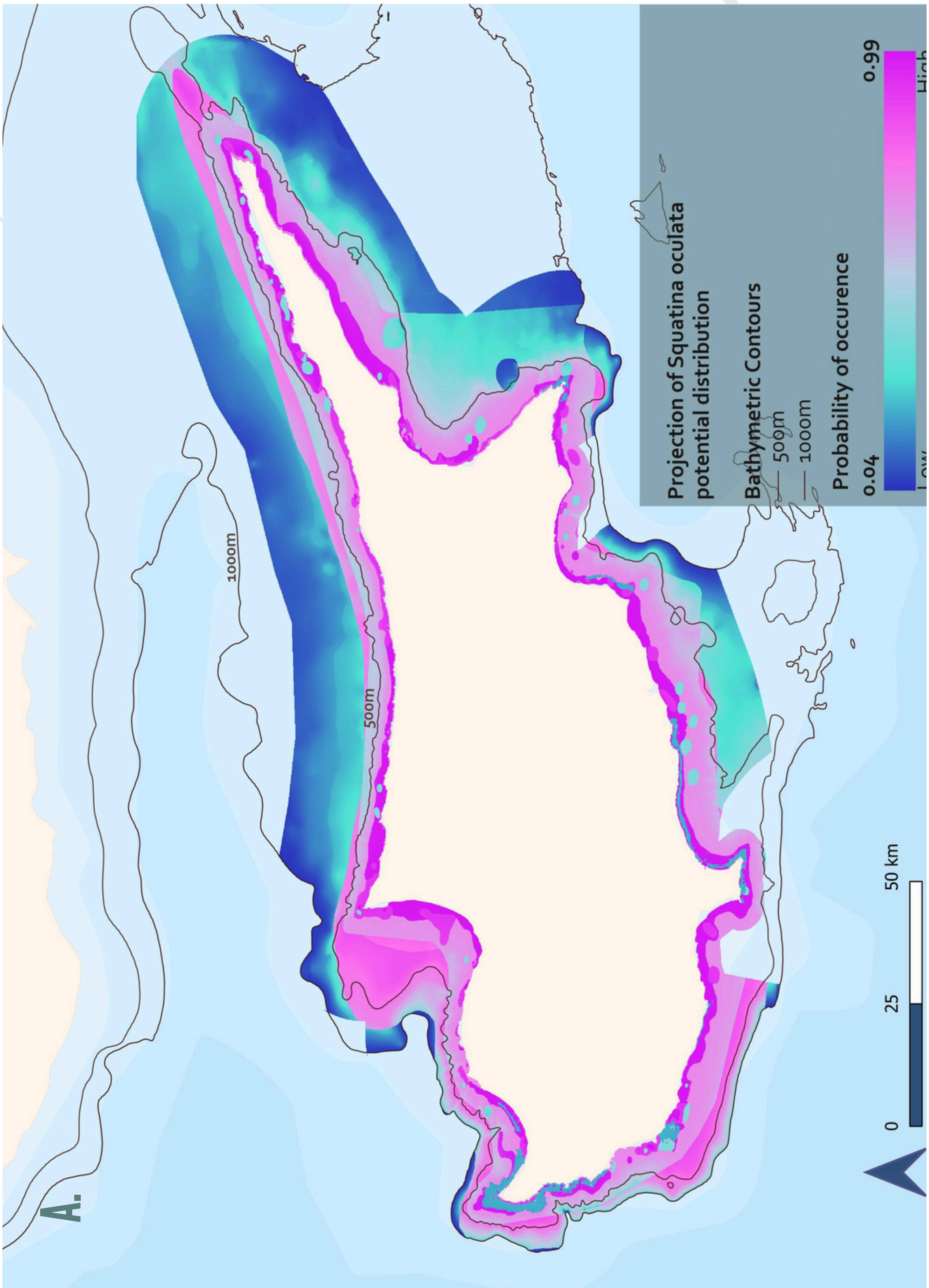
Appendix 1: The reports of angel sharks in Cyprus collected from all sources and used in the context of this work.

#	Species	Date of sighting	No Individuals	Source	Type of report
41	*Squatina squatina*	28/04/2022	1	SPOT	Bycatch
42	*Squatina squatina*	27/04/2022	1	SPOT	Bycatch
43	*Squatina oculata*	24/04/2022	1	SPOT	Bycatch
44	*Squatina oculata*	13/05/2020	1	SPOT	Bycatch
45	*Squatina oculata*	22/03/2019	1	SPOT	Bycatch
46	*Squatina squatina*	20/02/2018	1	SPOT	Bycatch
47	*Squatina* spp.	09/05/2018	1	Giovos et al., 2019	Bycatch
48	*Squatina oculata*	-	1	Gordon et al., 2019	Bycatch
49	*Squatina squatina*	24/06/2022	1	DFMR (Cyprus EU DCF Work Plan)	Bycatch
50	*Squatina squatina*	28/11/2024	1	DFMR (Cyprus EU DCF Work Plan)	Bycatch

APPENDIX

Appendix 2: Higher quality projections of Potential Distribution Maps based on the probability of occurrence for A. *Squatina oculata*, B. *Squatina squatina,* C. *Squatina* genus, D. *Squatina* spp.



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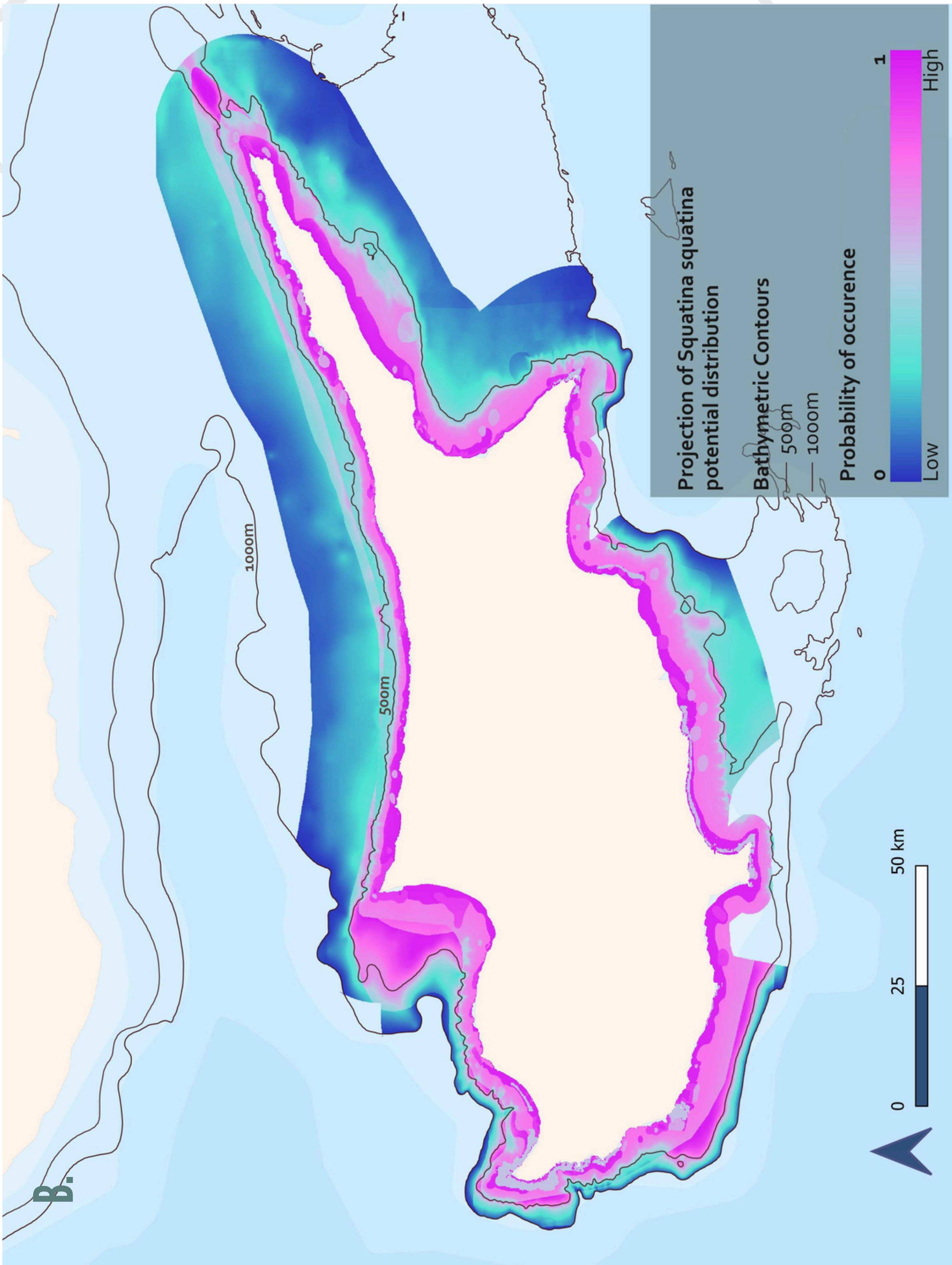
Appendix 2: Higher quality projections of Potential Distribution Maps based on the probability of occurrence for A. *Squatina oculata*, B. *Squatina squatina,* C. *Squatina* genus, D. *Squatina* spp.



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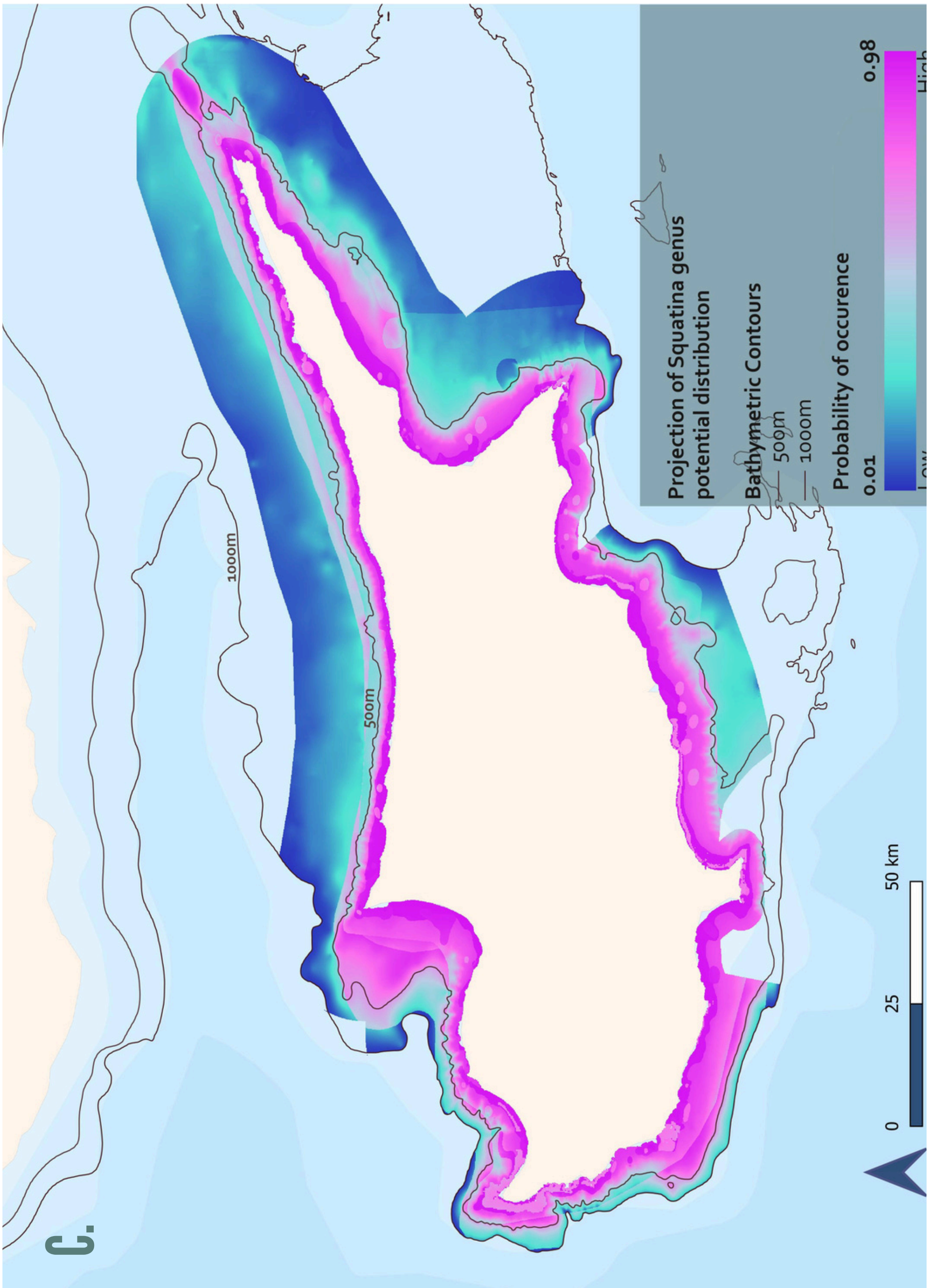
Appendix 2: Higher quality projections of Potential Distribution Maps based on the probability of occurrence for A. *Squatina oculata*, B. *Squatina squatina,* C. *Squatina* genus, D. *Squatina* spp.



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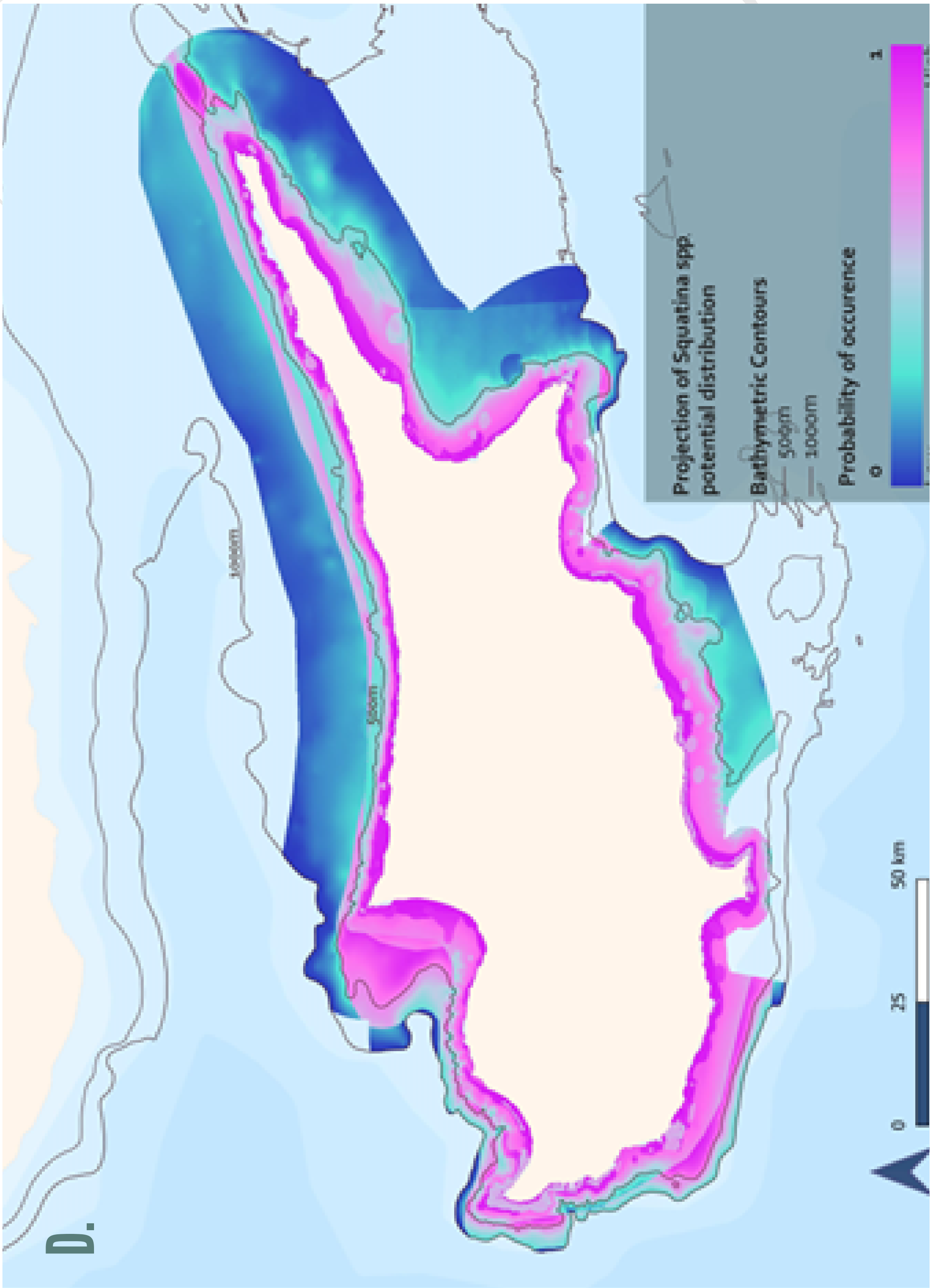

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