Supplementary Data

Mediterranean Marine Science
Indexed in WoS (Web of Science, ISI Thomson) and SCOPUS
www.hcmr.gr
DOI: https://doi.org/10.12681/mms.43060

Updated distribution mapping of *Posidonia oceanica* meadows, coralligenous assemblages and marine caves in the Mediterranean Sea: implications for conservation and restoration

Vasilis GEROVASILEIOU, Antonio SÁNCHEZ-ESPINOSA, David RODRÍGUEZ-RODRÍGUEZ, Simonetta FRASCHETTI, Inés MAZARRASA, Cyrine BOUAFIF, Atef OUERGHI and Dania ABDUL MALAK

Mediterranean Marine Science, 27 (1) 2026

Annex 1

Initial habitat data provided by SPA/RAC

Common information

Digital data

• Official country boundary layer
• GIS layers of distribution of Mediterranean seagrass species (Magnoliophyta) in 9 countries: Croatia, France, Greece, Italy, Malta, Monaco, Slovenia, Spain and Türkiye.

Non digital data

• PDF (UNEP/MED Decision and scientific article) and Excel versions of the Updated Classification of Benthic Marine Habitat Types for the Mediterranean Region.
• Collection contains various project reports in the database of the Ministry of Economy and Sustainable Development that include data on marine benthic habitats in Croatia.

Habitat 1: *Posidonia oceanica* meadows

Digital data

• GIS layers of known distribution of *P. oceanica* in 14 Mediterranean countries, including Albania, Algeria, Croatia, Cyprus, France, Greece, Italy, Libya, Malta, Monaco, Slovenia, Spain, Tunisia and Türkiye.
• Detailed data for six Spanish provinces.
• GIS layers of distribution of Mediterranean seagrass species (Magnoliophyta) in 9 countries: Croatia, France, Greece, Italy, Malta, Monaco, Slovenia, Spain and Türkiye.
• *P. oceanica* GIS distribution layer for different regions of Italy.
• *P. oceanica* GIS distribution layer in Croatia.

Non digital data

• Excel database of scientific references on *P. oceanica* in the Mediterranean Sea (N=136).
• PDF report on the legal analysis on protection of *P. oceanica* meadows in the Mediterranean Sea.
• PDF report on state of knowledge on the geographical distribution of marine Magnoliophyta meadows in the Mediterranean (ENG & FR).
• PDF scientific article on seagrass meadows in the Bay of Boka Kotorska (Croatian).

Habitat 2: Coralligenous assemblages

Digital data

• Coralligenous GIS distribution layer in the Mediterranean Sea
• Coralligenous GIS distribution layer (Italy)
• Coralligenous GIS distribution layer (Croatia)

Non digital data

• UNEP/MED report on State of knowledge of the geographical distribution of the coralligenous and other calcareous bio-concretions in the Mediterranean.
• UNEP/MED report on Synthesis of the cartographic information on the coralligenous assemblages and other biogenic calcareous formations in the Mediterranean Sea.

Habitat 3: Marine caves

Digital data

• Habitat distribution maps provided by Italy in the IV National Report (2013-2018).

Non digital data

• No data were provided for marine caves

Annex 2: Data Review Form

		Data source					Spatial and time scales						Technical quality				Data validity (ecological quality)		Data habitat nomenclature		Data IMAP relevance		Data limitations	Overall review	
Topic	Dataset	Source	Data provider	URL	Data availability	Comments	Format	Spatial features	Spatial coverage	Resolution / Scale	Temporal coverage	Temporal resolution	Data Lineage	Methodology link	Technical quality	Technical comments	Ecological quality	Ecological comments	Habitat nomenclature (SPA/RAC UNEP-MAP)	Nomenclature comments	IMAP relevant	IMAP comments	Gaps/Issues	Overall data assessment	Overall assessment comments

General information:

- **Topic:** topic of the data, habitats or type of content with which it is related. Possible values are: *Posidonia*, Coralligenous, Marine caves or Common Data (related to more than one habitat). This field is merely a filter to organize the data easily.
- **Dataset:** dataset name.
- **Source:** source of the data. Where the files are hosted/available, not who has generated them (this is related to methodological information). In many cases it is the same.
- **Data provider:** organization (and person, if known) providing the data.
- **URL:** link to the online source to obtain the data.
- **Data availability:** data availability situation (public data, on demand, for sale, etc.).
- **Comments:** short description of the dataset and its content.

Spatial and time scales:

- **Format:** data format (vector, raster, tabular, gridded, etc.).
- **Spatial features:** spatial elements contained in the data (polygons, lines, points or pixels).
- **Spatial coverage:** geographic coverage of the data (e.g., World, Europe, Mediterranean, etc.).
- **Resolution/Scale:** spatial resolution (e.g., meters or kilometres) or scale. If no numerical scale is available, descriptors can be used (e.g., national, regional, local, site).
- **Temporal coverage:** reference data of the dataset (e.g., year). If it differs from the year of publication, please specify. Sometimes the year of publication and the time frame covered by the data are different.
- **Temporal resolution:** period in which new data is received or updates are made (e.g., 5-years-basis, annual, monthly, etc.).

Technical quality:

- **Data Lineage:** how data was produced in a few words (e.g., model based, *in situ* data, remote sensing based data, etc.).
- **Methodology link:** link to methodology or technical report. Any source containing more information about how the data was produced.
- **Technical quality:** assessment on the technical quality based on a thorough review of the methodological documentation available (e.g., High, Medium, Low).
- **Technical comments:** comments on the previous assessment value. Information on the methodology or any technical issues could be included here to justify the technical quality assessment.

Data validity (ecological quality):

- **Ecological quality:** assessment on the ecological quality (e.g., High, Medium, Low). Define if the data is useful from an ecological point of view.
- **Ecological comments:** comments on the assessment value. Why the data is valid/relevant or not.

Data habitat nomenclature:

- **Habitat nomenclature (SPA/RAC UNEP-MAP):** whether or not data uses a nomenclature system compatible with the "List of Marine Habitat Types for the Selection of Sites to be Included in the National Inventories of Natural Sites of Conservation Interest in the Mediterranean" or if data nomenclature could be translated easily to meet these criteria.
- **Nomenclature comments:** comments on the nomenclature system, how it could be translated and potential limitations.

Data IMAP relevance:

- **IMAP relevant:** whether or not data can support the IMAP and its purposes.
- **IMAP comments:** comments on the IMAP relevance.

Data limitations:

- **Gaps/Issues:** comments on limitations of the dataset to be used in the assessment. Any problem, data or methodology gap (e.g., low spatial resolution, high uncertainty, outdated, etc.). Issues related to no data are highlighted here, especially in those cases where the non-data cannot be defined as absence of habitat but unknown, being data that can underestimate their extension.

Overall review:

- **Overall data assessment:** overall data assessment based on all the previous information (High, Medium, Low). This field summarizes whether or not the data is useful in some way for the habitat mapping.
- **Overall assessment comments:** comments on the overall data assessment.

Annex 3: Introductory letter template

Dear Sir / Madam,

SPA/RAC is engaged in a study on the "Elaboration of the Mediterranean distribution Maps of *Posidonia* Meadows, coralligenous assemblages and marine caves habitats" as also foreseen in PoW 2020-2021 (Activity 3.2.1.2.b). The objective is to provide the CPs with distribution Maps of *Posidonia* Meadows, coralligenous assemblages and marine caves habitats as provided for in the Work programme and timetable for the period 2012-2017 of the Action Plan for the conservation of marine vegetation in the Mediterranean Sea, Action Plan for the conservation of the coralligenous and other calcareous bio-concretions in the Mediterranean Sea and Action Plan for the conservation of habitats and species associated with seamounts, underwater caves and canyons, aphotic hard beds and chemo-synthetic phenomena in the Mediterranean Sea.

The present study is part of the Regional Project "Empowering the legacy: Scaling up co-managed and financially sustainable No-Take Zones/Marine Protected Areas" (NTZ/MPA Project). This project is coordinated by WWF, carried out by 8 direct partners (including WWF): Association de Gestion Intégrée des Ressources (AGIR), BlueSeeds/ Vertigo Lab, Hellenic Centre for Marine Research (HCMR), Low Impact Fishers of Europe (LIFE), Network of Marine Protected Areas Managers in the Mediterranean (MedPAN), Notre Grand Bleu (NGB), and Specially Protected Areas Regional Activity Centre (SPA/RAC), and financially supported by the MAVA Foundation.

The overall objective of the project is to support the creation of new no-take zones (NTZs) and deliver a set of solutions to improve the management and governance of existing NTZs and marine protected areas (MPAs). Each pilot site will showcase specific approaches and tools to address recurrent issues in terms of governance, design, financing, and enforcement and enable inspiration and potential replication.

SPA/RAC is supported in this habitat mapping study by the European Topic Centre of the University of Malaga (ETC-UMA), which will deal with habitat data collection and analysis. The study aims at producing the most complete, reliable and updated mapping of the distribution of the three habitats across the Mediterranean Sea, which will be made available to the Parties to the Barcelona Convention and the other stakeholders upon completion. Rest assured that no raw data will be shared outside the study team or made publicly available without the prior written consent of data providers. Furthermore, once national habitat distribution maps are produced, they will be shared with each of the Parties for review and validation, prior to their integration in a regional map.

In the framework of the above-mentioned study, *we kindly ask for your collaboration in helping us identify and collect existing digital data on each of the three focal habitats*: 1) *Posidonia* meadows; 2) Coralligenous assemblages; and 3) Marine caves *in your country*.

We would highly appreciate it if you could help us fill a short habitat data collection template for your country/area (provided with this email) **by Wednesday 23rd of February**.

Please provide data-metadata in any GIS supported format when possible. However, if reliable, updated information exists in other digital formats (e.g., pdf, Word, Excel -with coordinates-, etc.), kindly provide them too. The ETC-UMA will work to digitise them to a usable GIS format when feasible.

Please do not hesitate to get back to us for any needed clarification.

Looking forward to hearing from you soon.

Sincerely,
XXXX

Contact:
Person (email; phone number)

Annex 4: Data Collection Template

	Data source			Spatial and time scales						Data limitations	
Dataset name	**Source**	**URL**	**Short description**	**Format**	**Spatial coverage**	**Resolution / Scale**	**Date**	**Methodology link**	**Technical comments**	**No data interpretation**	**Gaps/Issues**
Name of the dataset	*Source*	*Link to online source if available*	*A brief description of the dataset and the information it contains*	Raster, vector, table, etc	*Global, European, National, etc.*	*Resolution in any geographical or GIS unit*	*Date of the dataset*	*Link to online resources with information on the methodology: technical reports, scientific papers, etc.*	*Brief summary of how the data was generated.*	*If possible, specify if no data, including empty areas within the layer coverage, correspond to an actual absence of the habitat/species or a lack of knowledge (e.g. areas not sampled, areas not assessed).* *If there are specific classes or layers that help identify and differentiate these "no data" areas, please specify.*	*Any relevant gap or limitation of the data to take into account.*
EUSeaMap 2021 - Broad-Scale Predictive Habitat Map for Europe	EMODnet	https://www.emodnet-s	Predictive Biological Zone layer produced by EMODnet Seabed Habitats. The extent of the mapped area includes the Mediterranean Sea, Black Sea, Baltic Sea, and areas of the North Eastern Atlantic extending from the Canary Islands in the south to the Barents Sea in the North. The map of biological zone was produced using underlying physical data and thresholds derived from statistical analyses or expert judgement on known conditions.	Vector	European Seas	~ 100 m	2021	eng/catalog.search#/metadata/10d	The map was produced using a "top-down" modelling approach using classified habitat descriptors to determine a final output habitat: Biological zone, Energy class, Oxygen regime, Salinity regime, Seabed substrate and Riverine input	No data correspond to areas outside the spatial coverage of the layer. In the Mediterranean they are true no habitat data. There is an specific "No habitat" class for those areas with a lack of data to classify seabed habitats. Empty areas are outside layer coverage (no knowledge available).	High confidence are mainly located in coastal areas. Model confidence is moderate to low in most areas of the Mediterranean.

Instructions for filling in the Data form *(next sheet)*

This questionnaire aims to **collect data and some metadata on three marine habitats** across the Mediterranean Sea: **Posidonia oceanica meadows**, **Coralligenous assemblages** and **Marine caves**.

Above there is a brief description of the fields and an example based on the EUSeaMap 2021 data available on the EMODnet Seabed Habitat Portal to help you understand the requested information.

In the "Data_review" tab you can enter your answers. Please, in case of including more than one data, use a row for each one. Except for the name, the

Annex 5: Input data used for the aggregation process and the finalmaps

This annex contains the data inventory used in the marine habitat data aggregation process. A unique numerical identifier has been assigned to each dataset. The first table shows the list of Mediterranean countries and unique identifiers. The X marks show those countries where the source provides spatial data that have been used in is study.

The second table shows the list of datasets with its identifier, type of habitat (topic), sources, provider, temporal coverage and link for reference.

Data ID	Country																				
	Albania	*Algeria*	*Bosnia and Herzegovina*	*Croatia*	*Cyprus*	*Egypt*	*France*	*Greece*	*Israel*	*Italy*	*Lebanon*	*Libya*	*Malta*	*Monaco*	*Montenegro*	*Morocco*	*Slovenia*	*Spain*	*Syrian Arab Republic*	*Tunisia*	*Türkiye*
3							X	X		X								X			
7																	X				
14		X					X		X				X					X		X	
15	X	X			X		X			X		X	X	X			X			X	X
16														X							
17	X										X				X					X	
21	X																				
38										X											
52																		X			
53																		X			
54																		X			
58																		X			
59			X			X						X				X					X
60								X													
61										X											
63	X	X		X	X		X	X	X	X	X		X		X	X	X	X		X	X
64							X														
65				X																	
66																					X
68											X										
69											X										
72		X																			
73															X						
74															X						
79										X											
81															X						
83										X											
84										X											
86		X													X	X				X	
87		X			X											X				X	X
88				X																	
89								X													

Common data: related to more than one habitat

Posidonia oceanica data

Coralligenous assemblages

Marine caves

ID	Topic	Dataset	Source	Data provider / Contact person	Temporal coverage	URL
3		**Individual habitat maps from surveys**	EMODnet	EMODnet	Variable	Link
7		**Habitats directive - official 2018 reported distribution grids (*Posidonia* + Reefs + Submarine structures made by leaking gases)**	EMODnet	EMODnet	2013-2018	Link
14		**Synthesis of the cartographic information on the coralligenous assemblages and other biogenic calcareous formations in the Mediterranean Sea**	SPA/RAC	SPA/RAC	1971-2007	-
15		**Mediterranean *Posidonia* Network - Comparative legal analysis on protection of *Posidonia* meadows in the Mediterranean Sea**	Golder Associates S.r.l.; Office Français de la Biodiversité, Ministère de la Mere, République Française	SPA/RAC	1972-2021	-
16		**State of knowledge on the geographical distribution of marine Magnoliophyta meadows in the Mediterranean**	SPA/RAC	SPA/RAC	1951-2008	-
17		**Habiat Maps - MedMPAnet Project**	MedMPAnet Project, SPA/RAC	SPA/RAC	2016-2018	-
21		**Underwater marine habitats mapping of the National Marine Park Karaburun-Sazan (Albania)**	Rhône-Méditerranée-Corse Water Agency and the Conservatoire du littoral ("French public coastal agency") in collaboration with NAPA	SPA/RAC Albania National Focal Poing	2016	-
38		**Marine Habitats Liguria (Atlante Habitat Marini, 2020)**	Regione Liguria	Seascape Ecology Lab DiSTAV (Monica Montefalcone, Alice Oprandi) University of Genoa	2020	-
52		**ATLAS POSIDONIA ISLAS BALEARES. POSIDONIA**	IEDIB	Department of the Environment and Territory (Balearic Government)	2021	-

Continued

ID	Topic	Dataset	Source	Data provider / Contact person	Temporal coverage	URL
53		**Compendium of information on the location of seagrass surfaces (marine phanerogams) on the coast of Andalusia (Spain)**	Ministry of Agriculture, Livestock, Fishing and Sustainable Development (Andalusian Government)	AMAyA (Andalusian Environment and Water Agency)	2014, 2019 and 2020	-
54		**Seagrass meadows from Catalunya, Spain**	Departamento de Acción Climática, Alimentación y Agenda Rutal, Generalitat de Catalunya, Gencat	Departamento de Acción Climática, Alimentación y Agenda Rutal, Generalitat de Catalunya, Gencat	2020	-
58		***Posidonia oceanica* distribution along the coast of Murcia and Comunidad Valenciana**	Atlas de las praderas marinas de España	Instituto Español de Oceanografía (IEO)	2015	Link
59		**Distribution of marine caves, coralligenous formations and *Posidonia oceanica* meadows in the Mediterranean Sea**	Giakoumi S, Sini M, Gerovasileiou V, Mazor T, Beher J, Possingham HP, *et al.* (2013) Ecoregion-Based Conservation Planning in the Mediterranean: Dealing with Large-Scale Heterogeneity. PLoS ONE 8(10): e76449.	Sylvaine Giakoumi, Maria Sini, Vasilis Gerovasileiou and co-authors	2013	Link
60		**Distribution of seagrass beds, rhodolith beds and coralligenous formations, marine caves and other habitats in the Aegean Sea**	Sini M, Katsanevakis S, Koukourouvli N, Gerovasileiou V, Dailianis T, *et al.* (2017) Assembling Ecological Pieces to Reconstruct the Conservation Puzzle of the Aegean Sea. Front. Mar. Sci. 4:347.	Maria Sini, Stelios Katsanevakis, Vasilis Gerovasileiou and co-authors	2017	Link
61		**Marine caves of Italy**	Cicogna, F., Bianchi, C.N., Ferrari, G. & Forti, P. (eds) 2003. Le Grotte Marine: Cinquant'Anni di Ricerca in Italia. Rome: Ministero dell'Ambiente e della Tutela del Territorio.	Raw data provided to Vasilis Gerovasileiou by Graziano Ferrari – CLEM (Centro Lubrense di Esplorazioni Marine)	2003	-
63		**Mediterranean marine caves dataset**	Data by Vasilis Gerovasileiou	Vasilis Gerovasileiou	2013 data + additions/ corrections in 2022	-
64		**Grottes submergées ou semi-submergées sur le littoral Corse**	CREOCEAN-DREAL (2010) Recensement des grottes submergées ou semi-submergées sur le littoral Corse. Rapport final. 80 p.	Claude Reveret	2010	-
65		**Marine caves of Croatia**	Ministry of Economy and Sustainable Development - Project EU IPA 2007 "Identification and setting-up of the marine part of Natura 2000 network in Croatia" (Thanks to all participants of project workshops that contributed with their knowledge on important marine habitats)	Petra Rodić	2013	-

Continued

ID	Topic	Dataset	Source	Data provider / Contact person	Temporal coverage	URL
66		**Marine caves of Türkiye**	Öztürk, B. (ed.) 2019. Marine Caves of the Eastern Mediterranean Sea. Biodiversity, Threats and Conservation. Istanbul: Turkish Marine Research Foundation (TUDAV) Publication no. 53.	Bayram Öztürk and authors of individual chapters	2019	Link
68		**Marine caves of Lebanon, 2013**	SPA/RAC - UNEP/MAP, 2013. Synthesis report of the ecological characterization of the marine areas of Nakoura, Tyre and Saida in Lebanon. By Ramos-Esplá A.A., Bitar G., El-Shaer H., Forcada A., Limam A., Ocaña O., Sghaier Y.R., and Valle C. Ed. SPA/RAC - MedMPAnet Project, Tunis: 38 p + annexes.	SPA/RAC - UNEP/MAP	2013	Link
69		**Marine caves of Lebanon, 2014**	SPA/RAC - UNEP/MAP, 2014. Ecological characterization of sites of interest for conservation in Lebanon: Enfeh Peninsula, Ras Chekaa cliffs, Raoucheh, Saida, Tyre and Nakoura. By Ramos-Esplá A.A., Bitar G., Khalaf G., El Shaer H., Forcada A., Limam A., Ocaña O., Sghaier Y.R. & Valle C. Ed. SPA/RAC - MedMPAnet Project, Tunis: 146 p + annexes.	SPA/RAC - UNEP/MAP	2014	Link
72		**Marine caves in Île de Rachgoun (Algeria)**	PNUE/PAM-CAR/ASP, 2016. Algérie : Île de Rachgoun. Cartographie des habitats marins clés de Méditerranée et initiation de réseaux de surveillance. Par Ramos Esplá A., Benabdi M., Sghaier Y.R., Forcada Almarcha A., Valle Pérez C. & Ouerghi A. Ed. CAR/ASP - Projet MedKeyHabitats, Tunis : 113 pp + Annexes.	SPA/RAC - UNEP/MAP	2016	Link
73		**Marine caves in Platamuni and Ratac areas (Montenegro)**	Mačić V., 2014. Marine caves in the area of future MPA PLATAMUNI (Montenegrin coast). Stud. Mar. 27(1): 19–30	Vesna Mačić	2014	Link
74		**Marine caves in Platamuni and Ratac areas (Montenegro)**	UNEP/MAP-SPA/RAC, 2016. Montenegro: Platamuni and Ratac areas. Mapping of marine key habitats and initiation of monitoring network. By Torchia G., Pititto F., Rais C., Trainito E., Badalamenti F., Romano C., Amosso C., Bouafif C., Dragan M., Camisassi S., Tronconi D., Macic V., Sghaier Y.R. & Ouerghi A. Ed. SPA/RAC - MedKeyHabitats Project, Tunis: 77 pp + Annexes.	SPA/RAC - UNEP/MAP	2016	Link

Continued

ID	Topic	Dataset	Source	Data provider / Contact person	Temporal coverage	URL
79		**Marine caves Liguria**	Canessa, M., *et al.* Submerged marine caves of Liguria: Updating the knowledge. In: Proceedings of the 1st Mediterranean Symposium on the Conservation of Dark Habitats. Tunis: United Nations Environment Programme/Mediterranean Action Plan (UNEP/MAP)–Regional Activity Centre for Specially Protected Areas (SPA/RAC), 2014. p. 27-32.	Seascape Ecology Lab_DiSTAV (Monica Montefalcone, Alice Oprandi) University of Genoa	2015	-
81		**AMARE Project - Habitat map of project pilot sites (MPAs)**	AMARE Project	AMARE Project	2015 - 2021	-
83		**Habitat data Campania Region - FEAMP ISSPA Project**	FEAMP ISSPA Project	FEAMP	2008, 2020	-
84		**Prampolini *et al.*, 2015. *Benthic Habitat Map of the Southern Adriatic Sea (Mediterranean Sea) from Object-Based Image Analysis of Multi-Source Acoustic Backscatter Data.***	CNR-ISMAR	CNR-ISMAR	2015	Link
86		**MedKeyHabitats Project**	SPA/RAC	SPA/RAC	2013-2016	-
87		**MedKeyHabitats II Project**	SPA/RAC	SPA/RAC	2017-2019	-
88		**Mapping coastal and seabed marine habitats in the Adriatic Sea under national jurisdiction**	Ministry of Economy and Sustainable Development	Petra Rodić	2023	-
89		**Seagrass Meadows in the Greek Seas**	SEANOE	Aimilia Drouga	2022	Link