ABIOMMED - FINAL PROGRESS REPORT

ABIOMMED

SUPPORT COHERENT AND COORDINATED ASSESSMENT OF BIODIVERSITY AND MEASURES ACROSS MEDITERRANEAN FOR THE NEXT 6-YEAR CYCLE OF MSFD IMPLEMENTATION

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ABIOMMED

Coordinator

Dr Kalliopi Pagou

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1st July 2021, 30 months

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SUPPORT COHERENT AND COORDINATED ASSESSMENT OF BIODIVERSITY AND MEASURES ACROSS MEDITERRANEAN FOR THE NEXT 6-YEAR CYCLE OF MSFD IMPLEMENTATION

Final Progress Report

Period: from month 1 to month 30

(01/07/2021 -31/12/2023)

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Project	ABIOMMED
Title	Support Mediterranean Member States towards implementation of the MSFD new GES Decision and programmes of measures and contribute to regional/subregional cooperation
Reference (grant agreement)	**11.0661/2020/839620/SUB/ENV.C2**
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PREFACE

In 2020, the European Commission's Directorate-General for the Environment (DG ENV) issued a call for proposals (DG ENV/MFD 2020) with the purpose to support the preparation of the next 6-year cycle of MSFD implementation through the marine strategies. The focus of proposals was to be on (1) supporting the (sub)regional assessment of the extent to which Good Environmental Status (GES) has been achieved, (2) on supporting the quantification (notably ex-post) of the effect of the Programmes of Measures (PoMs), and (3) on supporting the establishment of new (sub)regionally-coordinated measures.

For the Mediterranean specific thematic priorities were identified: a) Assessment of GES of highly mobile species, b) identification of ecologically relevant assessment scales and broad habitat types for pelagic and benthic habitats, c) support the work on contaminants, d) support he work on TG Litter, e) support TG Noise, f) delivery of Article 8 contributing also to UNEP/MP's QSR 2023, g) support the ex-post assessment of PoMs under UNEP/MAP, h) informing measures to reduce pressures on seafloor habitats.

In response to the call, 13 partners from 6 countries that are Contracting Parties to the Barcelona Convention, as well Plan Blue and SPA/RAC, submitted the ABIOMMED proposal.

The work in ABIOMMED is highly focused on GES of the biodiversity cluster of MSFD Descriptors (D1, D1C6, D6) and evaluating and informing measures.

This is the Final technical progress report presenting in summary the accomplished work and relevant scientific outputs per activity of the ABIOMMED project. Therefore, the main body of text of this report summarizes the initial aims of the project, the process towards delivery of the deliverables, the outcomes and potential next steps. Full technical and scientific details are found in the more than 50 Deliverables and Milestone's reports of the project. Each Activity in this project, has produced its own chapter with these elements, following the structure of the proposal and grant agreement.

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EXECUTIVE SUMMARY

The project was structured in six interconnected Activities:

Activity 1 - Coordination/Management, Dissemination – Engagement of Stakeholders and Competent Authorities (Lead HCMR);

Activity 2 - Pelagic habitat: using the plankton communities to address properly the status of pelagic habitat and relevant pressures (Co-Lead NIB & IOF);

Activity 3 - Towards ecologically-relevant scales and areas for assessment of benthic habitat and effective measures to reduce physical disturbance to the sea-floor in the Mediterranean Sea (Lead: ISPRA);

Activity 4 - Streamlining Descriptor's D1 selected criteria regarding mammals' species groups (small toothed cetaceans, deep diving toothed cetaceans and baleen whales) towards coordinated monitoring and assessment in the Mediterranean (Lead: ACCOBAMS);

Activity 5 - Socio-economic analysis of measures (Lead: Plan Blue);

Activity 6 – Integrating GES biodiversity assessment in a pan-Mediterranean scale (Lead: SPA/RAC).

The project is coordinated by HCMR-IO and the partners are: ISPRA, CNR, CONISMA (Italy), IWRS & NIB (Slovenia), IOF (Croatia), Univ. of Athens-NKUA (Greece), CSIC (Spain), ACCOBAMS, TETHYS, EcoOCEAN, Plan Blue, SPA/RAC, and is supported by UNEP/MAP and other international organisations, EU projects and Mediterranean competent authorities.

The project's Activities progress and achievements can be summarized as follows:

Activity 1 was about the coordination of the project and dissemination of its results, as well the engagement of stakeholders and Competent Authorities (Lead: HCMR).

The administration of the project and the consortium run smoothly and any unforeseen issues were resolved. The Management Office handled routine administrative, financial and reporting matters, communicated with partners on related issues, monitored activities, identified problems and took the necessary corrective actions to resolve them.

At beginning the project was progressing overall at a slower rate than planned. This was due to the fact that the project faced a delay during the first months of its implementation since several partners were involved simultaneously in the MEDREGION final deliverables and reports. However, effort had been devoted by the coordinator and the SC to increase the pace of the project and thus made up for the delays observed and overall, the project progressed well. However, during the course of the project, it became clear that a 6-month extension was required. This was requested and granted by DG ENV. The extension was asked because of: (1) The time line of the project and the main events of the relevant key policy and scientific meetings of the Commission and the RSC – UNEP/MAP, were

out of phase not allowing the desired streamlining and exchange of information, and (2) The "COVID-19" related restrictions for a significant period also caused disruption and delays (till spring 2022) during the first year of the project.

The Kick off, General Assembly & Scientific Workshops and Final Scientific Conference and Final General Assembly as well as Steering Committee meetings have been carried out according to plan, though some meetings were realized online or hybrid.

Engagement of stakeholders and policy makers was achieved through dedicated tasks. The Connection with the MSFD Competent Authorities (CAs) was materialized with the establishment of the Stakeholder, External Experts, Competent Authorities (CAs) of the EU Member States Panel (SHECAP) to ensure that the CAs are involved and consulted throughout the work of the project, so that the projects' results will respond to their needs, will be endorsed by them and are in a format that can directly put into use for the implementation of the MSFD on national and regional/subregional level in the Mediterranean. Although SHECAP meetings were performed at different times than originally foreseen and were merged with relevant workshops and meetings of the other Activities (namely Activities 3, 5 and 6) related to definition and assessment of pressures, setting the GES and appraising POMs they were successful allowing for more targeted workshops with specific audience. The Connectivity Forum consisting of stakeholders, representatives from the relevant projects' external experts from NGOs and other bodies, and non-EU countries with the aim to provide guidance, bring along their experience and convey the messages to their institutions was established at the beginning of the project at M1 and run as scheduled. Stakeholder engagement and participation was also assisted through specific Activity workshops (Activity 3, 5 & 6 stakeholder and Activity 4 technical workshops)

Collaboration with Relevant projects namely HELCOM BLUES, HARMONISE, NEA PANACEA, CETAMBITION, QUITESEAS has been established with their participation and presentations in the KO, GA and final meetings.

Overall, dissemination and communication of project's outcomes have been successful. The web site http://abiommed.eu/ has been operational throughout the project being the main dissemination and communication tool, where all project news, deliverables and products were available for dissemination. Specific pages have been created dedicated to stakeholders and policy makers, eliciting their engagement and disseminating the projects' results. Furthermore, general dissemination actions have been effectively performed, branded dissemination material has been produced and disseminated in various occasions. Also, the project succeeded in communicating and promoting its outcomes to all stakeholders. The dissemination will actions continue after the completion of the project by maintaining the webpage and by publishing scientific papers in journals and conferences.

Within the **Activity 2** the aim was to examine the use of different components of the plankton assemblages (phytoplankton and zooplankton) to assess their biodiversity status, to explore the possibility to set threshold values for those components in relation to ecologically relevant assessment areas, and to improve the coherence of Good Ecological Status (GES) definition for the

EU MSFD next implementation cycle across the Mediterranean. The work under Activity 2 was organized into three tasks, the first two were dedicated to the two main plankton groups, phytoplankton and zooplankton, respectively, while the third served to channel the work into case studies and to provide guidance to direct future efforts to integrate pelagic habitat components into biodiversity descriptor assessment systems not only for Member States but also for non-European countries that are Parties to the Barcelona Convention.

Within Task 2.1, a group of Mediterranean phytoplankton experts was brought together and data availability and comparability were evaluated. The existing approaches for determining phytoplankton status were reviewed and a comparative catalogue of possible phytoplankton indicators with their strengths and weaknesses was created. Based on this, the most suitable phytoplankton indicators for testing in case studies were selected. With the scope of defining relevant assessment scales based on pressures and prevailing natural conditions, a CMEMS product was utilized to analyse the surface distribution of phytoplankton in the Mediterranean Sea. Clustering was applied to identify aggregations for phytoplankton functional types and size classes, revealing ten clusters as the appropriate regionalization, which revealed distinct geographical patterns aligning with trophic conditions in the Mediterranean Sea. Changes in cluster distribution over two decades comprised widening of the most oligotrophic clusters with the dominance of picophytoplankton. These shifts, particularly in the western and northern parts, suggest dynamic spatial and temporal variations influenced by rising sea surface temperatures, possibly linked to climate change and indicating potential shifts in trophic efficiency.

Zooplankton indicators and methodologies for GES assessment of the pelagic habitats across Mediterranean were identified and reviewed within Task 2.2. The work of the group of zooplankton experts, who joined their efforts for the first time at the basin scale, comprised the evaluation of zooplankton data availability and comparability. Relevant zooplankton parameters (biomass, abundance) and zooplankton groups were selected for further work and comparative and extended catalogue of possible zooplankton indicators was compiled with strengths and weaknesses and specific criteria used by each member state in determining GES for criterion D1C6. The work also comprised some preliminary indicators tested in case studies in relation to prevailing natural conditions.

The task 2.3 encompassed extensive work on phytoplankton and zooplankton case studies and collaborative work of plankton experts to foster a more harmonized approach towards defining GES for pelagic habitats in the Mediterranean Sea.

The case studies were conducted based on the findings from Tasks 2.1 and 2.2. First, areas for the testing of assessment tools were selected in different Mediterranean subregions as driven by data availability, but ultimately covering different Mediterranean subregions, namely Adriatic Sea, Eastern Mediterranean with Aegean and Ionian Seas, and Western Mediterranean with Tyrrhenian and Ligurian Seas. In this way, a wide range of prevailing natural conditions were covered. Phytoplankton and zooplankton case studies were designed to cover different aspects of temporal and spatial scales of plankton communities and pelagic habitat in general, so that the trend analyses could be

conducted within long-term perspective or differences on spatial gradients analysed. Several plankton parameters, like abundance, alpha and beta diversity indices were tested in case studies.

The results stressed the considerable fluctuations in diversity of both the phytoplankton and the zooplankton communities, which were more related to the prevailing conditions than to direct anthropogenic influences. Moreover, research evidenced a switch to a more erratic community dynamics in the recent years, probably triggered by climatic and hydrological factors at the mesoscale. For both plankton components, significant differences were observed between areas with different prevailing conditions that could not be linked to anthropogenic influences. In this way, the case study results made clear that the observation and interpretation of trends in plankton diversity dynamics is extremely important to link these changes to large-scale influences related to climate change, which is predicted to have a massive impact on plankton abundance and diversity.

The main results of case studies and outputs were summarized and organized into recommendations to guide future efforts to include pelagic habitat components in MSFD assessment systems. The recommendations include: i) assessment scales should take into account climate regimes and allow tracking of trends possibly with the inclusion of satellite data and modelling products; ii) importance of investigating relevant phytoplankton and zooplankton groups/size classes; iii) integration of long-term ecological research (LTER) data; iv) support a more uniform and consistent sampling frequency; v) consider an alternative, expert-based approach to GES in connection to expert judgment; vi) establish connections to Descriptor 4 and focus on changes in food webs; vii) ensure the continuation of cooperation through a working group of multidisciplinary experts for pelagic habitat. As the final remark, it is necessary to stress that, regardless of the currently insurmountable challenges in defining GES, reference conditions and thresholds, detailed information on the taxonomic analysis of plankton will always be required to correctly interpret the patterns of other variables such as biomass or abundance of plankton components (e.g. phytoplankton and meso-zooplankton) or functional groups on which other indicators may be based.

The main objective of **Activity 3** was to support the national Competent Authorities to set up a consistent approach for the assessment of the status of benthic habitats subjected to human pressures, as well for the establishment of regional measures to protect sea-floor integrity (and its biological component) from physical disturbance, under MFD Descriptor 6 and, consistently with Ecological Objective 6 (IMAP). This work entails working on the scientific development and test of approaches, but also at the interface between science and policy liaising and collaborating with international actors from the national to the sub-regional and regional levels. Activity 3 approached such a goal by bridging MSFD D6 and EO6 framework in the Mediterranean context, thus facilitating exchange and developments across the Common Implementation Strategy (CIS) – e.g. TG SEABED, SPA/RAC (through cooperation with Activity 6) and relevant international bodies including EC, UNEP MAP, GFCM, ICES. The work was directed towards ensuring: i) consistent approaches to habitat and scale definition (Task 3.1), ii) the identification of the main pressures affecting the seabed (Task 3.2) and iii) the informed selection of alternative measures to cope with the main physical pressures on the seafloor (Task 3.3). The hints and lessons learned developed within this process were critically

analyzed, iv) to form a roadmap that will guide future developments and implementations on the topic in the Mediterranean Sea context.

The dynamic development of the technical approach towards D6 at the EU level (e.g. the latest adoption of D6C4 and D6C5 threshold values by TG SEABED and ICES), suggested a certain degree of adaptation of some of the MSs, which achieved within the project. This resulted in an increased effort to participate in the work of *ad hoc* WGs, to promote ABIOMMED approach, tools and outcomes.

Key to this Activity 3 work was the cooperation with Activity 6 and SPA/RAC, and the consultant developing the proposal for EO6 (Mr David Connor). The strategic role played by ABIOMMED scholars facilitated such exchange and the contribution to developing consistent approaches. This was reflected - among others - in the alignment of EO6 proposal with standards developed at EU and Mediterranean levels, and the establishment of an *ad hoc* subgroup dedicated to D6 implementation at the Mediterranean Sea that will work in the next three years in the context of TG SEABED.

In addition, the debate on the appropriateness of some spatial measures to reduce trawling impact was deeply informed by ABIOMMED outcomes and entered into the policy debate between GFCM and its CoPs, including EC.

Standards developed to assess the implication of such alternative measures were also adopted into the ICES context, or used as a reference to compare elaborations that are largely based on approaches developed, so far, in the northern European context.

Activity 3 achievements span from the IMAP proposal for EO6 to identification of data gaps and issues to be solved under TG Seabed capitalizing the ABIOMMED roadmap, as well the outcomes of the other EU funded projects as NEA PANACEA and GES4SEAS and establishing links with TG SEABED and SPA/RAC. Furthermore, is recommended that data at relevant spatial resolution are needed to address seafloor integrity in the Mediterranean Sea and build synergies among policies, frameworks and institutions to efficiently progress in the assessments is needed. Mediterranean-wide data sets on pressures and impacts on habitat condition could be further improved by CoPs/MS contributing to IMAP (and also through links to ETC/ICM). Also, models and scientific frameworks to assess fisheries spatial management scenarios for the seafloor protection have been developed by ABIOMMED and both methods and outcomes have been shared with fisheries institutions and research agencies (GFCM, EC, ICES) with positive feedback. No one-size-fits-all solution is available, but the tools developed by ABIOMMED have been incorporated/informed the scientific assessments at the EU level and the policy debate at GFCM/EC level. The Roadmap developed by ABIOMMED can be used as a reference to guide future technical progress to address seafloor integrity in the Mediterranean Sea.

Activity 4 worked for most of its outcomes within the obligations of legislation such as the MSFD. In the course of MSFD implementation, it was evident that GES for cetaceans could not be adequately assessed and thus is not possible to understand the accurate state of marine environment and consequently, propose and implement appropriate conservation measures.

The current limitations for GES assessment for cetaceans' status stem from several, still present, challenges, such as lack of systematic monitoring, lack of regional cooperation in defining GES assessment elements (e.g. thresholds), lack of standardized approach to GES assessment.

At the same time, certain efforts have been already invested in the GES assessment process, and these positive elements should be taken into account and upgraded in the future, such as undertaking of dedicated basin-wide surveys (ACCOBAMS Survey Initiative), some progress in monitoring of criteria D1C2 (population abundance) and D1C4 (species distributional range and pattern), aggregation of existing complementary large-scale or small-scale datasets collected with the standardized monitoring methods, application of certain assessment techniques, etc.

The ABIOMMED project offers a set of overall recommendations, as a contribution towards improved GES assessment for cetaceans, and ultimately to more effective implementation of the MSFD in the future. The more detailed technical information and recommendations are elaborated in the studies specified under Activity 4 Deliverables.

The target audience for the recommendations are foremostly: European Commission and other EU bodies, intergovernmental organizations (agreements), national and regional authorities, research institutions and other relevant experts.

The Activity 4 related recommendations are about:

Monitoring**: i)** Develop and officially adopt systematic monitoring programmes/protocols for all MSFD GES assessment criteria for cetacean in Mediterranean and Black Sea EU Member States where monitoring programmes are not yet in place. Such programmes should contain information about monitored species, monitoring methods, geographical and temporal scales, data storage and availability, subjects in charge and projection of costs; ii) Monitoring of D1C1 (mortality rate) under Data Collection Framework Regulation (DCF) should be conducted with observation efforts that allow the detection of bycatch of cetacean species. Alternatively, dedicated bycatch studies should be systematically planned. Support of fisheries sector is important in implementation of these monitoring efforts; iii) Establish more systematic monitoring of D1C4, D1C3 and improve monitoring of D1C5 (e.g. look at seasonal changes); iv) Continue to implement, on a regular basis, region-wide dedicated and internationally coordinated surveys as well MSFD national monitoring at sub-regional level having in due regard the synchronization with other relevant Member States; vi) Improve coordination between EU and non-EU countries for the monitoring and data analysis, in terms of synchronization and standard protocols.

GES assessment methodologies: i) Improve regional cooperation to propose and establish thresholds for all D1 cetacean-related criteria; ii) Agree on/identify several basic elements of the GES assessment, notably: a list of species for the Mediterranean region at subregional level, definition of "population/s" or "unit/s to conserve" for each cetacean species and for all criteria, at regional and subregional level, reconsider the assessment scales given in Commission Decision 2017/848, for Descriptor 1 on the basis of new ecological and genetic data, standardize and establish methodological/analytical approach for the assessment and indicators/thresholds, achieve

agreement on “change” in regard to trends, combine assessment results for different MSFD criteria to facilitate interpretation.

Data availability: ensure data is easily accessible and available to download and further use (e.g. EU WISE platform, EIONET, NETCCOBAMS and national databases).
Cooperation with Regional Sea Conventions: to further improve cooperation with relevant regional sea conventions and linkages to their GES assessment processes and monitoring activities which extend beyond the EU, notably EcAp/IMAP process under the Barcelona Convention and ACCOBAMS’s Long-term monitoring programme in the Mediterranean region, as well as the Black Sea Integrated Monitoring and Assessment Programme (BSIMAP) of the Black Sea Commission in the Black Sea region.

In **Activity 5**, the extensive work undertaken by all partners is presented in summary within this final progress report and in details in its specific deliverables, showcasing a comprehensive array of analyses and recommendations vital for shaping marine protection policies in the Mediterranean region. Activity 5 aimed to support the implementation of the MSFD in the Mediterranean region by providing socioeconomic insights into the use and management of marine waters. Aligned with UNEP/MAP-Barcelona Convention and the Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast (IMAP), it focused on quantifying the impact of Measures (PoMs) toward Good Environmental Status (GES) through ex-post analysis. The goal was to assess effectiveness, costs, benefits (including human wellbeing), and conduct multi-criteria analysis. The activity also evaluated the capacity of monitoring systems to indicate the effects, costs, and benefits of measures, emphasizing regional measures under the UNEP/MAP-Barcelona Convention. Stakeholder consultation ensures Mediterranean-wide cooperation.

The main outputs and final results of Activity 6 can summarise as follows:

The work commenced (Task 5.1) with a thorough literature review entitled "Socioeconomic outcomes of the Barcelona Convention and MSFD measures: Compendium of Case Studies." This review synthesized ex post socioeconomic assessments across various scales, elucidating the diverse forms and tools employed in such analyses. Notably, it emphasized the scarcity of these assessments due to resource limitations and prioritization of field applications over monitoring. It highlighted the pressing need for increased support and resources for socioeconomic monitoring and ex post assessment to bridge the knowledge gap. It proposes methodological frameworks for assessing socioeconomic benefits in marine protected areas, addressing crucial knowledge gaps.

Building on the aforementioned review, a second deliverable (Task 5.2) outlined critical recommendations to integrate ex-post socioeconomic analysis into decision-making processes. Leveraging insights from the SHECAP meeting of ABIOMMED, held in Athens on 24-26 October 2022, it underscored the political and institutional importance of such analyses, advocating for explicit inclusion in Good Environmental Status assessments. The report stresses that enhancing institutional arrangements is necessary to support the implementation of ex-post socioeconomic analysis from transversal and vertical perspectives and facilitate efficient action toward understanding the socioeconomic outcomes of marine policies and their integration into adaptive decision-making.

However, enhancing institutional support alone is insufficient; a real increase in resources, particularly in financial terms, is necessary to support robust and comprehensive ex post socioeconomic analysis.

The culmination of these efforts manifested in an original ex-post socioeconomic assessment of measures (Task 5.3). This assessment probes into the benefits, costs, distribution, regional/cross-border aspects, and decision-making utility of implemented measures. It featured the following distinct analyses: 1) A broad, replicable framework applicable across diverse measures and regions, serving as a preliminary assessment tool (Section I); 2) Detailed ex-post case studies from Port-Cros, France, and Palamos, Spain, delving into real-world observations of implemented measures, highlighting strengths, limitations, and resource intensiveness (Section II): The focus of the first case study is the Bagaud Zone for Mooring and Light Equipment (ZMEL) within France's Port-Cros National Park, an area implementing eco-mooring systems to protect the *Posidonia oceanica* seagrass. This initiative, critical for preserving the ecosystem's balance and supporting biodiversity, exemplifies effective measures to maintain the good environmental status of the Mediterranean coastal zone. The second case study encapsulates a comprehensive ex-post socioeconomic evaluation of conservation initiatives centered around Los Palamos City, serving as an illustrative model within the scope of the Barcelona Convention Plans. The Long-Term Management Plan (LTMP) implemented in Los Palamos has effectively curtailed overfishing and fostered sustainable practices across various species. The findings emphasized a significant increase in income per fishing day for fishers and an overall rise in societal benefits post-implementation of biodiversity measures. The evaluation outcomes from Palamós could serve as a catalyst for endorsing the replication or adaptation of the Palamós Management model in other Mediterranean regions facing comparable challenges.

An integral aspect of Activity 6 involved fostering collaborative discussions and enriching preliminary results derived from the initial three tasks through engagement with stakeholders (Task 5.4). Through SHECAP meetings and WG POMESA meetings, during the project, fruitful exchanges allowed to fortify and refine the findings obtained from the preceding tasks by engaging practitioners and stakeholders actively involved in socioeconomic analysis linked to MSFD. Competent authorities' involvement was pivotal in ensuring comprehensive insights and aligning the assessment's outcomes with the regulatory framework and practical implications. The stakeholder dialogues served as a platform for collaboration, allowing diverse perspectives to converge. They facilitated the exchange of ideas, practical experiences, and insights crucial for refining the preliminary results obtained from the first three tasks.

Finally, the collaborative efforts of **Activity 6**, led by SPA/RAC and involving ISPRA, CNR, and Plan Bleu, aimed at seamlessly integrating the assessment of Good Environmental Status (GES) regarding biodiversity on a pan-Mediterranean scale. This initiative aligns with the Ecosystem Approach (EcAp) process and the Integrated Monitoring and Assessment Programme (IMAP) under the Barcelona Convention, capitalizing on collective knowledge from projects like IMAP-MPA, EcAp MED II and III, MEDREGION, and JPI-Ocean action 'Science for GES (S4GES).' The overarching objectives include providing guidance on GES assessment through IMAP application, disseminating knowledge across the Mediterranean, and focusing on benthic habitats and sea floor integrity. The IMAP, grounded in

an ecosystem-based approach, closely aligns with the EU MSFD. Notably, Ecological Objective (EO) 6 on seafloor integrity was absent in the 2017 IMAP proposals; however, substantial progress has been made, during the ABIOMMED project, in developing a proposal for EO6 with GES descriptions, targets, and indicators.

To achieve these objectives, three tasks were executed. Task 6.1 enhanced regional coordination on the assessment of benthic habitats for the 2023 Mediterranean Quality Status Report (MED QSR). Task 6.2 addressed GES assessment elements, including climate change, while Task 6.3 focused on developing indicators for EO6 in synergy with Descriptor 6.

Activity 6 has been marked by significant milestones, with the Meetings of the Online Working Group (OWG) on benthic habitats (Milestone 6.1, January 2022) representing a pivotal step. This meeting illuminated progress in monitoring and assessment scales, criteria, and baseline values for IMAP Common Indicators CI1 and CI2, emphasizing alignment with ABIOMMED project tasks and contributing to the Mediterranean Quality Status Report (2023 MED QSR). Another critical milestone, (MS6.2), involved an OWG meeting in December 2022, witnessing expert discussions on the EO6 proposal, ultimately leading to its finalization and presentation for endorsement by the Barcelona Convention governance meeting, including the EcAp Correspondence Group on Monitoring (CORMON), Biodiversity and Fisheries CORMON meetings, and EcAp coordination group meeting.

The successful synergy and coherence between project activities were evident in the co-organization of M6.5 – Workshop on D6/EO6 assessment in the Mediterranean Sea in November 2023. This event facilitated the development of a shared roadmap for sea floor integrity work in the Mediterranean region, aligning IMAP and MSFD efforts, methodologies, and fostering potential future collaborations.

While Task 6.1 and 6.2 focused on benthic habitats and sea floor integrity, Task 6.2 tackled a broader subject related to GES assessment under IMAP and MSFD. It contributed to the creation of a regional dialogue with scientific communities in the Mediterranean to support a comprehensive assessment of GES, exploring all available datasets with a focus on the effects of climate change and other cumulative pressures. Milestones 6.3 and 6.4, the first and second workshops of GES experts in October 2022 and June 2023 respectively, provided a comprehensive platform for understanding GES within the IMAP context, with discussions ranging from numerical approaches to biodiversity considerations, addressing challenges, and proposing integrated solutions.

Another objective under Task 6.2 was to strengthen knowledge and scientific understanding of crucial aspects connected to GES, considering lessons learned from GES assessment within the Barcelona Convention, MSFD, and other initiatives/projects. In this context, Deliverable 6.2, a report on the state of the art regarding available information on GES and the effects of climate change and other cumulative pressures in the Mediterranean, was elaborated. It identified impediments in GES determination, particularly the impacts of climate change on GES assessment. One of the objectives is to foresee complications that climate change could cause in the way GES is assessed within IMAP and MSFD. Each of the aforementioned milestones and deliverables has woven a narrative of collaborative progress, setting the stage for significant advancements to follow. In particular, further advancements in the trajectory of Activity 6 unfold with continuous work on the proposal of

Ecological Objectives EO4 and EO6 within the Barcelona Convention's new EcAp cycle (2024-2029). This journey aligns seamlessly with UNEP/MAP's Plans of Work for 2024-2025, reflecting a commitment to revising existing ecological objective definitions.

In conclusion, Activity 6 advances the systematic assessment of GES in the Mediterranean, emphasizing collaboration, knowledge sharing, and private sector engagement. The achievements lay a robust foundation for future tasks, contributing to a comprehensive understanding of environmental health in the region.

1 Scope

The ABIOMMED project work plan was in accordance to the 3 main objectives of the DG ENV/MSFD 2020 call and covered the three priorities set for the Mediterranean Sea. Specifically, it addressed the following:

1) Support the (sub)regional assessment of the extent to which GES has been achieved focusing on implementation of the 2017 GES Decision through practical delivery of Article 8 assessments (i.e., defining lists of elements, following specific topics):

- D1: Coordinated (regional) assessments, especially of highly mobile species groups (taking into account their broad distributional range) and of under-reported groups (e.g., cetaceans, sharks and other non-commercial fish species); support when relevant the work of the MSFD Expert Networks (all regions);
- D1C6 and D6: identification of ecologically-relevant scales and areas for assessment of pelagic and benthic (broad) habitat types, taking account of work by TG Seabed, EUSeaMap modelling approaches and Copernicus data (particularly NE Atlantic and Mediterranean).
- Coordination and delivery of Article 8 (sub)regional assessments for specific descriptors, contributing also to UNEP/MAP's QSR 2023 and complementing the EcAp III project for South Mediterranean countries.

2) Support the quantification (notably ex-post) of the effect of the PoMs:

- Support the ex-post assessment of programmes and measures adopted under UNEP/MAP, with a specific focus on their costs and benefits, and on cross-border aspects that involve both the EU context and the third Countries. (Mediterranean Sea)

3) Support the establishment of new (sub)regionally-coordinated measures:

- Support to the development of effective regional measures to reduce the levels of physical disturbance to the sea-floor from fisheries and other relevant activities, taking account of work by TG Seabed (all regions)

The biodiversity elements which the project is focusing are: plankton, benthos and cetaceans.

Regarding case studies, where and when needed, the 3 Adriatic EU MSs (Italy, Slovenia, Croatia) included in the consortium, therefore a core of neighbouring partners, a local cooperation existed and comparisons and consistency were feasible to be made. However, case studies were performed not only n Adriatic Sea but also in Eastern Mediterranean with Aegean and Ionian Seas, and Western Mediterranean with Tyrrhenian and Ligurian Seas.

Concluding, the overall purpose of the ABIOMMED project was to support the competent authorities of the Mediterranean region, as well as UNEP/MAP for a (sub) regional cooperation for the preparation of the next 6-year cycle of MSFD implementation through the marine strategies, by setting up working arrangements, meetings, workshops, experts' platforms and synergies with other projects and initiatives and to ensure feedback from EU or UNEP/MAP relevant working and technical groups.

2 Progress achieved during the reporting period (M1-M30)

Activity 1: Coordination/Management, Dissemination – Engagement of Stakeholders and Competent Authorities

Lead: HCMR

Work completed

Activity 1 had a four-fold focus and scope: administrative and scientific coordination and management of the project, engagement of MSFD Competent Authorities, communication and outreach, as well networking and stakeholder engagement. Therefore, was structured around 4 relevant tasks, as follows:

Task 1.1: Administration

The administration of the project was the responsibility of the coordinator, the project manager and the management office, which comprised the administrative body of the project that: a) monitored the activities and progress of the work to assure the conformity to the Description of Work (DoW)/Inception report with special attention to the timeline and quality of deliverables and b) was responsible for the communication with the Commission on technical, administrative, reporting and financial matters.

Administration of the project and the consortium run smoothly during the whole reporting period of the project (M0 – M30: July 2021 – December 2023). The Coordinator and the Management Office (MO) handled routine administrative matters, communicated with partners on related issues, monitored activities, identified issues and took all necessary corrective actions to resolve them.

The MO being responsible for the financial affairs of the project has received and distributed the Commission funds (pre finance payment 30% and second interim payment 30%).

Within this frame, a Cooperation Agreement has been drafted as requested by the Grant Agreement, based on the DESCA H2020 Consortium Agreement model and the Cooperation Agreements of the other DG ENV funded projects and became in force signed by all partners. It has been in effect since 28/2/22.

General Data Protection Regulation (GDPR) issues have been addressed, Data Protection Officers (DPOs) have been assigned by all partners and GDPR rules are enforced in all related meetings and events (Privacy notice on protection of personal data & Registration Forms).

The 1st progress report for months 1 - 10 (Deliverable D1.3) and the 2nd pre-financing payment request (accompanied with the statement on the use of the previous pre-finance) have been delivered and the received payment has been distributed to the partners. The final Report (D1.4) is this current document. The task associated deliverables (D 1.1 Inception Report (M3)) and Milestones

(MS1.2 - Kick off & 1st SC Meeting, M1; MS1.10 - General Assembly, M12 & Scientific Workshop; and MS1.17 - Final General Assembly & Conference, M23) have being achieved and reported also in the relevant section of this document.

During the course of the project, partners requested budget and administration changes which were forwarded to the Commission for their notification and approval.

Extension

The project's coordinator requested and granted by DG ENV a 6 months extension (starting on 1st July 2023 and ending on 31st December 2023). The main reasons for this prolongation with budget reallocation (but without exceeding the approved budget) and shifting of milestones and deliverable were two:

1) The time line of the project and the main events of the relevant key policy and scientific meetings of the Commission and the RSC – UNEP/MAP e.g. relevant groups established under the auspices of UNEP/MAP and Working Groups and Technical Groups established in the context of the MSFD Common Implementation Strategy, were out of phase not allowing the desired streamlining and exchange of information to and from these key stakeholders and end users and for the representation of the project as originally envisaged in important meetings and workshops organised both by the project or other orgnisations.

2) The COVID-19 situation with the restrictions and remotely working in all countries for a significant period also caused disruption and delays (till spring 2022) during the first year of the project.

By extending the project's duration, ABIOMMED became able to overcome these handicaps and perform better its tasks and deliverable

Task 1.2: Scientific coordination & Governance

Scientific management, including Steering Committee and Advisory Board meetings and the connection with the Commission, progressed according to plan, however some adjustments needed to be made, as described below.

The Kick Off meeting, 1st Steering Committee (SC) and Advisory Board (AB) meetings have been conducted according to plan during the July 2021 General Assembly (M1, detailed description at Milestone MS1.2). The 2nd SC run smoothly too at M7 (see MS1.7), and an ad hoc SC tele-meeting was held in M25 (May 2022) related to the organization of the annual General Assembly and workshops with stakeholders and invited experts. The 3rd and 4th SCs were held as scheduled (MS1.13 on January 2023 M21 and MS1.15a on M27). An extra SC Meeting (MS1.15b on M28) was also held for the organisation of the final events. The General Assembly & Scientific Workshop (MS1.10 at M12) as well as the Final General Assembly & Conference and the Final Connectivity Forum and Final SHECAP (MS1.17 and MS1.18 respectively at M30) were conducted as scheduled.

The project has been connected with the Commission, but not as initially planned. The (pre) Kick off Meeting with the Commission (set at M1) was not held as originally scheduled (see MS1.1). The reason for that was the absence of project's scientific, and there was a delay to the assignment of a

new scientific officer. However, the 'connection' with DG ENV unit C2 has been achieved through the participation of other officials at the KO (MS1.2) or other meetings, until the assignment of Ms Antidormi on October 2021.

Overall, the project has faced a delay at its beginning. This was due mainly to the fact that it started on 1st July 2021, when its predecessor, the MEDREGION project, was still running having 1 month left for its completion and its reporting period still to come. Since the main core of the partners were common and involved in both projects, this overlap period of 3 months (=1 month to project's end and 2 months for reporting) has caused a delay to the ABIOMMED progress during its starting period that is reflected in the delay of management meetings (KO, SC, AB etc.) and the deliverables set at the first months of the project (and the onset of the scientific work). These delays did not affect significantly the overall progress of the project and adjustments were effectuated accordingly.

Finally, also the Deliverable D1.5 - Synthetic report of the project's outcomes (M30) has been accomplished (see part achievement of Milestones and Deliverables).

Task 1.3: Engagement of Stakeholders and Policy Makers

Engagement of stakeholders and policy makers was achieved through the dedicated Task 1.3. The Stakeholders, Experts and Competent Authorities Panel (SHECAP) and the Connectivity Forum have been established in the Kick-Off meeting and run during the project. A number of activities related to the engagement of Stakeholders and Policy Makers have been lined up in the DoW/Inception report and executed accordingly.

The Connection with the MSFD Competent Authorities (CAs) was materialised with the establishment of the Stakeholder, External Experts, Competent Authorities (CAs) of the EU Member States Panel (SHECAP) to ensure that the CAs are involved and consulted throughout the work of the project, so that the projects' results will respond to their needs, will be endorsed by them and are in a format that can directly put into use for the implementation of the MSFD on national and regional/subregional level in the Mediterranean.

SHECAP meetings were foreseen every 6 months; however, this schedule was not followed for a number of reasons described below. Instead, several meetings with stakeholders were realised according to specific issues and activities

- 1st SHECAP meeting (MS1.4) took place back- to-back with the KO meeting. The two bodies convened and their role was established.

- 2nd SHECAP meeting (MS1.8), set at M6 was not materialized. Following discussion during the 1st SHECAP meeting it was decided that the 2nd SHECAP meeting should be postponed to a later date, when project work was going to be more mature to be presented, discussed and receive feedback from stakeholders. The 2nd SHECAP meeting was thus cancelled and efforts were devoted to the 3rd SHECAP meeting that was scheduled for M12.

- As mentioned above, the 3rd SHECAP meeting (see MS1.1) was originally anticipated at M12, but was finally accomplished at M16 (October 2022). "MSFD Competent Authorities (CAs), Stakeholders, & External Experts (SHECAP) Workshops'' were held at Athens 24 – 26 October 2022

(hybrid) comprising of 4 workshops (Workshop 1: Defining Competent Authorities' needs; Workshop 2: Ex post socioeconomic assessment of PoMs; Workshop 3: Spatial management scenarios for fishing impact on benthic habitats; Workshop 4: Dialogue to achieve a Good Environmental Status) as described under MS1.12) [merged with MS6.3 and MS3.3].

- The 4th SHECAP meeting (MS1.14, M18) was conducted in conjunction with the "ABIOMMED workshop on Climate change and Good Environmental Status (GES) - "A Mediterranean Sea under pressures of climate and anthropic changes: Towards a dynamic assessment of the Good Environmental Status" (Tunis, 19 June 2023) [merged with MS6.4 and MS3.4].

The Connectivity Forum consisting of stakeholders, representatives from relevant projects, external experts from NGOs and other bodies, and non-EU countries, with the aim to provide guidance towards the project's outcomes, bring along their experience and convey the messages to their institutions, was established at the beginning of the project at M1 (see MS1.3, 1st Connectivity Forum meeting) and run as scheduled; the 2nd Connectivity Forum meeting realised at M12 (see MS1.11) and the Final Connectivity Forum at M30 (MS1.18) with the participation of many stakeholders and interventions. Stakeholders' engagement and participation was also assisted through specific Activities' workshops (Activity 3, 5 & 6 stakeholders and Activity 4 technical workshops).

The work related with stakeholders, policy makers and experts within this task fed Deliverable D1.2 - Competent Authorities' needs.

Collaboration with relevant projects namely HELCOM BLUES, HARMONISE, NEA PANACEA, CETAMBITION, QUITESEAS has been established with their participation and presentations in the KO, GA and final meetings (see MS1.2 & MS1.3, MS1.0 & MS1.11 & MS1.17 & MS1.18).

Meeting with French Competent Authorities (French Biodiversity Agency – OFB), experts and stakeholders held on 24/1/22, in order to streamline the activities of the two entities and pave the collaboration.

The ABIOMMED Project was presented also in a number of other meetings, which are listed in Chapter 3 of this report.

Task 1.4: Communication, Dissemination and Outreach

The Dissemination and Communication Plan (DCP) of the project (MS1.5) has been produced with emphasis on GDPR and publication rules.

Project's web site (www.abiommed.eu) has been created and run as the main communication and dissemination tool of the project (see details in MS1.6). The web site will be maintained after the end of the project.

Logo and presentation templates have been produced and disseminated to partners for promotional use. Introductory project leaflet and banner have been created and displayed in many occasions.

Achievement of milestones and deliverables

Milestones:

MS1.1 - Pre-Kick off Meeting with the Commission, M1 (responsible: HCMR) ✗ (Not materialized as the Commission had not assigned a project officer then);

MS1.2 - Kick off & 1st SC Meeting, M1 (responsible: HCMR) ✓ (27 July 2021);

MS1.3 - 1st Connectivity Forum Meeting, M1 (responsible: HCMR) ✓ (27 July 2021);

MS1.4 - 1st SHECAP meeting, M1 (responsible: HCMR) ✓ (27 July 2021)

MS1.5 - Dissemination and Communication Plan, M4* (responsible: HCMR) ✓ (November 2021)

MS1.6 - Website, M5 (responsible: HCMR) ✓

MS1.7 - 2nd SC Meeting, M7 (responsible: HCMR) ✓

MS1.8 – 2nd SHECAP meeting, M6 (responsible: HCMR) CANCELLED (see previous section of this report. Not realized, instead several meetings with stakeholders were realized according specific issues)

MS1.9 - Meeting with the Commission, M12 (responsible: HCMR). ✗ (Not materialized as the Commission had not assigned a project officer then);

MS1.10 - General Assembly, M12 & Scientific Workshops (responsible: HCMR) ✓

MS1.11 - 2nd Connectivity Forum Meeting, M12 (responsible: HCMR) ✓

MS1.12 - 3rd SHECAP meeting, M12 (responsible HCMR) ✓ Materialised at M17 as SHECAP workshops, Athens 24 – 26 October 2022 (merged with MS6.3 and MS3.3);

MS1.13 - 3rd SC Meeting, M18 (responsible: HCMR) ✓

MS1.14 - 4th SHECAP Meeting, M18 (responsible: HCMR) Materialised at M25 as ABIOMMED workshop on Climate change and Good Environmental Status (GES), Tunis 19 June 2023 merged with MS6.4 and MS3.4;

MS1.15a - 4th SC Meeting, M24 (responsible: HCMR) realised M27 September 2023;

MS1.15b - 5th SC Meeting, M28 (responsible: HCMR) ✓ November 2023;

MS1.16 - Final Meeting with the Commission officers, M30 (responsible: HCMR);

MS1.17 - Final General Assembly & Conference, M30 (responsible: HCMR) ✓

MS1.18 - Final Connectivity Forum, Final SHECAP, M30 (responsible: HCMR) ✓

***Deliverables**:*

D1.1 – **Inception report specifying the proposed methodology for the tasks of the project**, M3 (responsible: HCMR). Status: Achieved M6

D1.1 Brief description: The Inception report specifying the proposed methodology for the tasks of the project, scheduled at M3 has been accomplished on M6 by adding more details under each task

/subtask, defining better the synergies among Activities and elaborating further the engagement of stakeholders. Timeline and GANNT chart have been modified accordingly (see Annex).

D1.2 - **CAs needs**, **M8** (responsible: HCMR). Status: Postponed (see description of Task 1.3 above)

D1.2 Brief description: The aim of this deliverable is to map the needs of the CAs towards the next 6-year MSFD cycle in order to ensure that the project is geared towards them. An online questionnaire has been developed to collect this information and its purpose has been presented in the first SHECAP meetings. However, as the CAs responses were limited it was agreed to modify the deliverable and instead report the outcomes of the stakeholders' workshops that were realised for the specific issues and needs of the Activities by upgrading their scope. D1.2 includes the outcomes of the Ex post socioeconomic assessment of PoMs; Spatial management scenarios for fishing impact on benthic habitats; Dialogue to achieve a Good Environmental Status) and workshop on Climate change and Good Environmental Status (GES).

D1.3 – **(PR1) 1st Progress report** (Months 1-10) (responsible: HCMR). Status: Achieved on M12

D1.3 Brief description: 1st Progress report that includes description of the tasks performed against the work plan, an updated Gantt chart with milestones and deliverables, preliminary conclusions, and justification for any identified deviation or risk and accompanying payment request.

D1.4 (FR) – **Final progress report** (Months 1-30) (responsible: HCMR). Status: current report

D1.4 Brief description: This report describes clearly the executed tasks and results covering the complete reporting period, including all the specific products and deliverables produced in the context of this project the impact of the project results into the authorities' implementation cycles and an executive summary and accompanying payment of balance request (M30).

D1.5 – **Synthetic report of the project's outcomes** (M24).

D1.5 - Brief description

Common methodologies and implementation across countries in a coordinated and consistent manner could be very important to achieve coherent ad coordinated assessment of biodiversity and measures across the Mediterranean basin towards achievement of GES according to the 2017 GES. To achieve this objective the ABIOMMED project was structured as a series of interdependent activities, which are presented in the position paper, as well as the results and products issued within the whole period of the project's implementation. Furthermore, in the position paper, is stated what needs to be done, to achieve coherent and coordinated assessment of GES in relation to biodiversity and relevant measures, based on the project's results, by translating the new findings gained into meaningful suggestions/recommendations for the CAs and policy makers, in order to better apply these findings and protect and manage the whole Mediterranean Sea biodiversity and implement the second phase of the MSFD.

It is expected that this Position Paper will have a major impact at basin level; therefore the Competent Authorities are invited to: i) Take note and make use of the main findings of the project to improve coherence in the implementation of the MSFD and related international legislation and increase cost-

effectiveness during the second phase of MSFD implementation; ii) Provide a firm basis for international collaboration and supporting ongoing and future work in the Regional Sea Convention for this purpose and seeking operational collaboration with neighbouring countries.

Problems encountered and solutions

- As described under Task 1.2, the project faced a delay during the first months of its implementation since several partners were preparing simultaneously the MEDREGION final deliverables and reports. Also, there has been an issue with the late appointment of the project officer. However, as effort has been devoted by the coordinator, the SC and the partners to increase the pace of the project had been increased and made up for these delays.

- The project coordinator asked and granted a 6 months extension (starting on 1st July 2023 and ending on 31st December 2023). The main reasons for this prolongation with budget reallocation (but without exceeding the approved budget) and shifting of milestones and deliverable were two:

1) The time line of the project and the main events of the relevant key policy and scientific meetings of the Commission and the RSC – UNEP/MAP e.g. relevant groups established under the auspices of UNEP/MAP and Working Groups and Technical Groups established in the context of the MSFD Common Implementation Strategy, were out of phase not allowing the desired streamlining and exchange of information to and from these key stakeholders and end users and for the representation of the project as originally envisaged in important meetings and workshops organised both by the project or other orgnisations.

2) The COVID-19 situation with the restrictions and remotely working in all countries for a significant period also caused disruption and delays (till spring 2022) during the first year of the project.

By extending the project's duration, ABIOMMED became able to overcome these handicaps and perform better its tasks and deliverables.

- SHECAP meetings were performed at different times than originally foreseen and were merged with relevant workshops and meetings of the other Activities (namely 3, 5 and 6) related to definition and assessment of pressures, setting the GES and appraising POMs. This allowed for more targeted workshops with specific audience. However, it has to be mentioned that the CAs interest was not as expected.

- D1.2 CAs needs (M8): The aim of this deliverable was to map the needs of the CAs towards the next 6-year MSFD cycle, in order to ensure that the project is geared towards them. An online questionnaire has been developed to collect this information and its purpose has been presented in the first SHECAP meetings. However, as the CAs responses were limited it was agreed to modify the deliverable and instead to report the outcomes of the stakeholders workshops that were realised for the specific issues and needs of the Activities. The scope of the workshops was upgraded to fulfil the new requirements under the overall supervision of the management group. D1.2 now includes the

outcomes of the Ex post socioeconomic assessment of PoMs; Spatial management scenarios for fishing impact on benthic habitats: Dialogue to achieve a Good Environmental Status and workshop on Climate change and Good Environmental Status (GES).

The deliverable was thus produced towards the end of the project, when all the workshops were completed.

Activity 2 Pelagic habitat: using the plankton communities to address properly the status of pelagic habitat and relevant pressure

Lead: NIB and IOF

Work completed

The aim of the Activity 2 was to address the gaps in the biodiversity assessment for pelagic habitats (Criterion D1C6) in the Mediterranean Sea and to ultimately propose tailored recommendations derived from the comprehensive synthesis of work on phytoplankton and zooplankton components, which play a critical role in marine food webs and are sensitive to environmental pressures. Specific objectives of Activity 2 were:

- To define tailored GES for pelagic habitats and in this way fulfil the first general objective of the call: "Support for the (sub)regional assessment of the extent to which GES has been achieved".

- To explore the use of different components of the plankton assemblage (phytoplankton and zooplankton) to assess the biodiversity status, to set threshold values for those components in relation to ecologically relevant assessment areas, and to improve the coherence of GES definition for the MSFD next implementation cycle across the Mediterranean.

The work under Activity 2 was organized into three tasks, the first two were dedicated to the two main plankton groups, phytoplankton and zooplankton, while the third served to channel the work into case studies and to provide guidance to direct future efforts to integrate pelagic habitat components into biodiversity descriptor assessment systems not only for Member States but also for non-European countries that are Parties to the Barcelona Convention.

Task 2.1: Towards common methodologies and indicators in GES assessment of pelagic habitat using the phytoplankton component.

Subtask 2.1.1 – Selection of available phytoplankton indicators for testing and further development

The work in this subtask has brought together a quite large group of Mediterranean phytoplankton specialists, allowing a formation of an expert work group focused on the phytoplankton component of the pelagic habitat. First, data availability was evaluated by each of the Activity 2 partner to increase geographical coverage and comparability between data was checked. Along with this, monitoring programs were compared in terms of sampling methods, frequencies and coverage of the

stations. In parallel, the existing methods/approaches for determining phytoplankton status were reviewed, and by drawing on knowledge from HELCOM and OSPAR area,s as well as from past projects, a comparative catalogue of possible phytoplankton indicators, together with their strengths and weaknesses was created. Based on this, the most suitable phytoplankton indicators for testing were selected. The subtask was completed with the Deliverable D2.1a ('A list of selected phytoplankton indicators, their strengths and weaknesses, and specific criteria used by each MS in determining GES for criteria').

Subtask 2.1.2 Define relevant assessment scales based on pressures and prevailing natural conditions

The research conducted under this subtask aimed to contribute to the delineation of relevant spatial and temporal assessment scales that consider both anthropogenic influences and prevailing natural conditions within Mediterranean pelagic habitats. For this, a readily accessible open-source data acquired at a high frequency was utilized, namely the CMEMS product "Mediterranean Sea Reprocessed Surface Chlorophyll Concentration and Phytoplankton Functional Types from Multi-Satellite Observations." The product was utilized to analyse the surface distribution of phytoplankton in the Mediterranean Sea. Clustering was applied to identify aggregations in the 6- and 3-dimensional space for phytoplankton functional types and size classes, revealing ten classes/clusters for the regionalization of the Mediterranean Sea. Differences between the clusters' coverage in the two decades, for the overall period and for the seasons, were calculated and confronted with change in sea surface temperatures. The identification of relevant assessment scales was also an important first task of the newly established multidisciplinary group of experts for pelagic habitat, nominated by the Contracting Parties of the Barcelona Convention, under the SPA/RAC. The first meeting of the group resulted in a new tentative list of habitat types in the epipelagic layer of the Mediterranean Sea. As a result of the Subtask 2.1.2, the Deliverable D2.1b (Criteria for the definition of relevant assessment scales for the pelagic habitat) was prepared.

Meeting of Mediterranean phytoplankton specialists working group (Milestone 2.1) streamlined the work towards its completion.

Task 2.2: Towards identification of common and operable zooplankton indicators for pelagic habitats GES determination across (sub)region.

Subtask 2.2.1 Comparison of existing approaches for zooplankton indicators and determination of assessment scales

Similarly to the phytoplankton case, also the work in this subtask brought together zooplankton specialists and presented the first tentative to work commonly on zooplankton indicators in the Mediterranean area. As a first assignment, zooplankton data availability was evaluated for each MS to increase geographical coverage and data comparability was checked. Relevant zooplankton parameters (biomass, abundance) and zooplankton groups were selected for further work. Monitoring strategies, sampling methods and protocols, frequencies and coverage of the stations were compared among different areas. Besides, existing methodological standards/approaches and availability of thresholds for determining zooplankton indicators were reviewed with the aid of HELCOM and OSPAR experiences. The comparative and extended catalogue of possible zooplankton

indicators was included in the Deliverable D2.2a ("Report on zooplankton indicators, their strengths and weaknesses, and specific criteria used by each MS in determining GES for criteria D1C6").

Subtask 2.2.2 Testing and further development of zooplankton indicators based on prevailing natural conditions

Based on the outcome of reviewing and assessing the existing approaches (under subtask 2.2.1), most suitable indicators were selected for the application on the gathered Mediterranean zooplankton data. These indicators were used for testing in case studies, which were conducted using similar and agreed approaches and comprised data from 5 marine assessment units (Tyrrhenian, Adriatic, Ionian, Aegean and Levantine Seas). Preliminary results from the case study areas in Greece, Italy and Croatia were presented in the Deliverable D2.2a. The preliminary analysis was carried out using the abundances (ind.m^{-3}) of the various identified taxa of the mesozooplankton and different indices expressing evenness, dominance and diversity were calculated. The possibility of testing the zooplankton functional groups based on various functional traits for the assessment of status of pelagic habitat was also agreed in the connection to Task 2.3. The outcomes of the work are presented in D2.2b ("Criteria for the definition of relevant assessment scales for the pelagic habitat").

Meeting of Mediterranean zooplankton specialists working group (Milestone 2.2) streamlined the work towards its completion

Task 2.3: A step towards the determination of GES for the pelagic habitat based on phytoplankton and zooplankton components

Subtask 2.3.1 Case studies

The case studies were conducted based on the findings from Tasks 2.1 and 2.2. First, areas for the testing of assessment tools were selected in different Mediterranean subregions as driven by data availability, but ultimately covering different Mediterranean subregions, namely Adriatic Sea, Eastern Mediterranean with Aegean and Ionian Seas, and Western Mediterranean with Tyrrhenian and Ligurian Seas. In this way, a wide range of prevailing natural conditions were covered. Phytoplankton case studies were designed to cover different aspects of temporal and spatial scales of phytoplankton communities and pelagic habitat in general. Croatian case study in the eastern Adriatic Sea and Slovenian case study in the northernmost part of the Adriatic Sea could be performed in the long-term perspective, so the trend analyses were conducted. The Italian case study covered the spatial gradient in detail since it encompassed all Italian regions and three Mediterranean subregions. A case study was also performed with Greek data from the Aegean Sea but provided no solid conclusions because of the very limited sampling frequency of the data. The zooplankton case studies represented a valuable first step towards understanding the diversity of zooplankton in the Mediterranean Sea on a broader temporal and spatial scale. The three zooplankton case studies also covered either greater temporal variability, with the Croatian and Greek datasets covering more than a decade, or greater spatial coverage by the Italian case study. Several plankton parameters, like abundance, alpha and beta diversity indices were tested in case studies. The results of the case studies were presented in the Deliverable D2.3 ("Report on the consolidated GES definition(s) for the pelagic habitat (D1C6) based on MSs assessments").

Subtask 2.3.2 Toward a consistent approach across the Mediterranean

The most important findings of all Activity 2 tasks were canalized into the last Subtask 2.3.2. In the frame of this subtask, periodical on-line meetings have been conducted, either gathering the phytoplankton or zooplankton group of experts, or the whole think tank of pelagic habitat experts. The support of the long-term cooperation, which will provide lasting guidance for the development and upgrading of pelagic habitat assessment systems, was also one of the recommendations that emerged from the work in this subtask. To foster a more harmonized approach towards defining GES for pelagic habitats in the Mediterranean Sea, several recommendations were elucidated that were based on the lessons learnt from the case studies and from a comprehensive synthesis of the work done within other tasks of the Activity 2. Although it was not possible to advance towards the definition of threshold values in the context of D1C6, an alternative approach based on defining trends in plankton communities and applying expert knowledge to inform the competent authorities was proposed. The lessons learnt from the case studies together with the recommendations for a more harmonized approach towards the GES definition for pelagic habitat in the Mediterranean Sea were included in the deliverable D2.3.

A "Think Tank" of plankton experts for the pelagic habitat has been established through the cooperation of phytoplankton and zooplankton experts during the whole duration of the project and by newly established multidisciplinary group of experts for pelagic habitat, nominated by the Contracting Parties of the Barcelona Convention on M22 (MS2.3).

Achievement of milestones and deliverables

Milestones:

MS2.1 Meeting of Mediterranean phytoplankton experts (Responsible: NIB and IOF) M12. Achieved at Internal meeting of phytoplankton experts on M13.

MS2.2 Meeting of Mediterranean zooplankton experts (Responsible: HCMR) M10. Achieved at Internal meeting of zooplankton experts on M13.

MS2.3 Establishment of a Think Tank of plankton experts for the pelagic habitat assessment (Responsible: CONISMA). Achieved through the cooperation of phytoplankton and zooplankton experts during the whole duration of the project and by newly established multidisciplinary group of experts for pelagic habitat, nominated by the Contracting Parties of the Barcelona Convention on M22.

Deliverables:

D2.1a – A list of selected phytoplankton indicators, their strengths and weaknesses, and specific criteria used by each MS in determining GES for criteria D1C6.

Responsible NIB, M12. Status: Achieved Final Version M28.

D2.1a Brief description:

The deliverable presents an updated review of phytoplankton indicators, highlighting the progress done in the framework of OSPAR and HELCOM Regional Sea Convention. OSPAR, covering the North-East Atlantic, employed three pelagic habitat indicators: i) PH2 focuses on changes in phytoplankton biomass and zooplankton abundance, offering insight into temporal deviations from assumed natural variability; ii) PH1 evaluates changes in phytoplankton and zooplankton communities, using relative abundances of lifeform pairs based on functional traits; and iii) PH3 identifies changes in plankton diversity using taxonomic diversity indices. HELCOM's holistic assessment includes different phytoplankton and zooplankton indicators in open sea and coastal areas. The document acknowledges the immature state of the indicators under the Barcelona convention and stresses the requirement of an agreed reference list of pelagic habitat types. Moreover, it reveals that there are no established thresholds for the Mediterranean Sea due to various difficulties.

The deliverable then presents strengths and weaknesses of the selected phytoplankton indicators and review the specific criteria for determining GES for D1C6 used by Mediterranean MSs. Some challenges are then presented, which could interfere with the roadmap towards a definition of GES, such as linking non-linear responses of plankton communities to human pressures, setting reference conditions, and determining the specific needs of MAs for Good Environmental Status (GES). The deliverable emphasizes the importance of considering spatial and temporal scale-dependency, understanding pressure-response relationships, and establishing baselines. The OSPAR-developed system using indicator thresholds or temporal changes linked to impacts based on expert judgment is seen as a promising approach for defining GES in the absence of thresholds.

D2.1b – **Criteria for the definition of relevant assessment scales for the pelagic habitat**. Responsible NIB, M26. Status: Achieved (M29)

D2.1b Brief description:

The document presents the work carried out under the Subtask 2.1.2, which aimed at defining relevant assessment scales based on prevailing natural conditions for the pelagic habitat of the Mediterranean Sea, using differences in phytoplankton composition, abundance and distribution that can be identified through satellite observations. The research was focused on the Mediterranean Sea, utilizing open-source data and presented a case analysis exploring the temporal and spatial dimensions of phytoplankton functional types and size classes. In the introduction, different regionalization studies conducted in the Mediterranean Sea, which leveraged on satellite data to understand phytoplankton variability, identify trophic regimes, clusters, and ecoregions. The “Materials and Methods” section presents the utilization of Copernicus Marine Service data to explore the temporal and spatial dimensions of phytoplankton functional types (PFTs) and phytoplankton size classes (PSCs).

Both clustering on PSCs and PFTs a yielded similar and meaningful discrimination of different areas, reflected a trophic gradient in chlorophyll-a biomass and contributions of PFTs or PSCs. Subsequently, the focus of the results was given on PFT clustering, which revealed distinct geographical patterns aligning with trophic conditions in the Mediterranean Sea. Changes in cluster distribution over two

decades were the most notable in the western and northern parts of the Mediterranean Sea. Almost all shifts comprised widening of the most oligotrophic clusters with the dominance of picophytoplankton, only in the areas with a steep gradient of clusters (highly productive coastal areas) these changes comprised also other clusters. These shifts, particularly in the western and northern parts, suggest dynamic spatial and temporal variations influenced by rising sea surface temperatures, possibly linked to climate change. The observed changes indicate potential shifts in trophic efficiency, aligning with previous research. However, the distinction between anthropogenic influence and natural variability remained challenging.

The deliverable underscores the importance of spatial and temporal scales for understanding Mediterranean pelagic habitats, emphasizing the often-overlooked picophytoplankton component. To address these gaps, we recommend diversified *in situ* data collection techniques, including flow cytometry, microscopy, and size-fractionated filtration, alongside HPLC. This strategy is crucial for refining algorithms for phytoplankton community structure in ocean colours, enhancing pelagic habitat assessments. The work supports the significance of long-term studies, such as Long-Term Ecological Research (LTER) stations, integrating satellite data and modelling for informed assessments. Monthly sampling is deemed most appropriate for maintaining adequate long-term data on plankton assemblages.

In conclusion, the deliverable stresses the contribution of valuable insights into the complex dynamics of the Mediterranean pelagic habitat, highlighting the need for a re-evaluation of GES criteria, consideration of various temporal scales, and incorporation of climate regimes. The findings emphasize the importance of sustained long-term studies, comprehensive monitoring, and diversified data collection strategies for a more accurate understanding of pelagic habitats and their response to environmental changes.

D2.2a – Report on zooplankton indicators, their strengths and weaknesses, and specific criteria used by each MS in determining GES for criteria D1C6. Responsible HCMR, (M12). Status: Final version achieved M20

D2.2a Brief description:

The deliverable describes the identification of common and operable zooplankton indicators for pelagic habitats GES determination across (sub)regions, as identified in the Task 2.2 by the Mediterranean zooplankton working group of experts from Greece, Italy, Slovenia and Croatia, who joined their efforts for the first time at the basin scale. The work includes review and classification of the existing methodological standards/approaches and thresholds (if any available) for determining zooplankton indicators that were found to reflect GES and show sensitivity to human-induced pressures. Most of the indicators presented are in use under HELCOM and OSPAR regional sea conventions. Thus, a comparative and extended catalogue of possible zooplankton indicators was compiled with strengths and weaknesses and specific criteria used by each Member State (MS) in determining GES for criterion D1C6. Based on the outcome of reviewing and assessing the existing approaches (indicators) for determining the zooplankton status possibly related to GES/no GES determination, the most suitable ones were selected for application on the available Mediterranean

data. The deliverable also shows the preliminary results of the indicators testing in case studies of Greece, Croatia and Italy in relation to prevailing natural conditions.

The review of zooplankton indicators showed that none of the available zooplankton-based state indicators is designed, or has defined thresholds, for the Mediterranean Sea and its sub-regions due to several difficulties. According to the catalogue of indicators provided, the development of indicators is based mainly on the following zooplankton metrics: total abundance, total biomass, copepod abundance, % copepod abundance, copepod biomass, % copepod biomass (since copepods are the most abundant group in the meso-zooplankton community), microphagous species biomass, % microphagous species biomass, cladocerans/copepods ratio, rotifers+cladocerans/copepods ratio, zooplankton mean size. However, the deliverable acknowledged that the development of zooplankton indicators in the Mediterranean Sea has lagged behind other European Seas, generally hampered by slow progress in standardization of methods and, metrics, as well as large research efforts and long history of data collection that have favored individual approaches and low levels of synchronization among Mediterranean zooplankton research groups.

D2.2b – **Criteria for the definition of relevant assessment scales for the pelagic habitat.** Responsible HCMR, M26. Status: Achieved M29

D2.2b Brief description:

Within the framework of Task 2.2, the selection of suitable indicators for determining zooplankton status was based on a thorough review and assessment of existing approaches (see D2.2a). In the Deliverable 2.2b, these chosen indicators underwent testing through case studies and further development. Given the pioneering nature of this initiative, aiming to amalgamate zooplankton data from different sub-regions of the Mediterranean Sea for Marine Strategy Framework Directive (MSFD) purposes, an evaluation of data availability was conducted to enhance geographical coverage. Collaborating ABIOMMED partners from Croatia, Italy, and Greece have providing official data from their programs related to MSFD, Water Framework Directive (WFD), and other national or European monitoring projects spanning the last 12 years. An exhaustive metadata file, encompassing area coverage, station details, sampling methodology, availability of environmental parameters, pressures, and zooplankton parameters (zooplankton biomass, abundance, species/taxa abundance), was compiled.

This collaborative effort not only represents a significant step in harmonizing zooplankton data across the Mediterranean but also serves as a crucial exploration of methodologies to enhance the effectiveness of future MSFD implementations. A number of selected indicators are applied including their strengths and weaknesses in each selected area in determining GES for criterion D1C6.

D2.3 – Report on the consolidated GES definition(s) for the pelagic habitat (D1C6) based on MSs assessments. Responsible: CONISMA, M29. Status: Achieved M30

D2.3 Brief description:

After an introduction, in which the premises of the work conducted under the Task 2.3 are described, the deliverable presents the results of case studies on plankton diversity in different subregions of

the Mediterranean Sea. For phytoplankton, these studies build on previous projects, while focusing on a more detailed investigation of temporal diversity patterns. In addition, the Italian case study included in this deliverable examines spatial patterns at relatively high resolution. For zooplankton, where the development of indicators in the region has faced challenges including slow progress in the standardization of methods, considerable research effort and historical data collection methods, the deliverable presents the results of the first collaborative study of indicators in the Mediterranean using a common methodology.

Phytoplankton case studies covered the eastern Adriatic, the northern Adriatic, Italian regions and the Aegean Sea and aimed to capture different temporal and spatial aspects. Long-term trend analyses were carried out in the eastern and northern Adriatic, showing increasing richness and decreasing abundance, especially in the oligotrophic eastern Adriatic. Stations in the open sea showed more pronounced trends, suggesting that environmental changes generally affect phytoplankton communities independently of anthropogenic influences. In both the eastern Adriatic and the northern Gulf of Trieste, the observed changes were consistent with trends towards increased oligotrophy and reduced pollution, suggesting that the changes are due to broader factors, such as climate change.

The Italian case study underlined the considerable temporal and spatial variability of phytoplankton communities in the Italian regions. Despite minimal differences between transect stations, alpha diversity indices showed limited discriminatory potential, while beta diversity indices such as LCBD proved to be potentially valuable tools to identify changes. On the contrary, studies of the LTER Senigallia-Susak dataset highlighted differences between coastal and offshore stations related to water circulation and water masses, overshadowing direct anthropogenic influences. The shift to erratic community dynamics at LTER stations underlined the influence of climatic and hydrological factors at the mesoscale and emphasized the importance of long-term ecological research for understanding large-scale trends like climate change.

The zooplankton case studies presented in the deliverable mark a crucial initial step towards understanding the diversity of zooplankton in the Mediterranean Sea on a larger scale. With datasets spanning more than a decade (Croatian and Greek) or providing broader spatial coverage (Italian), the studies included five Marine Reporting Units (MRUs): Tyrrhenian, Adriatic, Ionian Sea, Aegean, and Levantine Seas. However, the sub-regional differences in monitoring frequency and duration, and selection of zooplankton parameters posed a challenge for the comparison of results, highlighting the complexity of zooplankton community dynamics.

The extensive datasets revealed findings such as that microzooplankton in the central eastern Adriatic can serve as a potential indicator, suggesting an extension of spatial coverage in the eastern Adriatic. The Italian case study emphasized the need to test the indices at the local level and suggested a monthly homogeneous sampling frequency. Overall, the studies underlined the complexity of zooplankton dynamics and advocated for standardized methods, a spatial consideration, and further research on the mechanisms shaping (meso)zooplankton communities in the context of anthropogenic pressures and impacts. Deliverable expose the need to further explore the potential

benefits of functional diversity and the selection of appropriate indicators for (meso)zooplankton in the context of environmental pressures.

The deliverable then summarizes the lessons learnt from all case studies. First, it stresses the considerable fluctuations in diversity of both the phytoplankton and the zooplankton communities, which were more related to the prevailing conditions than to direct anthropogenic influences. Moreover, research at the LTER stations evidenced a switch to a more erratic community dynamics in the recent years, probably triggered by climatic and hydrological factors at the mesoscale. The three zooplankton case studies underlined the complexity of zooplankton community dynamics, the need for standardized methods and the importance of appropriate spatial and temporal consideration. In addition, further research is advised to shed more light on the mechanisms that shape the structure of (meso)zooplankton communities in the context of anthropogenic pressures and impacts. For both plankton components, significant differences were observed between areas with different prevailing conditions that could not be linked to anthropogenic influences. The observed trends were difficult to link to other processes that were not related to hydrological and climatic influences on a larger scale. In this way, the case study results made clear that the observation and interpretation of trends in plankton diversity dynamics is extremely important to link these changes to large-scale influences related to climate change, which is predicted to have a massive impact on plankton abundance and diversity. The importance of data from long-term ecological research (LTER) for understanding changes in the plankton community over time, particularly in relation to climate change, is emphasized throughout the deliverable.

In the last part, the deliverable summarizes the recommendations to improve the harmonization of GES definitions for pelagic habitats in the Mediterranean Sea, which were made based on the comprehensive synthesis of the work completed in all Activity 2 tasks, to guide future efforts to include pelagic habitat components in biodiversity descriptor assessment systems. The recommendations can be summarized as follows:

1. *The importance of assessment scales*: Comprehensive spatial coverage of monitoring stations in the subregions and Marine Reporting Units (MRUs) is advisable, with the inclusion of satellite data and modelling products to track phytoplankton trends on a broader scale. This needs to go hand in hand with a multi-temporal approach that allows the inclusion of climate regimes in assessments and helps to distinguish between anthropogenic influences and natural variability, recognizing the challenges involved.

2. *Importance of investigating relevant phytoplankton and zooplankton groups/size classes*: It is recommended to study additional phytoplankton and zooplankton groups/size classes to better recognize environmental changes. As an example, the inclusion of picophytoplankton in the assessment is proposed.

3. For a comprehensive understanding of environmental change, it is advisable *to integrate data from long-term ecological research (LTER) stations with data from monitoring stations.* To this end, the maintenance and possible expansion of the LTER network is recognized, which would build on its adaptability to incorporate new methods.

4. *Support a more uniform and consistent sampling frequency across Member States* for meaningful cross-regional comparisons, with monthly sampling for phytoplankton and at least seasonal for zooplankton.

5. *Evaluation of trends and trust in expert judgment*: As an alternative to rigid thresholds, a different, expert-based approach to GES is recommended, assessing regional trends and changes, emphasizing that there are no specific thresholds in the Mediterranean.

6. *Establish connections to Descriptor 4 and focus on changes in food webs considering observed trends in phytoplankton and zooplankton communities.* Including multiple trophic guilds could allow easier detection of cascading effects of different natural and human influences.

7. *Continuation of cooperation through a working group of multidisciplinary experts*. The group could operate under the MSFD umbrella or the Barcelona Convention and aim for standardized monitoring protocols and a harmonized approach across the Mediterranean Sea.

Notwithstanding the currently insurmountable challenges in defining GES, reference conditions and thresholds, detailed information on the taxonomic analysis of plankton samples will always be necessary to correctly interpret the patterns of other variables such as biomass or abundance of plankton components (e.g. phytoplankton and meso-zooplankton) or functional groups on which other indicators may be based.

Problems encountered and solutions

During the initial stages of Activity 2, significant challenges emerged in obtaining adequate data for plankton case studies, particularly from the western Mediterranean. A persistent difficulty to accomplish plankton datasets from official member states' data, especially with suitable taxonomic resolution and sampling frequency, posed a major obstacle. At the end, the extensive dataset from Italy, comprising both phytoplankton and zooplankton data from all the Italian regions, allowed the case studies to cover also the western Mediterranean, at least in part with Tyrrhenian and Ligurian Seas. The spatial availability of the data in relation to open sea was also of concern, with most sampling stations situated in coastal waters and limited representation of open sea data.

In the zooplankton expert group, the challenges were compounded by the heterogeneous nature of data, encompassing different parameters, uneven levels of taxonomic identifications, and monitoring schemes with differing sampling frequencies and spatial coverage. Despite these obstacles, the team successfully navigated the complexities by adopting a dual analytical perspective—examining the dataset both longitudinally and spatially, but separately by case studies.

Challenges also arose in identifying suitable indicators for plankton diversity with established pressure-impact relationships that could allow for the definition of baseline conditions and threshold. While this possibility was recognized already before the project start challenges, certain envisioned actions faced implementation hurdles. Instead, the team proposed alternative measures, incorporating trend analyses, expert judgment, and a directed effort towards a more robust assessment for D4 - food webs.

Activity 3: Towards ecologically-relevant scales and areas for assessment of benthic habitat and effective measures to reduce physical disturbance to the sea-floor in the Mediterranean Sea

Lead: ISPRA

Work completed

The main objective of Activity 3 was to support the national Competent Authorities to set up a consistent approach for the assessment of the status of benthic habitats subjected to human pressures, as well as for the establishment of regional measures to protect sea-floor integrity (and its biological component, i.e. species/communities/habitats) from physical disturbance, under Descriptor 6 (MSFD) and, consistently with Ecological Objective 6 (EcAp). This work is complex, as the science bases are still under development and little implementation is available at national/international level. In addition, its development implies a strong coordination and the harmonization of the approaches among actors from the national to the sub-regional and regional levels.

To address this issue, within the context of the Common Implementation Strategy (CIS), an EU overarching approach is being developed under the umbrella of TGSEABED, and ABIOMMED Activity 3 has contributed to this framework in the context of the Mediterranean Sea by facilitating the development of common approaches towards D6 and EO6 assessments, considering Mediterranean ecological and institutional specificities. The work was directed towards ensuring: i) consistent approaches to habitat and scale definition (Task 3.1), ii) the identification of the main pressures affecting the seabed (Task 3.2) and iii) the informed selection of alternative measures to cope with the main physical pressures on the seafloor (Task 3.3). The hints and lessons learned developed within this process were critically analyzed iv) to draft a roadmap, which is meant to guide future developments and implementations on the topic in the Mediterranean Sea context.

As this process needed the engagement of multiple actors, as well as sharing and building knowledge on scientific and institutional processes, Activity 3 was characterized by continuous cooperation with Mediterranean scholars and international institutions. This attitude started with the direct cooperation within the project and with Activity 6. The latter had the aim of facilitating the development of a common approach to Ecological Objectives 6 – coordinated by SPA/RAC - and therefore, a close cooperation and sharing of approaches among Activity 3 and 6 was enforced, with the direct engagement of experts from the Online WG on Benthic ecology. Further institutions and international bodies, including stakeholders' fora, were actively engaged and included UNEP/MAP, DG ENV, DG MARE, GFCM, ICES, and MEDAC, as well as TG Seabed experts.

Activity 3 comprised 3 Tasks subdivided into 7 Subtasks and 4 related Deliverables whose contents, outcomes and main findings are detailed below.

Here we report the main activities, difficulties faced and how they were tackled, along with the main deliverable's contents and related findings.

Task 3.1: Enhancing consistency in subregional and regional approaches to benthic habitats and scales in the Mediterranean Sea. Partners: ISPRA, IOF, NIB, HCMR, CNR, CONISMA, IzVRS, NKUA, SPA/RAC; Lead: ISPRA and HCMR)

What should be the common ground for addressing benthic habitat protection and sustainable use concerning the physical disturbance of the seafloor? Task 3.1 was developed to address this question considering two different aspects, i.e. habitats to be considered and the assessment scales.

Within subtask 3.1.1 (Subtask 3.1.1 – A common approach towards habitats' specification; Lead HCMR), participants mainly worked on the identification of the proper elements for the assessments (habitats) in the Mediterranean context. In this framework, the activities were directed towards the identification and comparison of the major classification schemes for habitat selection under MSFD reporting (MSFD methodological standards, EUNIS classification, RSC habitats and projects related to Sensitive Benthic habitats) and in the systematization of cross-walk table that connects such classifications with others, particularly Vulnerable Marine Ecosystems (VMEs). Indeed, the latter have a strong relevance for managing the most widespread pressure on the seafloor of the Mediterranean Sea, i.e. demersal fishing, and bridge conservation practices with sustainable management of human pressures. The elements of assessment (from coarse, i.e. Benthic Broad Habitat Types) to more refined approaches (i.e., Other Habitat Types and sensitive habitats) were discussed to allow integrating broad scale and local (habitats) assessments.

In the context of subtask 3.1.2 (*Consistency between ecological and assessment scales: Lead:* ISPRA) the issue of the appropriate scale to be used for the assessment of seafloor integrity in relation to physical disturbance was addressed. The work focused on identifying the main elements that are part of D6 assessment process that show to be scale-dependent and link them to the possible scale adopted for the ecological assessment benthic status. Comparing elements like accuracy in spatial footprint of physical pressures, habitats distribution and condition, reflections on the consistency scale for ecological analyses, a discussion about the most appropriate scale was carried out showing how high resolution data would be needed for a proper assessment of seafloor status. As such approach needs accurate data, currently not available at the Mediterranean level, a stepwise approach with increasing data resolution is discussed and later developed in Task 3.2 and Tast 3.3.

The achievement of the work was paved through Milestones MS3.1 and MS3.2 and resulted in Deliverable D3.1 (see relevant section).

Milestones MS3.1 and MS3.2 allowed coping with the above-mentioned issues, favoring the direct exchange of knowledge and the debate among benthic experts of the Mediterranean Sea, and relevant institutions (GFCM, SPA/RAC, DG ENV), thus facilitating the building of a common shared vision on the best approach to address benthic ecosystems. MS3.1 and MS3.2 were carried out at the beginning of the activities, and in the second part of the project, respectively. They allowed the engagement of the benthic expert group of SPA/RAC and clarified how Mediterranean experts perceived not only Broad Habitat Types as a major focus of D6/EO6 implementation but also the fundamental role of Other Habitat Types, in particular, those most sensitive and vulnerable. This

disclosed the need for the development of a key, harmonized approach for their protection under MSFD and EcAp of both BHT and OHT.

Task 3.2: Harmonizing the approaches to identify key physical pressures on benthic habitat and relative role at subregional and regional level (Partners: ISPRA, IOF, NIB, HCMR, CONISMA, CNR, IzVRS, NKUA, SPA/RAC; Lead: IzVRS and CNR)

All anthropogenic marine coastal activities leave a footprint and generate pressures on the marine environment, and unless they are moderated, they will create significant impacts on the natural and human systems. As the seabed provides humans with invaluable resources, numerous sectors exploit them often leading to cumulative pressures. The aim of task 3.2 was to analyse the available framework to assess the cumulative effects of multiple pressures and to rank them consistently. In addition, a method for ranking pressures applicable to data-poor conditions like the Mediterranean Sea were developed and tested at subregional and multinational levels. The task was approached in the context of two subtasks.

Subtask 3.2.1 (Review of methods and applications developed in the context of MS; Lead: IzVRS*)* had *the* goal of producing a "*Review of methods and applications developed in the context of MSFD and MSP to identify and assess key physical pressures*". To this end, studies, applied to the identification of key pressures, and the assessment of cumulative effects (including methodologies and protocols, applied for a Bow-tie analysis) in the context of the Mediterranean Sea, were reviewed. Special attention was given to MSFD and MSP applications, built upon the results of the MEDREGION "Achieving coherence between MSFD and MSP" project, as well as other parallel Mediterranean wide initiatives. The Barcelona Convention Conceptual Framework for MSP and recommendations as well as the Mediterranean Regional Framework for ICZM 2017-2021 were considered. The key pressures review was also complemented by selected transboundary case studies from the Adriatic and Ionian Seas and the Central Mediterranean (Strait of Sicily). The Subtask included a literature review, for which national documentation, technical reports from international organizations and grey literature were considered, along with expert feedback from the MS3.1. and MS3.2. meetings.

Subtask 3.2.2 (Proposal for a harmonized approach for the identification of key pressures and their ranking from national to subregional and regional scales; CNR, NIB). This *subtask* dealt with producing a "Proposal for a harmonized approach for the identification of key pressures and their ranking from national to sub-regional and regional scales". The work was carried out based on the review from Subtask 3.2.1. Legislative formal MSFD requirements, as well as developments from the EU TG SEABED (Technical Group on seabed habitats and sea-floor integrity; the EU expert group tasked to provide advice to WG GES and MS under the Common Implementation Strategy) and international frameworks, were also considered. To ensure Mediterranean-wide applicability, the proposal was discussed, integrated, and shared with experts involved in TG SEABED, belonging to countries not directly engaged in the project, along with national experts and representatives of the international bodies invited to the M3.1. meeting. Existing legislation and policies, related to the descriptor in question, were analyzed and provided an insight into the linkage between cumulative effects and management strategies to prevent effects and mitigate impacts. A Bow-tie analysis was performed to evaluate consistency between EU/national legislation and the requirements of MSP and MSFD. The

work was characterised by a strong engagement of all partners sharing national data and contributing to the development of the methodology, either on the side of how to approach the quantification of spatial footprint with multiple levels of data resolution and in the development of common understanding and scales for assessing the impact of pressures on benthic broad habitat types.

The achievement of the work was paved through Milestones MS3.1 and MS3.2 and resulted in Deliverable D3.2 (see relevant section).

MS3.1 and MS3.2 were joint with Task 3.1. They allowed the direct exchange of knowledge and the debate among benthic experts of the Mediterranean Sea, and relevant institutions (GFCM, RAC/SPA, DG ENV) for both Task 3.1 and Task 3.2. Considering the latter, the meetings allowed the discussion of the criticalities of addressing cumulative pressures on the seabed. Within the debates, in both occasions, it emerged how data gaps, and the uneven availability of high-resolution data, was hampering any quantitative integrative approach to test an assessment at the Mediterranean level. They also clarified that restricting the evaluation to physical pressure would overlook the overall effects on the seafloor as climate change, alien species invasion, and input of nutrients/pollutants – among others – could be relevant drivers to be addressed. Such considerations and exchanges drove the process of developing/testing the application of a semi-quantitative approach that is less data-demanding under T3.2. At the same time MS3.2 stimulated reflections on how to proceed in the future to ensure a pan-Mediterranean assessment of seafloor integrity.

Task 3.3: Assessment and implications of alternative measures for reducing physical disturbance from fisheries and other key pressures under different scenarios (Partners: CNR, CONISMA, IOF, NIB, HCMR, ISPRA, IzVRS, NKUA, SPA/RAC; Lead: CONISMA)

Task 3.3 had the aim of facilitating the work of MSs and CoP towards the selection of measures to protect seafloor integrity from physical disturbance and foster a common approach for future Mediterranean Sea assessments and implementation of measures. To this purpose, three different subtasks were implemented.

Subtask 3.3.1 (Exploring alternative measures for reducing the fishing impact on the sea floor with spatially explicit models, Lead: CONISMA, CNR) was focused on fisheries impact and on the measures to reduce it. The topic entails a series of complexities, including the presence of transboundary stocks and of multiple fishing activities. The work was carried out considering four different case studies, including transboundary case studies (the Adriatic Sea) where the cooperation among ABIOMMED partners allowed the sharing of data needed for the development of a series of models and simulations. The work benefited from the selection of a series of spatial management scenarios (e.g. implementation of FRAs, change in depth where trawling is forbidden, an increase of the distance from the coast where fishing is banned) whose definition was consolidated through debate and interactions with policymakers (e.g. DG MARE, DG ENV, GFCM) and stakeholders (MEDAC).The results assess the trade-off between spatial protection measures and economic costs, and, even in the progress of the tasks, informed the policy makers in relation to the adoption of ad hoc measures to reduce the spatial footprint of fishing.

Subtask 3.3.2 (Exploring alternative measures for reducing other key-sources of pressures on the sea-floor; Lead: ISPRA, IzVRS) was aimed to test and develop an application that allows the selection of most suitable measures for seafloor protection. Indeed, the focus of the work was the implementation of a framework to ensure that risks (i.e. risks poses by pressures on seafloor habitats) are managed effectively and efficiently, as well as coherently within the MSFD policy context to facilitate more effective decision making. To this purpose a risk assessment applied the Bow-Tie and LOPA analyses to assess the likelihood of failing Descriptor 6 GES in the marine waters of Italy, Slovenia, Croatia and Greece due to cumulative pressures, as well as the likelihood of their impacts. In this effort, the effectiveness of D6 MSFD measures established by these MSs was investigated with regards to their estimated effectiveness in addressing generated physical pressures and mitigating their impacts. The approach, if properly extended with other data, could be applied at the Mediterranean level to guide the identification of most promising measures to protect seafloor integrity. The findings of subtasks 3.3.1 and 3.3.2 are summarized in Deliverable 3.3 (see below for synopses).

Subtask 3.3.3 (Roadmap towards common assessment and measures to limit physical disturbance on sea-floor integrity in the Mediterranean Sea; Lead: NKUA, ISPRA and CONISMA) had the aim of summarizing the major findings of Activity 3 and putting them into the context of the broader frameworks of MSFD implementation, considering technical development under TG Seabed. To this purpose the subtask analysed the main findings of Activity 3 (and 6) and, based on the technical elements needed for proper implementation of an assessment of Seafloor integrity, provides a series of hints in a structured framework. In this context, elements like habitats, scales, identification and ranking of pressures, selection of measures are presented along a common process, linking them to analyses carried out within ABIOMMED and other initiatives. The most relevant elements of the roadmap are summarized in the Synopses of Deliverable D3.3, below.

The achievement of the work was paved through Milestones MS3.3 and MS3.4 and resulted in Deliverable D3.3 and D3.4 (see relevant section).

Milestone MS3.3 was planned at M18 and was achieved on M16, through a Workshop on the portfolio of alternative measures – organized in collaboration with Activity 6 in the context of the SHECAP meeting - on expanding towards the Mediterranean through SPA/RAC and EcAp initiative. MS3.3 planning was adapted for the given conditions (see below problems and difficulties encountered). In particular, it was considered necessary, before the testing of the alternative measures, to facilitate a discussion among stakeholders and institutions of the possible measures to be tested. MS3.3 was thus achieved through a WS (embedded into the October 2022 SHECAP meeting, M16) carried out to discuss the list of alternative measures to be tested in T3.3.

MS3.4 was related to the organization of a High-level policy conference with SPA/RAC, to the purpose of promoting the outcomes of Activity 3. However, timeline and agenda of potential meetings (e.g. UNEP/MAP), prevented the organization of an *ad hoc* activity. At the same time through the progress of Task 3.3, it was felt most appropriate to liaise and influence the work of the technical group dedicated to the theme addressed by Activity 3, sharing both methods and outcomes. To this purpose, Task 3.3 scholars participated in high-level scientific meetings (in particular in the context

of GFCM, ICES and TG Seabed), and the MS3.4 was thus achieved through the contribution to these meetings, between M18 to M29, being finally achieved at M29.

Achievement of milestones and deliverables

Milestones

MS3.1 – Scoping webinar meeting with Mediterranean TG SEABED experts, Technical experts, EC representatives, GFCM and SPA/RAC experts of the OWG on benthic Habitats (activities in conjunction with T3.2 and M6.1), M6 Status Achieved M13

MS3.2 – Meeting with Mediterranean TG SEABED experts, MSs representatives, Technical experts, SPA/RAC and GFCM experts (activities in conjunction with T3.2 M6.2), M6, Final Status Achieved M29.

MS3.3 – Workshop on the portfolio of alternative measures in collaboration with Activity 6 on expanding towards the Mediterranean through SPA/RAC and EcAp initiative with GFCM and key stakeholders in the main sectors (fishing, aquaculture, others), M18.

MS3.4 – High-level policy Workshop with SPA/RAC experts, and national representatives, M28.

Deliverables

D3.1 – **Report on enhancing consistency in subregional and regional approaches to benthic habitats' specification and ecologically relevant scales**, M20 (ISPRA). Status: Achieved final version M28

D3.1 Brief Description:

The assessment of seafloor integrity under Descriptors 1 and 6 in the Mediterranean is to be based on a relevant set of "Broad habitat types" (sensu MSFD, EU 2017) or "Other habitat type" (sensu HD or other typologies) consistent with Mediterranean Regional processes such as the IMAP process. Moreover, there is a need to define all the relevant scales of assessment that can ensure coherence while acknowledging Mediterranean ecological peculiarities.

Coherence in the assessments requires 2 essential elements: a common approach towards habitats' specification (Task 3.1.1) and consistency between ecological and assessment scales (Task 3.1.2). To address habitat coherence, a review of all relevant typologies currently used by policy instruments and/or regional and international bodies was performed to fill a major gap and produce a correspondence framework of 'like-with-like' habitats following a nested approach.

Consistency of observational ecological scales and assessment scales adopted by MSs has been addressed, identifying criticalities and assumptions that are needed to consistently expand the assessment of the status of benthic communities from the smaller spatial scales (i.e. local) to the subregional and regional ones. To this end, the most updated outputs from TG SEABED (e.g. EC 2022, and the following reports) concerning regional and subregional specifications relevant to the Mediterranean were also reviewed. Finally, the IMAP Barcelona Convention process has been considered in terms of assessment of Ecological Objective 6 (EO6) for both habitat specification and scale aspects of the assessments.

The analysis allowed us to gather a series of **lessons learnt and findings** that shall guide future approaches to tackle physical pressures on the seafloor consistently.

Pertaining the elements of the assessment, it appeared that both Broad Habitat Types (BHT) and Other Habitat Types (OHT) needs to be addressed for a comprehensive assessment.

Indeed, BHT represent a valuable reference and their standard use for D6 and E06 implementation is suggested, However, there is a need of high-resolution data on their distribution and the use of EUSeaMap is thus a building block in this context- However the latter needs continuous updates and improvement from MS and CoP, who should share data to update EUSeaMap.

Pertaining other habitat classification schemes, i.e. OHT, they are also relevant for some pressures and in relation to conservation concerns, but their assessment may need even higher resolution data. To prevent a mixture of assessment scales and elements, with overlapped areas, it is suggested to apply a nested approach that allows high resolution assessments (e.g. for OHT) within BHT. In this context methods to integrate assessments across scales need to be agreed upon and tested at the Mediterranean level to ensure common implementation and prevent distortion/lack of comparability of seabed assessments.

When dealing with OHT, specific attention should be paid to biogenic habitats, whose vulnerability (and little recovery potential) deserve much attention. The assessment of biogenic habitats needs high accuracy. In particular, the evaluation of recent and historical loss of specific species/habitats shall be carried out at high habitat resolution (e.g. EUNIS 5+) entailing the need for high-resolution maps of the OHTs of concern and, more prominently, the need for data on their condition. In this context, measures developed for the protection and/or restoration of biogenic habitats shall be developed accordingly at high-resolution habitat classification.

A final remark is due on Vulnerable Marine Ecosystems (VMEs), which are a concept developed under FAO within the framework of fisheries management and are critical since their assessment is hampered by lack of historical data. Current D6 and EO6 frameworks do not consider VMEs explicitly, but the alignment of VMEs assessments and measures should be ensured, despite that a framework bridging the two is missing. This would be needed also to harmonize the measures for their protection developed in the context of fisheries management (under GFCM).

Finally, deliverable 3.1 also provides a crosswalk between EUNIS classification, BHTs, OTH and VMEs focused on the Mediterranean context as a tool to facilitate common approaches and transpositions.

D3.2 – **Proposal for a common framework for identifying/rank key pressures**, M20 (IzVRS). Status: Achieved final version M30

D3.2 Brief Description:

Deliverable 3.2 is functionally divided into two parts to allow for an in-depth representation of both aspects of the assessments, i.e. review of methods and application of a specific method to the Mediterranean Sea. Although being separated the two parts are to be considered not only complementary but part of the same assessment process. Part A of Deliverable 3.2 deals with the review of methods and applications developed in the context of MSFD and MSP to identify and assess

key physical pressures. To this end, studies applied to the identification of key pressures, and the assessment of cumulative effects in the context of the Mediterranean Sea, were reviewed. During this review, it was found that first attempts at developing methods for assessing cumulative effects and identifying key pressures of human activities on the marine environment in the EU were carried out in the context of HELCOM, which was later followed by a plethora of other international, regional or national projects and programs, especially in the northern European seas. Most of the reviewed approaches are based on the so-called Halpern approach. Many were developed to assess either cumulative pressures, impacts or effects on ecosystem components, one was developed to assess cumulative risk, and the rest only looked at the impact of one specific pressure type on a specific ecosystem component or type of ecosystem components. The output of most of the reviewed approaches comes in the form of maps and pressure rankings, which can help in identifying key pressures exerted by human activities on the environment, or can even outright identify them. This enables the prioritization of measures for the appropriate management of human activities. In the one way or the other, all approaches rely on expert judgment, but steps are being actively taken to lower its overall importance and make the whole assessment process more objective. It has also been noted that expert judgement should only be used in the setting-up of linkage networks, while at the moment it still plays a major role in the setting of sensitivity scores and impact weights. Even though almost all approaches are set up to avoid the need for extensive sets of data (because data availability is most often the main obstacle in assessing the condition of a particular environment, or the impacts of pressures generated by human activities), all of the reviewed approaches work with spatial data, and almost all of them were consciously set up to employ simple mathematical functions and/or matrices. Another important aspect is that workflows have to be transparent, adaptable and easy to understand, with detailed instructions on how to work with them. The spatial data most often contains information on pressures and on ecosystem components. In many cases, data layers holding data on human activities were also employed, either directly, or to infer other information from them, like the location of pressure origins, frequency of occurrence, etc. For some of the approaches dedicated digital tools or GIS toolboxes were developed to aid in parts of the assessment processes or to conduct the assessments in full. In most cases, the approaches were modified to incorporate additional aspects and perspectives on marine ecosystem function and/or to fine-tune the assessment processes. However, uncertainties due to a lack of clear pressure-response-recovery relationships, historical data or trends is a common throughline, so the work towards a common methodology to assess the impact of pressures from human activities on ecosystem components is still ongoing.

Part B had the goal of establishing and testing a common methodology to assess the impact of various human activities and their manifested pressures on benthic habitats as well as rank identified pressures at Mediterranean region/subregion level. To this purpose, ABIOMMED participating MSs, i.e., Croatia, Greece, Italy, and Slovenia tested a harmonised methodology of risk assessment of pressures on benthic habitats to be applied at national, subregional, and regional scale. The data used had to be consistent and comparable ensuring that the national information is integrated in the assessment process in a compatible way and thus conclusions can be deducted both at national and broader scales. The objective of the deliverable is to establish and test a common methodology to

assess the impact of various human activities and their manifested pressures on benthic habitats as well as rank identified pressures at Mediterranean region/subregion level. The identification of the key human pressures that cause physical loss and disturbance is a critical element for the adoption of a common approach towards a consistent assessment of the status of benthic habitats and the definition of common regional measures to protect sea-floor integrity. To this purpose, ABIOMMED participating MSs, i.e., Croatia, Greece, Italy, and Slovenia tested a harmonised methodology of risk assessment of pressures on benthic habitats to be applied at national, subregional, and regional scale. The data used had to be consistent and comparable ensuring that the national information is integrated in the assessment process in a compatible way and thus conclusions can be deducted both at national and broader scales.

The tested methodology allowed a full assessment of the marine area of interest, integrating all MSFD activities and pressures, as well as all ecosystem components allowing for the screening of risks and the prioritization of linkage chains for management purposes. The physical pressures examined are physical disturbance, namely Abrasion and Other physical disturbance of the seabed and physical loss, namely Sealing and Other physical loss, as well as Changes to Hydrological conditions relevant to seafloor integrity. The report reflects how the risk to ecosystems from human activities can be assessed by adopting the exposure-effect approach. Abrasion was the most intense pressure in Italy (all assessment areas) and Greece, whereas Sealing was the most intense pressure in Croatia. For Slovenia, Sealing slightly outweighed Abrasion. At the Adriatic Sea level, Abrasion generated by Fish and shellfish harvesting (professional, recreational) _DEMERSAL occupied the top 3 places.

The **main findings** of this work show that the methodology is of great use in areas where there is limited data availability, such as the Mediterranean marine region, as it can incorporate expert judgement. Although such an approach may to some extent lack precision in comparison to a fully quantitative methodology, if applied under a set of guidelines which can safeguard a common approach and rationale, consistency can be achieved, and a reliable risk assessment of the marine environment can be performed. The methodology can be applied to other MSFD descriptors to provide evidence of the intensity and distribution of pressures and combined effects if activities and pressures are selected accordingly. In addition, the suggested methodology can structure the framework to advance towards the reduction of physical impact on the seafloor caused by pressures by prioritizing the necessary measures.

The application of the methodology allows identifying data gaps to be filled in order to move from a semiquantitative risk-based approach to a fully quantitative cumulative impact assessment. the consistency ensured by the approach enables comparisons between different regions, facilitating the identification of common patterns in environmental status, as well as the pressures and threats faced by seabed habitats in different parts of the Mediterranean region. Aligned with the MSFD 6-year assessment cycle, the proposed approach can support the implementation of Descriptor 6 and contribute to the requirements of Barcelona Convention IMAP Ecological Objective 6 on sea floor integrity.

D3.3 – **Portfolio of alternative measures to reduce pressures on the sea-floor with key examples**, Achieved final version M30 (NKUA, CONISMA, ISPRA).

D3.3 Brief Description:

The achievement of Good Environmental Status (GES) necessitates addressing human activities and generated pressures that impact seafloor integrity and cause physical disturbance and loss of the seabed within the Mediterranean. Deliverable 3.3 addressed the rather complex issue of identifying the key measures to reduce physical pressures on the seafloor. The approach comprised the development of two parallel analyses, one with a deeper focus to physical disturbance determined by fisheries and another related to the assessment of a method to define the most suitable measures to reduce physical pressures in a multiple pressure context.

Part A of the deliverable D3.3 specifically addresses bottom trawling, which is the most widespread human activity extending over a large range of benthic habitats and depths in the Mediterranean and elsewhere. In the Mediterranean Sea, bottom trawling is an ancient and abundantly represented activity, and the impacts of this activity on seafloor resources and communities have been widely reported. The recent Fisheries and Oceans Pact calling for Protecting marine ecosystems and resources and strengthening the ecosystem-based approach through better science (EC, 2023 a) and the EU Action plan: Protecting and restoring marine ecosystems for sustainable and resilient fisheries (EC, 2023 b) are of major direct policy relevance to the work included in this deliverable. In this way, multiple European policies are being implemented to gradually reduce the portion of the seabed impacted by towed gears such as the bottom otter trawling. However, this progressive reduction can only be inspired by the principle of sustainability in its original dimensions: ecological, economic and social. The report provides a thorough presentation of the modelling approaches applied within the ABIOMMED project that simulated the application and estimate the potential effects of different management scenarios, based on combinations of networks of existing and/or new spatial closures. The work focuses on bottom trawling fleets in four different areas of the Mediterranean Sea. Two modelling frameworks to assess the effects of different spatial based measures for management of bottom trawling were applied. The first modelling framework, inspired by the work carried out in the ICES context, and in particular in the Workshop on Trade-offs between the Impact of Fisheries on Seafloor Habitats and their Landings and Economic Performance, represents a spatial analysis of fishing effort, of resources productivity (i.e. the spatial LPUE) and of the main economic indicators associated with the observed exploitation patterns. This ultimately allows us to rank the spatial units (i.e. the grid of cells defined for the different case studies) and explore the “internal structure” of each fishery: Where are the main fishing grounds located? Which areas can be classified as “marginal”? Which areas are more important in terms of landing value or Gross Value Added (GVA)? The second modelling approach deals with the estimation of the potential effects of different management scenarios, based on combinations of networks of existing and/or new spatial closures within the five case studies. The adaptation of the fleets, in terms of displacement of fishing effort in alternative areas, was also explored to consider the potential increase of physical disturbance of fisheries outside the closed areas. This also allowed us to gain insight into the redistribution of catch by species as a consequence of the different management scenarios. Concerning the first “static” approach, this simulation-based method could provide indications (and warnings) of possible consequences (including negative ones such as increased fishing mortality for some stocks) that might be associated with the different scenarios explored. The economic outcome of the analyzed

scenarios, as predicted by the SMART model, was significantly different depending on the case study. The explored scenarios demonstrate that '*one size does not fit all*' and in addition to universal measures, further combinations of measures with national variations will be required (e.g. FRAs, MPAs, and spatial bans) to reach these targets, as well as the MSFD and forthcoming Nature Restoration Law targets of achieving Good Environmental Status and/or where needed restoring degraded habitats. Taking into account redistribution of effort (or its restriction) would be critical to afford protection to habitats under consideration. Sala et al. (2023), while looking at technological innovations, have also concluded that no single modus operandi can solve all the seabed impacts and a combination of approaches may be the most effective way forward.

Part B of deliverable D3.3. complemented the assessment widening the perspective in the context of multiple pressures. In particular, based on the methods developed under subtask 3.2.2, the report shows how it is possible to approach the key pressures identified in a given system and identify the most suitable measures to reduce their effect. To these purposes, stemming from the identified key pressures, a risk assessment was conducted applying the Bow-Tie and LOPA analyses to assess the likelihood of failing to achieve GES due to cumulative pressures and the likelihood of impacts. In this effort, the effectiveness of D6 MSFD measures established by MS was evaluated regarding addressing the pressures and mitigating impacts, found inadequate in certain cases.

To support the implementation of Descriptor 6 of the Marine Strategy Framework Directive (MSFD), *Subtask 3.3.2: Exploring alternative measures for reducing other key-sources of pressures on the sea floor* aims at assessing measure effectiveness in addressing cumulative pressures on the sea floor to explore alternative measures for reducing these pressures. Therefore, in *Deliverable 3.3: Portfolio of alternative measures to reduce pressures on the sea floor with key examples* a risk management process is proposed providing a framework to ensure that risks are managed effectively and efficiently as well as coherently within the MSFD policy context to facilitate more effective decision making.

The risk assessment conducted applies the Bow-Tie and LOPA analyses to assess the likelihood of failing Descriptor 6 GES in the marine waters of Italy, Slovenia, Croatia and Greece due to cumulative pressures as well as the likelihood of their impacts. In this effort, the effectiveness of D6 MSFD measures established by these MS is evaluated with regards to their value in addressing generated physical pressures and mitigating their impacts. The pressures used in the analysis are identified in ABIOMMED project *Subtask 3.2.2. Proposal for a harmonized approach for the identification of key pressures and their ranking from national to subregional and regional scales*, in which a semi-quantitative risk assessment methodology is used to link human activities to generated pressures and the marine environment components impacted. The physical pressures are assessed in terms of spatial extent, frequency of occurrence, and degree of impact, integrating both quantitative (data) and qualitative (expert judgement) information, as in the Mediterranean MS investigated there are occasions of lack of data or spatial imbalance in data availability.

More specifically, the approaches applied are integrated in the ISO/IEC 31010 Risk Management Process which constitutes a practical implementation of a risk-based approach, in which the risk assessment function is integrated within the MSFD policy context. The Bow-Tie analysis, a risk

assessment technique adopted by IEC/ISO 31010:2019, is a structured approach allowing the integration of policy and management responses to address policy objectives. It incorporates the multiple physical pressures (causes) taking place in the MS and their impacts (consequences) to analyze the MSFD D6 established measures intending to prevent the causes of possible failing GES both individually and collectively and mitigate and recover from the consequences. The LOPA analysis is applied for the assessment of the likelihood of failing to achieve GES due to cumulative pressures and the likelihood of the impacts, the assessment of MSFD measures established by MS in terms of effectiveness and consistency, the equivalency analysis of existing legislation and policies. The Bow-Tie and Lopa analysis are applied on the key pressures of the exhaustive list of activities generating physical pressures induced on the seafloor identified in Subtask 3.2.2. Abrasion related to fishing, and sealing caused by structures present the highest risk among physical pressures to impact seafloor integrity; the former spread over different broad habitat types, in a persistent manner and with intense impacts; the latter appearing locally, persistently with an acute impact.

The Bow-Tie analysis highlighted that the established prevention measures are not in most cases effective in managing the cumulative pressures generated across sectors and in reducing the likelihood of seafloor integrity being adversely affected. The IEC/ISO 31010:2019 Bow Tie and LOPA analyses can be useful methodologies to support management strategies aiming to prevent pressure effects and mitigate impacts on seafloor integrity in the framework of the Barcelona Convention. It is also shown that the combination of approaches (detailed spatial data and semi-quantitative analysis) is the most effective way forward in data-poor areas providing different levels of detail.

D3.4 – **Roadmap towards common assessment and measures to limit physical disturbance on sea-floor integrity in the Mediterranean Sea**, M29 (ISPRA).

D3.4 Brief Description:

The Mediterranean Sea is a biodiversity hotspot which hosts several endemic species and many vulnerable habitats, whose status is affected by a range of physical, chemical and biological anthropogenic pressures. Several policies and technical frameworks address its protection, via a series of assessments and measures. The deliverable reflect on the status of development of a common approach to protecting the Mediterranean Sea-floor in the context of MSFD and IMAP, identifying the major scientific gaps that will need to be tackled to make both assessments and measures operational. For this purpose, we considered the latest developments for a proposal for the IMAP Ecological Objective 6 (EO6) within the Barcelona Convention, the technical development achieved within the framework of TG Seabed, the MSFD Article 8 guidance for assessments of Descriptor 6 and progress achieved in relevant technical groups. Information gaps were classified according to four categories: i) knowledge base (data), ii) scientific methods for assessing impacts, iii) setting measures, and iv) the multilevel interlinkages between policy and scientific frameworks. Based on ad-hoc elaborations and a compilation of the latest applications we identify a series of steps, methods, approaches and critical issues that should be taken into account to fill this knowledge gap and propose a roadmap for future use in the context of the Mediterranean.

In particular, we suggest (among others) to i) build on the IMAP proposal for EO6 (stemming from ABIOMMED cooperation between Activity 6 and 3) as this is an overarching framework that allows modulation according to specificities and future scientific improvements; ii) learn from latest Med QSR to identify gaps in data, methods and align with plans for addressing future needs; iii) Support work and exchange between Med experts and the work carried out under TG Seabed, in particular in the subgroup with focus on the Mediterranean Sea; iv) streamline data collection processed building bridges and synergies among policies and frameworks; v) Build on models developed to assess fisheries management scenarios to engage fisheries institutions (GFCM, EC) and the stakeholders' sectors in identifying solutions to protect seabed and VMEs; vi) apply spatial cumulative pressures modelling and visualization, and if the context of lack of data, apply risk-based approach developed under ABIOMMED; vii) ensure appropriate platforms and WG (institutional, science organizations, projects) can contribute to science development through facilitating data exchange and use, and providing adequate economic support; viii) Actively contribute to the revision of the EcAp and MSFD process; ix) capitalize on EU research projects and insights/directions (not only ABIOMMED but also e.g. NEA PANACEA, GES4SEAS); x) Improve Mediterranean-wide data sets on pressures and impacts/habitat condition by CoPs/MS contributing to IMAP (links to ETC/ICM); xi) Build specific processes for key solutions needed (e.g EUSeaMap updates) to let them are enforced.

Problems encountered

A critical point for the development of the activities under Task 3.1 was the dynamicity of the technical and scientific developments in the given context and the uneven data availability and technical standards across countries. This was addressed ensuring that all actors and expertise were represented or informing the process.

Key to progressing in the activity was thus the sharing of the knowledge base to facilitate exchange among scholars and institutions which was achieved also through the MS.

The dialogue between Activities 3 and 6 prevented the development of separated, inconsistent workflows. On the opposite, thanks to the continuous exchange among experts in the ABIOMMED consortium, and those from the consortium joining EU and MED experts groups (TG Seabed, GFCM, ICES WGs, Experts of the Online Benthic group) the identification of key habitat types and classification schemes was facilitated fostering a standard implementation of an assessment approach at EU and Mediterranean level, while also allowing the sharing of methods to address physical pressures through common measures (see also Task 3.2).

The most critical point for the implementation of the Task 3.2 was the actual availability of data and experts for testing the cumulative pressure approach. In particular, the need for coding data with different levels of accuracy into the categories adopted for the risk-based approach implementation emerged. Such a process needed much effort from the partners, to ensure that a common approach was found, and it was coped with the increased availability of partners, beyond (and above) what was originally expected. This allowed intercomparison between high-resolution and low-resolution data and making assessments not only at national level but also at subregional level (i.e. Adriatic Sea). Several meetings allowed the definition of clear guidelines for such coding, from fully quantitative to

semiquantitative approaches, which represents a plus for a future setting of methodologies to rank and identify main physical pressures to the seafloor.

Different levels of difficulties were faced within the development of Task 3.3, that needed a certain degree of adaptation to the given conditions. The first issue regarded the sharing of data for fisheries simulations, which needed formal requests and agreement with national authorities slowing down the process. Given the major attention towards fisheries measures, it was also necessary to adapt the MS3.3 program/content, orientating the interactions in particular with those institutions mainly dealing with fisheries management whilst ensuring dialogue with the others to be maintained. Regarding the identification of most promising measures under Task 3.3 the work was further complicated by the need for input from several MSs experts, a condition that was tackled by dedicating multiple internal meetings to achieve the goals. Finally, also MS3.4 needed adaptation to ensure that the very dynamic technical and scientific debated around D6/EO6 implementation was informed by Activity 3. The strategy we selected was to ensure our approach (e.g. for testing alternative fisheries measures and related findings, addressing scales, including VMEs) was presented -and were possible-further tested/considered in the international WGs like those established under CIS (TG seabed, ICES and WGVMEs).

Activity 4: Streamlining Descriptor's D1 selected criteria regarding mammals' species groups (small toothed cetaceans, deep diving toothed cetaceans and baleen whales) towards coordinated monitoring and assessment in the Mediterranean

Lead: ACCOBAMS

The aim of Activity 4 was:

- To streamline the monitoring of D1 cetacean related criteria in the Mediterranean Sea, in particular by supporting regional coordination between EU countries and cooperation with non-EU countries;

- To capitalize on available information on the species groups (small toothed cetaceans, deep diving toothed cetaceans and baleen whales) on the basis of the information already acquired by EU Countries throughout the national monitoring programmes;

and in accordance with the 2017 Commission Decision on Good Environmental Status (Commission Decision 2017/848), to:

- further develop and operationalize cetaceans related criteria,
- support coordinated assessment of Mediterranean cetacean species, including the definition of D1C1, D1C2, D1C4 and D1C5 threshold values,
- assess and improve the consistency of the determination of GES related to cetacean species.

Work completed

Task 4.1: Strengthen regional coordination and cetaceans monitoring (Lead: ACCOBAMS)

The proposed ABIOMMED Working Group on cetaceans monitoring under MSFD was set up in M8 in line with Milestone MS4.2. Researchers/managers/experts in charge of the definition/implementation of their country's MSFD cetacean monitoring program were officially appointed by ACCOBAMS Focal Points. It was composed of national experts from EU Mediterranean Countries (Croatia, Cyprus, France, Greece, Italy, Malta and Spain – Expert from Slovenia was not appointed). Considering the ACCOBAMS geographical scope, the EU Black Sea countries (Bulgaria, Romania) and Portugal were also invited to appoint national experts to promote exchange of experience between the different marine regions. Subsequently, the experts from the EU Black Sea countries joined the Working Group. During the project period, altogether 3 meetings of the Working Group were organized (2 online meetings and 1 face-to-face meeting, with a possibility of online participation) (see MS4.3 and MS4.5)

The Task 4.1. produced two specific Deliverables (Review of the different elements of the MSFD related to cetacean in the EU Mediterranean countries, D4.1. and Report of the meeting of the Mediterranean working group on cetacean monitoring under MSFD, including recommendations on assessment, GES determination, criteria and thresholds D4.2.). A Consultant tasked to provide assistance to the ACCOBAMS Secretariat in the implementation of Task 4.1, in particular in the coordination of the Working Group activities and preparation of relevant project expected deliverables was recruited in March 2022 (Month 9).

As a next step, a **Policy Brief** on Activity 4 for was prepared. The objectives of this Brief are: to ensure that Activity 4 recommendations are perceived and further taken into account by European Commission and in general policy makers which participate in decisions about GES assessment under MSFD and related processes at the EU level; as well as to communicate the Activity 4 results to other relevant/interested institutions in the EU and beyond, such as intergovernmental organizations (agreements), national and regional authorities, research institutions and other relevant experts etc.

The Policy Brief summarises **r**ecommendations coming from Activity 4 in a condensed and user-friendly format and manner, including linkages to relevant policies and references to more detailed documents deliverables), as well as listing of institutions which are authors or supporters of such a Brief.

Task 4.2: Proposal for defining a roadmap to set the threshold values for cetaceans' related criteria

Review of existing information provided form the previous Task 4.1 to identify whether this can be representative and usable for trend analysis.

Review of existing threshold values definitions within the HD, MSFD and Barcelona Convention's EcAp/IMAP (with a view to other global and regional contexts: IWC, OSPAR, HELCOM)

The Task 4.2 produced the specific Deliverable D4.3 – Proposals for the definition of threshold values for cetaceans' related criteria and the Milestones: MS4.4 – Advanced drafts of deliverables 4.1, 4.3, 4.4, 4.5 and 4.6 (January 2023, M19) and MS4.6 – Proposal for the definition of threshold values for cetaceans' related criteria (Deliverable 4.3 – Task 4.2, May 2023, M23)

Task 4.3: Spatial distribution modelling

The Task 4.3 on *Spatial Distribution Modelling*, coordinated by CoNISMa (Local Research Unit of Bari), provided updated knowledge about distribution and suitable habitats for cetaceans' species regularly occurring in the Mediterranean Sea and contributed to evaluating how local datasets could complement the systematic national monitoring to improve the general knowledge on distribution and habitats of the species, in the general context of the assessment of MSFD criteria D1C4 and D1C5.

To reach the objectives of Task 4.3, it was decided to implement a participatory process to put on the table all the data and skills available to obtain a shared approach on the distribution modelling that can be of real support to the plans that are carried out within the Marine Strategy.

The idea to involve in the process several organizations/institutions, in addition to the units involved in other Tasks of Activity 4, is to expand the comparison and sharing network to achieve common objectives. Therefore, the first step was to invite organizations adhering to *Intercet* platform (https://www.intercet.it/), a web-based GIS, belonging to Region Liguria and managed by Fondazione Acquario di Genova, including a wide database of cetacean' sightings collected during several projects in different areas of the Mediterranean Sea. Successively, all organizations interested to be involved in the project decided how to provide their contribution in terms of time and data to dedicate/share. Finally, three working groups were established. The first one was focused on gathering basic information on areas and groups involved in cetacean monitoring in order to learn about historical series and typology of data available; the second aimed at providing an update review of techniques on Spatial Distribution Modelling; the last one focused on issues related to which tools and indicators could be suitable for responding to the requests of D1C4 and D1C5 through the implementation of case studies. The organization of 3 technical meetings and the participation in meetings and joint workshops organized by ABIOMMED partners enabled a constructive comparison and discussion of issues related to cetacean conservation in the context of different directives or conventions (e.g., Habitat Directive, Barcelona Convention, MSFD) by several field experts. These meetings immediately pointed out critical points such as the fragmentation of the available knowledge, both in spatial and temporal terms, and the heterogeneity of the data and of collection methodologies relating to the different species (e.g., different types of sampling, different platforms of observation) which can hinder the knowledge synthesis process. Further critical points addressed related to the possibility of jointly analysing datasets deriving from investigations conducted in different ways as well as to the difficulty of establishing reliable indicators to evaluate the complexity and variability of ecological processes. However, from the implementation of case studies emerged that there is the possibility of modelling the distribution of different species through a joint analysis of data deriving from opportunistic and standardized surveys (for example, FLT or distance survey sampling by vessels) through the use of Species Distribution Modelling techniques. Case studies provided a detailed description of strengths and weaknesses of the specific approach adopted according to the objective of the work as well as future improvements, recommendations to better address the issue related to which tools and indicators is possible to adopt in the framework of D1C4 and D1C5. What emerged from experiments done is the need to increase research efforts to provide answers or put fixed points to questions and critical issues.

Main recommendations derived from the activities carried out during the project are:

- the need to support adequate standardized vessel surveys to monitor spatial and temporal areas coherent with species ranges and ecological condition, migratory displacement distribution (highlight monthly, seasonal and yearly variability) in the Mediterranean;
- the need to support the process of identification of the "best" SMD technique for the type of data/sampling design available.

Main outcome has been the Deliverable D4.4 - *Report on the Spatial distribution modelling and the application of criteria for the assessment of D1C4 and D1C5,* which was achieved through a participatory process developed by the Scientific Responsible of the Task together to "ABIOMMED community" to achieve the main goals of the Task 4.3 in a series of technical meetings of responsible Partners of Task 4.3, 4.4, 4.5 for definition and implementation of a joint approach (MS4.1).

Milestones of Task 4.3: MS4.4 – Advanced drafts of deliverables 4.1, 4.3, 4.4, 4.5 and 4.6 (January 2023).

Task 4.4: Complementarity of results from different large-scale monitoring platforms

Monitoring schemes launched by EU countries may differ in terms of spatial and temporal scales, frequency of surveys and platforms used. Three mains large scale surveys schemes collecting data at sea and covering large Mediterranean areas exist: Aerial - based surveys, sometimes implemented every 6 years, Ferry - based surveys running each year (FLT Med Net) and - Boat - based surveys (small-scale surveys). The challenge is to integrate those spatially/temporally complementary datasets to assess monitoring criteria. Furthermore, data collection is time-energy-money consuming and therefore using existing datasets may be economic; Cetaceans are rare data in a statistical point of view, therefore, using more data may allow more precise or robust results and finally, surveys are spatio-temporally imperfect, therefore using the complementarity (spatial and/or temporal) of the different surveys may give a more complete picture.

The work within Task 4.4 was planned through 3 main steps:

- Step 1: review and compare (SWOT) methodologies to address D1C4 (distribution) and D1C2 (abundance)
- Step 2: tests on methodologies and indicators
- Step 3: Framework and recommendations

The related Deliverable **is D4.5***: Complementarity of results from different large-scale monitoring platforms has been the main product.* This deliverable developed a methodological framework for the evaluation of the status of cetacean populations distribution and abundance, proposing practical recommendations for the implementation of indicators for the relevant criteria. It also presented step 1 and 2 for D1C2 (SWOT analysis, test with 1 new method, 1 indicator tested) and the development of a new method (SPDE-Inlabru), which could answer both D1C2 and D1C4 through the same analysis.

The results and discussion lead to recommendations, considering:

- design for the collection of data at sea
- analysis for D1C4
- analysis for D1C2

Also included and discussed at the final meeting of task 4 (June 2023) and highlight the need of regular «synergy workshops».

In summary of the global work, considering D1C4, this study shows that to answer the MSFD criteria, the monitoring should ensure comparability in terms of area surveyed, even cells crossed, and the indicators used:

• Need to take into account the effort, and so the HD method is absolutely not adjusted for cetaceans,

• Need interpolation through model-based method, ideally species-specific,

• Input cells should be larger than 10x10 km,

• Aggregating data is valuable to fill spatio-temporal gaps.

Considering the indicators for D1C2, Ferry and aerial datasets give different abundances, depending on correcting factors, but over a common area the numbers are of the same order of magnitude. Considering the trends, which are seek by the MSFD, the block-kriging method is relevant. Considering the complementarity of existing sampling schemes, from aerial to ferry and also small-vessel, in terms of spatial and temporal coverage, tests were made to aggregate existing datasets using geo-statistics and block-kriging and furthermore, a promising method the SPDE.

Two workshops were organized gathering experts from statistical field, scientists in charge of national MSFD assessment and representants of different international working groups or European projects working also on indicators. Their outcomes are listed in the relevant milestones' reports.

Task 4.5: Comparison results of different temporal and spatial scale studies

The work done by Tethys research institute is included within the framework of activity 4 "Streamlining Descriptor's D1 selected criteria regarding mammal species groups (small toothed cetaceans, deep diving toothed cetaceans and baleen whales) towards coordinated monitoring and assessment in the Mediterranean region". Task 4.5 concerning "Comparison results of different temporal and spatial scale studies" was led by Tethys Research Institute involving also ISPRA, CoNISMa and Eco Ocean Institute. Aim of the study was to assess the effect of environmental variability in determining changes in the pattern of cetacean occurrence and the correlation of such changes with environmental factors of influence. Temporal trends analysis has been performed concerning the pilot area (i.e., the Pelagos Sanctuary) where cetacean long-term data series are available and have been correlated with some environmental (e.g. SST, chlorophyll-a) and anthropogenic predictors (e.g. naval traffic, fishing boats, proximity of ports or other marine infrastructures). The data series derives from 32 years of dedicated shipboard summer surveys, conducted by Tethys Research Institute between 1990 to 2021. Species studied are Balaenoptera physalus and *Stenella coereluoalba*.

The environmental covariates influence the spatial distribution patterns of both species which tend to be more disperse in conditions of lower primary productivity and higher SST.

This could be a first indication of system distress, as the trend in recent years sees a decrease in primary production in the area.

The aim of this task is to determine the size of the environmental variability that affects the distribution of these species and, based on the assessed correlation, to provide a guideline to better interpret the results of short-term synoptic surveys. Future aerial surveys then could take this into account when designing the survey, perhaps providing more coverage during periods when more animals are expected to congregate.

The descriptors outlined in the Marine Strategy Framework Directive (MSFD) are primarily designed to facilitate trend detection. However, the ability to identify trends may face challenges due to environmental variability and the temporal resolution of monitoring efforts. The temporal resolution of the assessments in fact is critical when studies concern highly mobile species interacting with dynamic oceanographic processes that vary at different time scales. Synoptic surveys, conducted to evaluate species abundance on a large scale, typically exhibit a temporal resolution ranging from days to a few weeks. Nevertheless, the temporal variability in species distribution has the potential to impact both the accuracy and precision of population size estimates. This effect should be considered with particular attention when designing synoptic surveys to estimate the abundance of species with low population density since a low coverage of the area might result in a low number of detections, and consequently in less accurate estimates of abundance.

This work resulted in Deliverable 4.6: *Assessment of potential factors of uncertainty on large-scale synoptic surveys assessing distribution and abundance of highly mobile species*

Insights for Task 4.5 were also presented for review and discussion during the face-to-face Workshop/meeting and contribute to the road map to set the GES threshold values for cetaceans' related criteria.

Achievement of milestones and deliverables

Milestones:

MS4.1 - Technical meetings of responsible Partners of Task 4.3, 4.4, 4.5 for definition and implementation of a joint approach (from November 2021 to Mid-2022). Achieved: Three online technical meetings (20 January 2022, 18 March 2022, 28 June 2022)
MS4.2 - Establishment of Cetacean Med MFSD Working Group (Task 1) by early 2022 – Month. Achieved: 9 -5 May 2022, online

MS4.3 - Cetacean Med MFSD Working Group 2nd meeting (M15) - Achieved: 16 November 2022, online
MS4.4 - Advanced drafts of deliverables 4.1, 4.3, 4.4, 4.5 and 4.6 (M19, January 2023)

MS4.5 – Final Cetacean Med MFSD Working Group Face to face meeting/workshop in Italy (first trimester 2023) – Month 21. Achieved: 14 and 15 June, 2023, Rome, Italy
MS4.6 – Proposal for the definition of threshold values for cetaceans' related criteria (Deliverable 4.3 – Task 4.2, May 2023)

Deliverables:

D4.1 – **Review of the different elements of the MSFD related to cetaceans in the EU Mediterranean countries** M29 (ACCOBAMS). Status: Achieved M29

D4.1 Brief Description:

The aim of the *Review of the different elements of the MSFD related to cetaceans in the EU Mediterranean and Black Sea* (Deliverable 4.1, extended to a Black Sea region) was to improve present MSFD reporting on cetaceans for Descriptor 1 criteria (D1C1, D1C2, D1C4, D1C5 and secondary criterion D1C3). In doing so, it particularly analyses for each Mediterranean EU Member State their current monitoring systems and endeavours, GES assessment approach, data availability and level of sub-regional/regional cooperation while implementing all these tasks. It further identifies gaps and limits of current systems and recommends future improvements.

The collection of relevant data and information required for the analysis started with a review of available materials, particular the National and Regional (Mediterranean Sea) technical reports of Member State's 2018 updates of MSFD Articles 8, 9, 10 and JRC reviews. However, it was soon recognized that a more detailed level of information is needed. Hence, a specific questionnaire was designed (jointly by ISPRA and Consultant) and distributed to the representatives of relevant EU countries. In order to ensure the questionnaires are filled by countries, a series of online consultation meetings was organized during March and April 2023 at sub-regional level (Adriatic Sea, Aegean-Levantine Sea, Ionian Sea and Central Mediterranean Sea, Black Sea and part of the Western Mediterranean Sea), supported with bilateral exchanges with experts from individual countries. As a result, altogether 9 (of distributed 10) questionnaires were filled, covering following countries. Bulgaria, Croatia, Cyprus, France, Greece, Italy, Malta, Romania, Spain. Slovenia did not send the filled questionnaire and hence data for this EU MS could not be included in the Deliverable 4.1. It should be noted that information provided by country representatives were also used for preparation of the Deliverable 4.3. *Proposals for the definition of threshold values for cetaceans' related criteria*, coordinated/prepared by ISPRA.

D4.2 – **Report of the meeting of the Mediterranean working group on cetacean monitoring under MSFD, including recommendations on assessment, GES determination, criteria and thresholds.** M29 (ACCOBAMS). Status: Achieved M29

D4.2 Brief Description:

As a key step in implementation of Activity 4, the face-to-face meeting of the Working Group was organized on 14 and 15 June 2023 in Rome, hosted by the Italian ISPRA. The objectives of the meeting were: to review different deliverables prepared by Activity 4 project partners and to prepare common recommendations, in particular regarding definition of threshold values for MSFD D1 cetacean

related criteria; and to facilitate regional coordination and exchange of information between the EU and non-EU countries, in particular in the context of the Ecosystem Approach (EcAp) lead by UNEP/MAP. The first day of the meeting (14 June) was opened to wider audience and the second day (15 June) was dedicated to meeting of the Activity 4 Working Group and partners. Altogether 36 participants attended the meeting, mostly present face-to-face: ABIOMMED WG members, Activity 4 partners, experts from non-EU countries, representatives from European Commission, Regional seas conventions: UNEP/MAP SPA/RAC, Black Sea Commission, ASCOBANS and CetAMBIcion project.

The meeting offered a unique opportunity to exchange information and learn more about the MSFD/GES assessment in the EU, particularly in other regions/sub-regions (e.g., taking benefit of the work done by ICES), as well as other GES assessment processes in the Mediterranean and Black Seas; notably in the scope of the UNEP/MAP EcAp/IMAP and BSIMAP. Furthermore, the meeting was also an opportunity to exchange information and experience with other similar projects. Based on the presented ABIOMMED draft deliverables, and taking into consideration other information presented at the meeting, the Working Group adopted a number of Conclusions and Recommendations for a future improvement of monitoring, GES assessment methodology, data availability and format, as well as regional cooperation.

D4.3 – **Proposal for defining a road map to set the threshold values for cetaceans' related criteria**. M29 (ISPRA). Status: Achieved M26

D4.3 Brief Description:

The study summarizes the different opinions to define threshold values for cetacean-related criteria, especially regarding the various approaches used by relevant Regional Sea Conventions and individual EU Member States.

For criteria D1C1 values for both Recovery Factor - FR and the Annual and population grow rate - Rmax are proposed to be considered in the Potential Biological Removal (U.S. version) formula according to the IUCN conservation status of the species. Data have been produced from the ASI abundance estimates of all species assessed. The same data have been deemed as a reference value for the D1C2 criterion. Regarding the D1C4 component on the species range (distributional range), the Habitats Directive webtool (range tool) was applied to four Mediterranean cetacean species: fin whale, sperm whale, striped dolphin and common bottlenose dolphin, using only Italian aerial surveys data collected in the MSFD framework in the two periods 2000-2018 and 2020-2023. Fin whales' range was investigated considering the ASI 2018 data on the whole Mediterranean Sea. Regarding distributional pattern (second component of D1C4) and habitat for species (D1C5), there is a general agreement that the current data and modelling approaches do not allow a quantification of these criteria, nor provide comparable maps. Member States will submit maps for a purely descriptive purpose at this stage.

Finally, a series of key recommendations identified focus on what still needs to be done (1) to obtain consolidated "thresholds" and "reference values", at least for the D1C1 and D1C2 criteria to inform management measures and (2) to facilitate their adoption by all Mediterranean EU countries at regional and sub-regional level.

D4.4 – Report on the Spatial distribution modelling and the application of criteria for the assessment of D1C4 and D1C5, M29 (CoNISMa). Status: Achieved M28

D4.4 Brief description:

The deliverables aim to present steps and results of participatory process developed by the Scientific Responsible of the Task 4.3 together to "ABIOMMED community" to achieve its the main goals.

Task 4.3 aimed to provide an updated summary of information available (research units/expertise/data) on cetacean's sightings and distribution in the Mediterranean region (sensu MSFD), as well as suggestions/recommendations to the system management procedures relating to the implementation of criteria D1C4 and D1C5 of Descriptor 1-Biodiversity of the MSFD. To reach these objectives, the responsible for the task decided to implement a participatory process able to put on the table all the data and skills available to obtain a shared approach on the distribution modelling that can be of real support to the plans that are carried out within the Marine Strategy.

Therefore, the first step was to invite organisations adhering to Intercet platform (https://www.intercet.it/), a web-based GIS, including a database of cetacean' sightings collected during several projects in different areas of the Mediterranean Sea. In particular, it was decided to work on different and complementary themes by establishing 3 working groups. The first one was focused on gathering basic information on areas and groups involved in cetacean monitoring in order to learn about historical series and typology of data available; the second one was aimed to provide an update review of techniques on Spatial Distribution Modelling; the last one focused to address issues related to which tools and indicators could be suitable for responding to the requests of C4 and C5 through the implementation of case studies.

This allowed for a constructive comparison and discussion of issues related to cetacean conservation in the context of different directives or conventions by several experts in field that pointed out as critical points the fragmentation of the available knowledge, both in spatial and temporal terms, and the heterogeneity of the data and of collection methodologies relating to the different species (e.g., different types of sampling, different platforms of observation) which can hinder the knowledge synthesis process. Further critical points addressed were related to the possibility of jointly analysing datasets deriving from investigations conducted in different ways as well as to the difficulty of establishing reliable indicators able to evaluate the complexity and variability of ecological processes. However, from the implementation of case studies emerged that there is the possibility of modelling the distribution of different species through a joint analysis of data deriving from opportunistic and standardised surveys (for example, FLT or distance survey sampling by vessels) through, for example, the use of Species Distribution Modelling techniques. Case studies provided a detailed description of strengths and weaknesses of the specific approach adopted according to the objective of the work as well as future improvements, recommendations to better address the issue related to which tools and indicators is possible to adopt in the framework of D1C4 and D1C5. What emerged from experiments done is the need to increase research efforts to provide answers or put fixed points to questions and critical issues.

A first main recommendation is the establishment of an official monitoring network on a spatial scale representative of species range and ecological conditions, as well as temporally representative of main species migratory/displacement distribution (highlight monthly, seasonal and yearly variability). This network should include related local, national and regional institutes and organisations within the Black Sea and Mediterranean Sea and should gather and combine data from opportunistic and systematically designed dedicated boat surveys as well as the aerial surveys. The second recommendation is the need for constant (e.g. biannual, to be defined) discussion/interaction between the scientific community and the management system to implement tools useful to develop effective implications for the conservation and management of cetaceans from the assessed human impacts.

The motivation towards the creation of cooperative projects at different scales, sub-regional and regional (sensu MSFD), represents a great opportunity to pool data which, taken individually, would not necessarily reflect the distribution of species on a larger scale but which analysed jointly would allow the acquisition of information on suitable habitats at a broad regional level. Therefore, the step that must necessarily be taken is that of implementing programs and projects dedicated to the conservation of cetaceans which allow the collection of information which otherwise will always remain fragmented and non-homogeneous. Finally, a global framework is presented, based on the conclusion of the tests on methods and indicators of this study, for D1C4 merely and for D1C2

D4.5 – Report on the complementarity of results from different monitoring platforms, airplane, boat and ferry, to answer the MSFD criteria for cetaceans, M29 (EcoOCean) Status: Achieved (M29)

D4.5 Brief description:

This report is the final report on the work done by EcoOcéan Institut about the MSFD Descriptor 1 on cetaceans, Criteria D1C4 considering spatial distribution and D1C2 considering abundances. It includes an introduction about the frame of this work, and the global objectives. Then it presents the final version of the overview of methods used or recommended to obtain results for D1C4 through a Strength/Weakness/Opportunities/threat (SWOT) analysis of the literature. The aim was to classify categories of method/indicator used considering several parameters (statistical advantages and disadvantages, type of data needed, complexity of implementation and ease of interpretation). At least eighteen methods were found, from simple ones to more complex ones. This table was shared, discussed and completed during a workshop with experts. All those firsts' results were presented in the draft report (David *et al*., 2022).

From that workshop was decided to use the same datasets (large-scale surveys implemented officially for MSFD by countries) and launched tests with a simple method recommended by the EU Commission and more complex ones, as Kernel and kriging, in order to compare results obtained for D1C4. Tests conducted with their associated maps and indicators are presented for fin whale. Those tests were conducted for two large-scale data set, aerial and ferry- based survey, and for two periods of successive years. Those further results were presented in the draft advanced report.

A similar literature review with a SWOT analysis has been conducted for D1C2 (abundance). Following, tests with block kriging have been realised and through maps of densities obtained by

including some parameters (effective strip-width, group size and availability) abundances of fin whale were obtained. Ferry and aerial datasets give different abundances, but over a common area the numbers are of the same order of magnitude. Considering the trends, which are seek by the MSFD, the method can be helpful.

Considering the complementarity of existing sampling schemes, from aerial to ferry and also small-vessel, in terms of spatial and temporal coverage, tests were made to aggregate such datasets using kriging and furthermore, a promising method the SPDE.

Finally, a global framework is presented, based on the conclusion of the tests on methods and indicators of this study, for D1C4 merely and for D1C2.

D4.6 – **Evaluation of potential factors of uncertainty on large-scale synoptic surveys assessing distribution and abundance of highly mobile species**, M29 (Tethys). Status: Achieved M29

D4.6 Brief description:

Highly mobile species interact with dynamic oceanographic processes that vary at time-scales from days to decades. Aim of this deliverable is to outline the lessons learnt from a long-term monitoring study concerning occurrence, spatial and temporal distribution of cetacean species in an area of about 40,000 km2 included within the Pelagos Sanctuary in the NW Mediterranean Sea. The data series derives from 32 years of dedicated shipboard summer surveys from 1990 to 2021, conducted between May and October. Indices of spatial patterns have been applied to the sighting data of the most frequent species (i.e., *Stenella coeruleoalba*, N: 4,458; *Balaenoptera physalus*, N: 1,036 sightings) and their variability was analysed in time. The analysis of the species distribution patterns revealed a significant temporal variability (Kruskal-Wallis: $P<0.01$). Concurrently, satellite area-averaged time series of 4 km chlorophyll-a (hereinafter chl-a) and sea surface temperature (hereinafter SST) were analysed. Since SST and chl-a are seasonally linked, present clear trends in the study area which are also correlated, the analysis was focused on chlorophyll in reason of its relevance for the marine ecosystem. A Hierarchical Cluster Analysis allowed to identify five clusters of chlorophyll-a monthly pattern. The spatial distribution of the two species was found more clumped in years where the chlorophyll-a concentration was lower, and its spatial pattern more homogeneous, while it was dispersed in years where the chlorophyll-a concentration was higher, and its spatial pattern more heterogeneous. These results suggest that the temporal variability of the species distribution may be affected by chlorophyll-a spatial patterns varying in time. A following simulation study based on 1,000 randomized sightings over an area of about 90,750 km2 allowed to demonstrate how such patterns have also the potential to affect the estimates deriving from synoptic surveys aimed to assess abundance of species at large scale.

Activity 5: Socio-economic analysis of measures

Lead: Plan Bleu

Work completed

Task 5.1. Literature Review on Ex Post Socioeconomic Analysis

Literature review on ex post socioeconomic analysis of measures in the Mediterranean area has been conducted with the contribution of activity 5 partners through remote desk work and frequent online meetings with the members of ABIOMMED and external partners. The aim of this targeted desk work was to obtain, review and synthesize available literature, and also to identify gaps. Online meetings with all partners facilitated the exchange of comments, suggestions for "additional literature" and to obtain feedback and comments about general and specific aspects of the literature review. This allowed to obtain a document which provides an overview on socioeconomic outcomes observed after the implementation of MSFD and Barcelona Conventions measures by the riparian countries of the Mediterranean. It also provides some insights on the conditions for these outcomes to be observable and measured. All in all, the work undertaken allowed to gather the necessary scientific knowledge and expertise for a comprehensive targeted literature review, a useful first tool for the Mediterranean community and for policy makers.

The main output of this work is Deliverable D5.1 "Compendium and critical analysis of ex-post socioeconomic assessment of measures carried out in the Mediterranean" which was accomplished aided by a number of dedicated workshops/Milestones (MS 5.1a, 5.1b and 5.1c, workshops during the SHECAP and WG POMESA meetings, see relevant section below)

Task 5.2: Recommendations for Ex Post Socioeconomic Analysis

An overview of issues limiting implementation of ex-post socio economic assessments of measures in the Mediterranean was produced. To address this issue, recommendations were formulated based on literature reviews, partner experiences and input from stakeholders. The report is thus also dedicated to helping decision-makers, who are willing to benefit from ex-post socioeconomic studies, facilitate their emergence and implementation. Therefore, extra attention was put by all partners for the report to discuss the need for institutional support and provide recommendations to overcome key challenges, including scarcity of data and of resources. Work specifically capitalized during the SHECAP meeting of ABIOMMED, held in Athens on 24-26 October 2022, during the discussions on the needs and means of implementing such analyses, involving participants from competent authorities, international organizations, and research partners.

Deliverable produced was D 5.2: Guidance and best practice report to streamline and conduct further ex-post socioeconomic analysis of measures in the Mediterranean. The task was supported by a number of dedicated workshops /Milestones (MS 5.2a and 5.2b, workshops during the SHECAP and WG POMESA meetings, see relevant section below)

Task 5.3: Original Ex-Post Socioeconomic Assessment

Desk review of available data/documentation and application of existing scientific methodologies, combined with qualitative interviews and stakeholder consultations conducted under Task 5.3, manifested in an original ex-post socioeconomic assessment of measures. The desk review served as the foundational step, delving into a variety of sources ranging from academic publications to governmental reports, extracting valuable insights and trends that contribute to a nuanced understanding of the socio-economic landscape. All partners provided their suggestions for literature

to be included, strengthening the overall work. Qualitative interviews (for example in Palamos fisheries, in MPAs such as Bagaud, for case studies, see also below) allowed capturing the nuanced perspectives of individuals directly impacted by the measures. Through these interviews, personal experiences, opinions, and contextual factors came to the forefront, enriching the analysis with qualitative depth. Stakeholder consultations further broadened the scope, incorporating the viewpoints of diverse groups, fostering a more inclusive and comprehensive assessment. This assessment also probes into the benefits, costs, distribution, regional/cross-border aspects, and decision-making utility of implemented measures. Distributional aspects were scrutinized to understand how the benefits and costs are distributed, shedding light on potential disparities and enabling the formulation of targeted policies to address any inequities that may arise from measures implementation.

The work is described under Deliverable D5.3: "Report on ex-post socioeconomic analysis of a regional biodiversity-related measure'' and accomplished through a number of dedicated workshops /Milestones (MS 5.3a, 5.3b, 5.3c and 5.4d, workshops during the SHECAP and WG POMESA meetings), see relevant section below)

Task 5.4. Stakeholder Dialogue and Information Enrichment

The task primarily centered on stakeholder interactions, including collaborative meetings with partners to share documentation and gather pertinent information relevant to Tasks 5.1, 5.2, and 5.3. Notably, Plan Bleu participated in essential EU MSFD WG POMESA meetings on 12 October 2021, 10 May 2022, 18 October 2022, 20 April 2023 and 9 October 2023. Meanwhile, all partners actively participated in workshops/sessions throughout the project, presenting ongoing work, such as AZTI discussing their preliminary assessment tool and SPA/RAC and IZVRS providing constructive comments and suggestions. Such participation in high level coordination or national MSFD related fora/meetings proved instrumental in complementing the literature review and gaining critical insights into Member States' interests and practices concerning ex-post socioeconomic studies. Additionally, discussions were held with the ABIOMMED Activity 6 team to facilitate seamless coordination between activities 5 and 6, ensuring cohesive and synergistic efforts within the project.

A number of milestones reached and workshops/sessions were delivered (MS5.4a, MS5.4b, MS5.4c, MS5.4d and MS5.4e). These milestones during the SHECAP and the WG POMESA meetings represented a consistent and ongoing effort to engage stakeholders and disseminate the findings and progress of the project within relevant forums.

Achievement of milestones and deliverables

Milestones

MS5.1.a - Workshop on Activity 5 during 2nd SHECAP meeting (M6): Status: achieved -Merged in larger Activity 5 Workshop during SHECAP meeting (24/10/2022 – 26/10/2022);

MS5.1.b - Workshop on Activity 5 during 3rd SHECAP meeting (M12): Status: achieved. -Activity 5 Workshop during SHECAP meeting (24/10/2022 – 26/10/2022);

MS5.1.c - Session on Activity 5 during WG POMESA meeting (M13): Status: achieved WG POMESA meetings no26 (10/05/22), no 27 (18/10/22), no 28 (20/04/23) and no 29 (09/10/2023);

MS5.2.a - Workshop on Activity 5 during 3rd SHECAP meeting (M12): Status: achieved - Activity 5 Workshop during SHECAP meeting (24/10/2022 – 26/10/2022);

MS5.2.b - Session on Activity 5 during WG POM ESA meeting, Status: achieved - WG POMESA meetings no26 (10/05/22), no 27 (18/10/22),no 28 (20/04/23) and no 29 (09/10/2023)

MS5.3.a - Workshop on Activity 5 during 2nd SHECAP meeting (M6): Status: achieved - Merged in larger Activity 5 Workshop during SHECAP meeting (24/10/2022 – 26/10/2022);

MS5.3.b - Workshop on Activity 5 during 3rd SHECAP meeting (M12): Status: achieved - Activity 5 Workshop during SHECAP meeting (24/10/2022 – 26/10/2022);

MS5.3.c - Session on Activity 5 during WG POMESA meeting (M13): Status: achieved - WG POMESA meetings no26 (10/05/22), no 27 (18/10/22), no 28 (20/04/23) and no 29 (09/10/2023);

MS5.4.c - Session on Activity 5 during WG POMESA meetings (Status: achieved – see above);

MS5.3.d - Workshop on Activity 5 during 4th SHECAP meeting (M18): Status: achieved - Organized back to back with Final meeting (11/12/23 - 12/12/23);

MS5.4.a - Session on Activity 5 during 2nd SHECAP meeting (M6) Status: achieved - Merged in larger Activity 5 Workshop during SHECAP meeting (24/10/2022 – 26/10/2022);

MS5.4.b - Session on Activity 5 during 3rd SHECAP meeting (M12)- Status: achieved - Activity 5 Workshop during SHECAP meeting (24/10/2022 – 26/10/2022);

MS5.4.c - Session on Activity 5 during WG POMESA meeting (M13) Status: achieved -WG POMESA meetings no26 (10/05/22), no 27 (18/10/22), no 28 (20/04/23) and no 29 (09/10/2023);

MS5.4.d - Session on Activity 5 during 4th SHECAP meeting (M18) MS- Status: achieved - Organized back to back with Final meeting (11/12/23 - 12/12/23);

MS5.4.e. - Presentation of Activity 5 results during final SHECAP meeting (M23)- Status: achieved - Final ABIOMMED meeting (11/12/23 - 12/12/23).

All milestones reached and workshops/sessions delivered are detailed above**.** These milestones represented a consistent and ongoing effort to engage stakeholders and disseminate the findings and progress of the project within relevant forums.

Deliverables:

D5.1 – **Compendium and critical analysis of ex-post socioeconomic assessment of measures carried out in the Mediterranean**. Responsible Plan Bleu (M14). Status: Achieved M27

D5.1 Brief description:

A 45-page report produced by Plan Bleu with support from partners HCMR, AZTI, SPA-RAC and IzVRS who provided valuable inputs to this report.

The literature review, titled "Socioeconomic outcomes of the Barcelona Convention and MSFD measures: Compendium of Case Studies," initiates a detailed examination of ex-post socioeconomic analyses. The review consolidates findings from various scales, outlining the diverse methodologies used in such assessments. The deliverable delves into the essence of ex-post analysis, observing outcomes and their impact on environmental decision-making. Tools like Cost Benefit Analysis (CBA), Cost Effectiveness Analysis (CEA), and Multi-criteria Analysis (MCA) are presented, as they aid in evaluating resource allocation alternatives, output costs, and comparing different criteria with distinct units of measure. Notably, it underscores the limited availability of assessments due to resource constraints and a preference for field applications over monitoring. The review emphasizes the urgent need for increased support and resources dedicated to socioeconomic monitoring and ex-post assessment to address knowledge gaps. It also proposes methodological frameworks for evaluating socioeconomic benefits in marine protected areas, aiming to fill crucial knowledge voids in the field.

D5.2 – **Guidance and best practice report to streamline and conduct further ex-post socioeconomic analysis of measures in the Mediterranean.** (M14) Responsible Plan Bleu Status: Achieved M28

D5.2 Brief description:

A 20-page report produced by Plan Bleu with support from partners HCMR, AZTI, SPA-RAC and IzVRS who provided valuable inputs to this report.

The deliverable provides crucial recommendations for incorporating ex-post socioeconomic analysis into decision-making processes. It emphasizes the political and institutional significance of such analyses, urging their explicit inclusion in Good Environmental Status assessments. The report advocates for formalizing elements and structuring institutional support to streamline actions aimed at understanding the socioeconomic outcomes of marine policies and integrating them into adaptive decision-making. The report highlights that augmenting institutional support alone is insufficient; a tangible increase in resources, particularly financial, is deemed necessary to facilitate robust and comprehensive ex-post socioeconomic analysis.

D5.3 – **Report on ex-post socioeconomic analysis of a regional biodiversity-related measure** (M22) Responsible Plan Bleu. Status: Achieved M30

D5.3 Brief description:

A 100-page report produced by Plan Bleu with support from partners HCMR, AZTI, SPA-RAC and IzVRS who provided valuable inputs to this report.

The deliverable features three distinct analyses:

- A broad, replicable framework applicable across diverse measures and regions, serving as a preliminary assessment tool (Section I). The methodology presented provides a straight-forward, transparent, and efficient way of assessing the effectiveness of MSFD PoMs, particularly in monitoring data-deficient EU marine regions or subregions. The effectiveness concept is assessed through a synthetic index which includes the cost-benefit of the measure. The study examines a subset of Spanish measures under the methodology. The study stresses the importance of clearly

defining assessment objectives to select appropriate measures. For the scoring system, even if previously co-developed/tested by competent authorities, may be interesting to make the weighting of factors flexible enough to better adapt to country/assessment priorities. In order to do so, it would then need to also define scales that would allow it to extract conclusions.

- Detailed ex-post case studies from Port-Cros, France, and Palamos, Spain, delving into real-world observations of implemented measures, highlighting strengths, limitations, and resource intensiveness (Section II).
    - The focus of the first case study is the Bagaud Zone for Mooring and Light Equipment (ZMEL) within France's Port-Cros National Park, an area implementing eco-mooring systems to protect the *Posidonia oceanica* seagrass. This initiative, critical for preserving the ecosystem's balance and supporting biodiversity, exemplifies effective measures to maintain the good environmental status of the Mediterranean coastal zone.
    - The second case study encapsulates a comprehensive ex-post socioeconomic evaluation of conservation initiatives centered around Los Palamos City, serving as an illustrative model within the scope of the Barcelona Convention Plans. The Long-Term Management Plan (LTMP) implemented in Los Palamos has effectively curtailed overfishing and fostered sustainable practices across various species. The findings emphasize a significant increase in income per fishing day for fishers and an overall rise in societal benefits post-implementation of biodiversity measures. The evaluation could serve as a demonstrative example within the Marine Strategy Framework Directive (MSFD), showcasing a successful integration of biodiversity measures and management strategies that align with its objectives.

Problems encountered

Within Task 5.1 the scarcity of available case studies and data within the Mediterranean region and related to ex-post socioeconomic assessments initially restricted the depth of the review. To address this challenge, meticulous screening and evaluation of available case studies and data sources ensured relevance, credibility, and comprehensiveness. Also, valuable feedback from the GA and ABIOMMED partners was obtained, as they had specialized knowledge and better access to varied resources.

Within Task 5.2 there was limited knowledge on the conditions that constrain the development of the expected and relevant ex-post socioeconomic analysis to support decision-making. As a solution to this issue, analysis of gathered information during the literature review (Deliverable D5.1) was combined with information derived from partners' experience regarding Mediterranean socioeconomic and MSFD/EcAp-related monitoring processes. A short questionnaire was also distributed to selected actors in the Mediterranean region in order to collect their opinions on difficulties linked to conducting ex-post socio-economic evaluations. Multiple elements raised from this questionnaire were confirmed by the contributions of participants in the workshop organized by partners of Activity 5 during the SHECAP meeting of ABIOMMED (held in Athens 24-26 October 2022). Another challenge was the possibility of facing a potential geographical bias in the collection of opinions through the questionnaire and workshop, resulting in a limited representation of diverse

perspectives. To mitigate the risk of limited representation, efforts were made to expand outreach and ensure inclusive participation in the workshop.

Several problems were encountered within Task 5.3 referred in bullets below:

- Difficulty Mobilizing some Partners: Certain partners, crucial for contributing to the deliverable, were initially difficult to mobilize. In response, Plan Bleu mobilized an additional in-house consultant and eventually all partners contributed their part, ensuring a comprehensive report.
- Covid-related Coordination Challenges: Impact of the COVID-19 pandemic, affected collaboration the first months among partners, therefore, the team leveraged virtual meetings and/or strengthened email exchanges, allowing for continued collaboration and compensating for the limitations posed by the pandemic.
- Insufficient Coverage with a Single Analysis: The initial plan of producing a single socio-economic analysis (case study) posed limitations in capturing the multifaceted aspects necessary for a comprehensive socioeconomic evaluation. To address this, the approach was expanded to conduct multiple analyses, comprising two in-depth case studies (led by Plan Bleu) alongside a broader assessment (produced by AZTI under the leadership of Plan Bleu). This decision aimed to provide a more extensive and detailed coverage of the socioeconomic impacts of the assessed measures.
- Issues on Methodology Selection: Varying views emerged among team members regarding the most suitable methodology for analysis. To resolve a pragmatic decision was made to adopt a dual approach. This involved utilizing both a broad methodology, applicable across diverse measures and regions, and a more specific methodology tailored for the detailed case studies. This dual approach ensured a comprehensive yet focused evaluation.
- Challenges in Case Study Focus: Determining the focus for the case studies posed significant challenges due to various considerations such as data availability, stakeholder engagement, and the potential for replication in other regions. Therefore, consultations were initiated with ABIOMMED partners. Insights obtained from these consultations were instrumental in guiding the selection process, ensuring that the chosen case studies were not only data-rich but also exemplars potentially replicable in other regions. This is how the two case studies of Bagaud and Palamos were ultimately selected.
- Staffing Challenges and Expertise Gap: The departure of a key economist from Plan Bleu led to slight issues regarding expertise continuity and potential disruptions in executing the assessment. To address this, immediate steps were taken to recruit a replacement expert swiftly. This recruitment ensured the continuity of the assessment, preserving the necessary expertise within the team and mitigating potential setbacks.

Detailed problems within Task 5.4:

- Covid-related Challenges impacting the organizations of meetings: Challenges arose due to the impact of the COVID-19 pandemic, affecting some meetings that were linked to specific milestones. To mitigate these difficulties, some meetings were merged and larger workshops were created (back-to-back events), allowing to reach all milestones.

- A main issue stemmed from the inherent heterogeneity across Mediterranean countries regarding available data on socioeconomic issues. The potential consequence was a lack of consensus on the transferability of hypotheses and the applicability of findings across different contexts. To address these challenges, a clear and well-defined methodology selection process was crucial. This involved establishing transparent criteria for selecting case studies, as explained above, identifying the scope that aligns with feasible objectives while avoiding overly ambitious undertakings. Building consensus with the stakeholders throughout the process became imperative, ensuring continuous dialogue among stakeholders to refine and agree upon methodologies and case study selections. This approach aimed to mitigate the risks associated with data heterogeneity by emphasizing methodological clarity and consensus-building at every stage of the study.

Activity 6: Integrating GES biodiversity assessment in a pan-Mediterranean scale

Lead: SPA/RAC

Work completed

Task 6.1: Strengthen regional coordination on reporting assessment.

This task focuses on the assessment of the Ecological Objective 1 (EO1, relevant to MSFD Descriptor 6) Common Indicator 1 and 2 (CI1 & CI2) on benthic habitats, based on a regional analysis of available data, lessons learnt, and efforts elaborated within previous and current projects implemented in the Mediterranean and provide recommendations towards a more coherent and effective monitoring and assessment programme for the Mediterranean benthic habitats.

Task 6.1 contributed to the elaboration of the 2023 Mediterranean Quality Status Report (2023 MED QSR) presented in Deliverable D6.1 of the Task 6.

To this aim, the results of the SPA/RAC work on the elaboration of assessment scales, assessment criteria, baseline and thresholds values for the CI1 and CI2 were used for the elaboration benthic habitats chapter of MED QSR 2023.

The related Milestone MS6.1 “Meeting of the OWG” organized in January 2022, discussed the progress in the elaboration of these elements, including filling information gaps on habitats and typical species indicated under the IMAP Reference list aligned with the updated Classification of Benthic Marine Habitat Types for the Mediterranean Region.

Task 6.2: Review of the different elements associated to GES assessment including climate change:

Task 6.2 focuses on a comprehensive review of elements associated with the assessment of Good Environmental Status (GES), with a specific emphasis on climate change. The primary objectives encompass the establishment of a regional dialogue with scientific communities in the

Mediterranean, aiming to fortify a robust GES assessment under the Integrated Monitoring and Assessment Programme (IMAP) and Marine Strategy Framework Directive (MSFD). This involves delving into the intricate dimensions of GES, exploring all available datasets, and considering the impacts of climate change and other cumulative pressures. The task also seeks to enhance knowledge and scientific understanding of crucial aspects related to GES, incorporating insights from lessons learned in the context of the Barcelona Convention, MSFD, and other relevant initiatives. Notably, the current state of IMAP and MSFD lacks an Ecological Objective or Descriptor specifically addressing climate change impacts, prompting ongoing discussions during their review.

Deliverable D6.2 prepared in the framework of Task 6.2, is a comprehensive report presenting the current state of information and datasets on GES, coupled with an analysis of the effects of climate change and cumulative pressures at the regional level. This report, informed by previous workshop discussions and recommendations, as well as a meticulous desk review of existing GES definitions, not only provides an overview but also offers recommendations and a forward-looking roadmap.

Furthermore, within the framework of Task 6.2, two pivotal workshops were organized. The MS6.3 workshop, held on 26 October 2022, marked the first working group session of GES experts, convened in conjunction with Activity 5, focusing on information sources for potentially informing cumulative pressures and their drivers. Organized within the SHECAP workshops, this dialogue aimed at achieving a Good Environmental Status. Furthermore, the MS6.4 workshop, held in Tunisia in June 2023, constituted the second and final session of the working group of GES experts. This hybrid event delved into the effects of climate change on GES definition and assessment under the theme "A Mediterranean Sea under pressures of climate and anthropic changes: Towards a dynamic assessment of the Good Environmental Status." With the active participation of the ABIOMMED community, key stakeholders, experts, and scientists engaged in climate change work at the Mediterranean level, the workshop garnered a substantial audience, including online participants. Special recognition was given to Ms Leila Chikhaoui Mahdaoui, Minister of the Environment of Tunisia, underlining the significance and reach of these efforts. These workshops, integral to the activities of Task 6.2, not only contributed to the ongoing dialogue but also enriched the foundation for the comprehensive review, emphasizing the interconnectedness of regional collaboration and scientific discourse in achieving GES objectives.

Task 6.3: Development of a set of indicators of EO6 on seafloor integrity in synergy with the D6

Task 6.3 focuses on the development of Integrated Monitoring and Assessment Programme (IMAP) Ecological Objective 6 (EO6) concerning sea floor integrity, aligning it synergistically with Descriptor 6 (D6) of the European Union Marine Strategy Framework Directive (MSFD). The task aims to put forward a proposal of IMPA EO6 incorporating GES definitions, environmental targets, and a list of common indicators (CIs) consistent with the MSFD Descriptor 6 and the work of the Technical Group on Seabed Habitats. Despite being left out from the initial IMAP phase, ongoing efforts address EO6 in conjunction with EO1's common indicators on benthic habitats. The EO6 proposal (Deliverable 6.3) provides comprehensive elements, including a reference list of marine habitat types, considerations of human activities as pressure sources, baseline data availability for each indicator, and linkages with other ecological objectives. Ongoing discussions explore potential alignment between EO1 and EO6

implementation, contemplating merging the two objectives for seabed habitats, aligning assessment scales and areas, reusing indicators or underlying data from EO1, and aligning GES and targets. The continuous trajectory involves collaborative work on proposals for Ecological Objectives EO4 on food webs and EO6 on seafloor integrity within the new Ecosystem Approach cycle (2024-2029) of the Barcelona Convention, harmonizing with UNEP/MAP's Plans of Work for 2024-2025 and emphasizing the revision of existing ecological objective definitions. This forward-looking approach reflects a commitment to refining and advancing ecological objectives within the evolving IMAP framework.

Milestones:

MS 6.1 – Meeting of the Online Working Group (OWG) on benthic habitats;

MS 6.2 – Meeting of the Online Working Group (OWG) on benthic habitats;

MS 6.3 – First workshop of the working group of GES experts (M12) (26 October 2022) ABIOMMED SHECAP Workshop: Dialogue to achieve a Good Environmental Status. 1st workshop of the working group of experts with a common session with Activity 5 on information sources to potentially inform cumulative pressures and their drivers organized in the framework of the SHECAP workshops 25-26 October 2022;

MS 6.4 – Second workshop of the working group of GES experts (M20) (Tunisia June 2023) 2nd and final hybrid workshop of the working group of experts Organized in Tunisia (19 June 2023), dedicated to the effects of climate changes on the GES definition and assessment. Entitled: "A Mediterranean Sea under pressures of climate and anthropic changes: Towards a dynamic assessment of the Good Environmental Status". In presence of ABIOMMED community, key stakeholders' experts and Scientists involved in the climate change work at Mediterranean level and with the participation of the Minister of the Environment of Tunisia;

MS 6.5 – Meeting of the Barcelona Convention OWG on Habitats (M22) (in conjunction with MS3.4). ABIOMMED project workshop on D6/EO6 29 November 2023 assessment in the Mediterranean sea: Habitat, scales, multiple pressures and measures.

Deliverables:

D6.1 – **Report providing guidance and recommendations for a common harmonized assessment of the habitats in the Mediterranean** (M23).

Brief description of D6.1:

D6.1 is focused on the assessment of the status of the benthic habitats EO1, as a contribution to the 2023 MED QSR: Common Indicator 1: Habitat distributional range and Common Indicator 2: Condition of the habitat's typical species and communities. This assessment was conducted based on a regional analysis of available data, lessons learnt, and efforts elaborated within previous and current project implemented in the Mediterranean.

Assessment was done at a broad scale and with a focus on assessing the extent of pressures: an overview of the pressures affecting sea-floor integrity across the region, and also on the three specific habitat types for which data reporting has started under IMAP (Posidonia seagrass meadows, Maerl

beds, coralligenous beds). Due to limited habitat maps, only a preliminary seabed assessment was possible revealing that coastal zones face severe pressure, with significant habitat loss due to coastal infrastructure and sea defences.

Among main findings of D6.1:
The Mediterranean seabed is a vital component of its marine ecosystem, offering diverse marine communities, seafood, coastal protection, and carbon sequestration.
Anthropogenic Pressures:
- Seabed faces pollution and physical damage from land and sea-based activities, threatening its health and biodiversity.

Coastal and Offshore Pressures:
- Coastal zones suffer habitat loss due to infrastructure, while offshore habitats, particularly below 1000m, face severe damage from bottom fishing.

Threatened Habitats:
- Critical habitats like coralligenous, maerl/rhodolith, and *Posidonia oceanica* seagrass meadows are at risk and monitored under biodiversity objectives. The Mediterranean seabed is a vital component of its marine ecosystem, offering diverse marine communities, seafood, coastal protection, and carbon sequestration.

Anthropogenic Pressures:
- Seabed faces pollution and physical damage from land and sea-based activities, threatening its health and biodiversity.

Coastal and Offshore Pressures:
- Coastal zones suffer habitat loss due to infrastructure, while offshore habitats, particularly below 1000m, face severe damage from bottom fishing.

Threatened Habitats:
- Critical habitats like coralligenous, maerl/rhodolith, and Posidonia oceanica seagrass meadows are at risk and monitored under biodiversity objectives.

D6.2 – Report on the state of the art regarding the available information/datasets on GES and the effects of climate change and other cumulative pressures in its determination at the regional level, with recommendations and way forward.

Brief description of D 6.2:

This deliverable presents the work done under Task 6.2. It addresses the review of elements associated with Good Environmental Status (GES) assessment, including climate change, within the Mediterranean region. The report explores the state of available information on GES and the impacts of climate change, focusing on impediments to GES determination, particularly the effects of climate change on assessment processes within the Integrated Monitoring and Assessment Programme (IMAP) and the Marine Strategy Framework Directive (MSFD).

The assessment delves into the difficulties encountered in GES evaluation, emphasizing inconsistencies within the IMAP definition, considering the context of climate change. Climate change impacts, such as increased sea temperature, acidification, and extreme weather events, are identified

as influencing habitats and species' spatial distribution and condition, particularly under IMAP Ecological Objective 1 (EO1).

The report highlights the need for clarifications in GES definitions, especially for EO1, addressing contradictions and specifying terms like "natural habitats" or "natural range" in the context of climate change impacts. Challenges in defining baseline values and threshold values, especially for benthic habitats under climate change conditions, are discussed, urging a consensus on methodologies.

The assessment extends to other Ecological Objectives, emphasizing the need for harmonization, clearer interrelations, and the development of indicators, methodologies, and threshold values. Climate change impacts on fisheries, non-indigenous species (NIS), and eutrophication are considered, with recommendations for integrating climate change effects into GES assessments.

Noteworthy points include the potential development of parameters related to climate change impacts on vulnerable coastal areas and the suggestion to introduce an Ecological Objective on climate change. The report concludes by emphasizing the ongoing efforts to renew the EcAp Roadmap, providing an opportunity to integrate climate change impacts efficiently into the existing monitoring program without adding new indicators.

In summary, the report calls for a comprehensive consideration of climate change impacts on GES assessments, emphasizing the importance of adapting methodologies, revising definitions, and integrating climate change parameters into the monitoring framework to enhance the understanding of cumulative effects on marine biodiversity in the Mediterranean region.

D6.3 – Proposal of GES definitions, related targets and common indicators of the EO6 in synergy with EU MSFD D6.

Brief description of D 6.3:

The Contracting Parties (CP) to the Barcelona Convention, during CoP 19 in Athens in 2016, adopted the Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast (IMAP) within the Ecosystem Approach (EcAp) process. IMAP focuses on agreed Ecological Objectives (EOs) and their common indicators, aligning closely with the EU Marine Strategy Framework Directive (2008/56/EC). The current IMAP addresses ecological objectives related to biodiversity (EO1), non-indigenous species (EO2), eutrophication (EO5), hydrography (EO7), coast (EO8), contaminants (EO9), and marine litter (EO10). However, ecological objectives for marine food webs (EO4) and sea-floor integrity (EO6) are not yet included due to initial proposals in 2013 highlighting the need for further development, given the lack of data and knowledge gaps in the Mediterranean Sea region.

This document focuses on the Ecological Objective for sea-floor integrity (EO6) and proposes Good Environmental Status (GES) descriptions, related targets, and indicators. It also addresses broad benthic habitats, considers sources of pressures impacting GES, and explores linkages with other EOs.

Significant progress has been made in implementing MSFD Descriptor 6 on sea-floor integrity, facilitated by the EU Technical Group on Seabed Habitats, regional sea conventions (HELCOM and OSPAR), and EU Member States. This scientific knowledge and practical experience contribute to the proposed EO6 framework, including GES descriptions, related targets, and indicators. The document

also outlines broad benthic habitat types, assessment scales, main anthropogenic pressures affecting the sea-floor, and linkages to other EOs and Common Indicators (CIs).

An environmental status assessment of seabed habitats has been prepared for the 2023 Mediterranean Quality Status Report, covering specific habitats under EO1 (biodiversity) and conducting a pilot assessment of the Adriatic Sea for EO6, using pressure data as a proxy for environmental impacts.
The proposal for the Ecological Objective for sea-floor integrity (EO6) was presented and discussed during integrated meetings of the Ecosystem Approach Correspondence Groups (CORMONs) in Athens, in March 2023, and at the 10th Meeting of the EcAp Coordination Group in Istanbul in September 2023. The document highlights ongoing efforts to refine and align the proposed framework, fostering comprehensive monitoring and assessment practices in the Mediterranean region

Problems encountered

Assessment of CI1 and CI2 on benthic habitats is a complex subject to deliver due to the number of seabed and associated species to consider in this exercise, as well as the luck of the data in several cases. Therefore, a call for consultancy to hire an expert to support SPA/RAC in the elaboration of the Deliverables under Activity 6 and the facilitation of the workshops was launched at the initial phase of the project. The first call considered unsuccessful and a second call was launched (April 2022, M10), which was successful with more than one offer received. Nevertheless, despite the delay in having a consultant on board, work has started preparing for the workshop's milestones and deliverables and the Aactivity 6 had been managed in house by the Activity leader SPA/RAC (until the successful consultant is hired). The late recruitment did not affect the progress of the work as the pace has been increased. Overall, the work was delivered as planned.

3 Project implementation

List of project meetings

General Project's meetings:

- ABIOMMED Kick Off & 1st Steering Committee meeting, 27th July 2021, Venue: remotely (ZOOM meeting);
- ABIOMMED 2nd Steering Committee meeting, 28th January 2022, Venue: remotely (ZOOM meeting);
- ABIOMMED Ad Hoc Steering Committee meeting, 23 May 2022, Venue: remotely (ZOOM meeting);
- ABIOMMED 1st Annual General Assembly, 3rd SC and 2nd AB Meeting, 12-13 July 2022, Venue: Athens (hybrid);
- 3rd SC Meeting, ZOOM Meeting, M20, 28 February 2023;

- 4th SC Meeting, ZOOM Meeting, M27, 28 September 2023;
- 5th SC Meeting, ZOOM Meeting, M29, 7 November 2023;
- Final General Assembly, Final Stakeholders' and Experts' Forum & Final Meeting with the Commission & Competent Authorities Meeting & Joint Stakeholder event (Hybrid), Athens, M30, 11-12 December 2023.

Internal activities meetings:

Activity 2

- Activity 2 group meeting (30 September 2021)
- Activity 2 -Zooplankton group meetings (5 November 2021)
- Activity 2 -Phytoplankton group meeting (17 January 2022)
- Activity 2 -Zooplankton group meeting (2 February 2022)
- Activity 2 -Meeting of Activity Task leaders (4 February 2022)
- Activity 2 - Internal meeting of phytoplankton experts (12 July 2022) **(MS2.1)**
- Activity 2 - Internal meeting of zooplankton experts (12 July 2022) (**MS2.2)**
- Activity 2 -Zooplankton group meeting (18 October 2022)
- Activity 2 - Meeting of the Task leaders (18 October 2022)
- Activity 2 - Zooplankton group meeting (1 December 2022)
- Activity 2 - Zooplankton group meeting (27 Apilr 2023)
- Activity 2 - Meeting with Italian partners (17 May 2023)
- Activity 2 - Zooplankton group meeting (19 May 2023)
- Activity 2 - Meeting of the Task leaders (8 November 2023)
- Activity 2 - Meeting of the Task leaders (21 Novembe 2023)
- Activity 2 - Several short on-line meetings by experts in smaller groups

Activity 3

- Activity 3 - ICES WKBENTH3. Workshop to evaluate proposed assessment methods and how to set thresholds for assessing adverse effects on seabed habitats. ICES headquarters, Copenhagen, 3-7 October 2022
- Activity 3 - ICES Workshop on Geo-Spatial Data for Small-Scale Fisheries - Faro, Portugal – 13 March 2023 – 16 March 2023

- Activity 3 - Working Group on Vulnerable Marine Ecosystems and Essential Fish Habitats (WGVME-EFH), including an ad hoc session on Isidella elongata - FAO headquarters, Rome, 7 - 10 March 2023
- Activity 3 - TG SEABED - 18 meeting on the development of methods and thresholds for the assessment of adverse effects under D6C5. Brussels, 12-13 October 2023
- Activity 3 - GFCM Scientific Advisory Committee on Fisheries (SAC) - Expert consultation on the 1000m-FRA pilot studies - Online (Zoom), 13 October 2023
- Activity 3 - ICES WGFBIT - Working Group on Fisheries Benthic Impact and Trade-offs University of Helsinki, Tvärminne Zoological Station, 20 - 24 November 2023
- Activity 3 - ICES WKTRADE4 - Workshop on Trade-offs between the Impact of Fisheries on Seafloor Habitats and their Landings and Economic Performance (WKTRADE4), 20-21 Sept (online) -07-09 November 2023, Copenhagen

Activity 4

Meetings organized under Task 4.1:

- Activity 4 - 1st meeting of the Cetacean Med MFSD Working Group – 5 May 2022, online
- Activity 4 - 2nd meeting of the Cetacean Med MFSD Working Group – 16 November 2022, online
- Activity 4 - 3rd meeting of the Cetacean Med MFSD Working Group - 14 and 15 June, 2023, Rome, Italy

Meetings organized under Task 4.3:

- Activity 4 - Three online technical meetings (20 January 2022, 18 March 2022, 28 June 2022)

Activity 5

- Activity 5 partners virtual meeting, 20 April 2022
- Activity 5 partners virtual meeting, 26 April 2022
- ABIOMMED Activities Internal Meetings at General Assembly (July 2022)
- Activity 5 partners virtual meeting 13 July 2023
- Activity 5 partners virtual meeting 19 July 2023
- Activity virtual meeting with Activity 4 partners (ACCOBAMS) 21 July 2023

Activity 6

- Activity 6 Meeting of the Online Working Group (OWG) on benthic habitats (Videoconference, 17 January 2022) MS6.1
- Activity 6 Meeting of the Barcelona Convention OWG on Habitats (Jointly with Task 6.3 and conjunction with MS3.2) OWG meeting on EO6 proposal Videoconference 9 December 2022, MS6.2
- Activity 6 First workshop of the working group of GES experts Athens, 26 October 2022, MS6.3

– Activity 6 Second workshop of the working group of GES experts (Tunis, Tunisia, Hybrid, 19 June 2023) MS6.4
– Activity 6 Meeting of the Barcelona Convention OWG on Habitats (in conjunction with MS3.4). (Online 29 November 2023) MS6.5

Updated list of dissemination activities (including interaction with stakeholders) and publications

Interactions with stakeholders:

- ABIOMMED project presentation to French Competent Authorities (French Biodiversity Agency – OFB), experts and stakeholders was held on 24 January 2022 (on line);
- Meeting with the French MSFD experts and Activity 2, 16 March 2022;
- ABIOMMED 1st SHECAP Meeting, 27 July 2021, (ZOOM meeting);
- ABIOMMED 1st Connectivity Forum Meeting, 27 July 2021, (ZOOM meeting);
- Meeting Activity 2 leaders with SPA/RAC, 25 November 2022;
- ABIOMMED Activities scientific workshops, 12-13 July 2022, Venue: Athens (hybrid);
- 3rd SHECAP meeting, "SHECAP workshops, Athens, 24 – 26 October 2022: 4 workshops (Workshop 1: Defining Competent Authorities' needs; Workshop 2: Ex post socioeconomic assessment of PoMs; Workshop 3: Spatial management scenarios for fishing impact on benthic habitats; Workshop 4: Dialogue to achieve a Good Environmental Status);
- Meeting of the Multidisciplinary group of experts nominated by the Contracting Parties organized by SPA/RAC, 5 April 2023 (on-line);
- Sixteenth meeting of the SPA/RAC and BD Focal Points, Malta, 22-24 May 2023;
- 4th SHECAP Meeting, "ABIOMMED workshop on Climate change and Good Environmental Status (GES), Tunis 19 June 2023;
- Final Stakeholders' and Experts' Forum & Final Meeting with the Commission & Competent Authorities Meeting & Joint Stakeholder event, 11-12 December 2023, M30, Athens (hybrid)
- Plan Blue experts and ABIOMMED coordinator participated in:
  - WG POMESA (October 2021)
  - WG POMESA (May 2022)
  - WG POMESA (18/10/22)
  - WG POMESA (20/04/23)
  - WG POMESA (9/10/2023)
- Several Cetacean Med MFSD Working Group meetings (Working Group on cetacean monitoring under MSFD)

<u>Other meetings:</u>

- Participation of the ABIOMMED project to HELCOM BLUES project KO meeting (project funded by DG ENV), 3rd February 2021, on line;
- Presentation of the ABIOMMED project during the NEA PANACEA KO meeting (project funded by DG ENV), 1st March 2021, on line;
- Presentation of the ABIOMMED project to MSc students, during a seminar for biodiversity indicators in the frame of the postgraduate studies in the University of Athens, on line (April/May 2022, 2023);

Publications

Gnone, G., Bellingeri, M., Airoldi, S., Gonzalvo, J., David, L., Di-Méglio, N., .. & Azzellino, A. (2023). Cetaceans in the Mediterranean Sea: Encounter Rate, Dominant Species, and Diversity Hotspots. *Diversity*, *15*(3), 321.

UNEP/MAP SPA/RAC (2023a). Development of the IMAP Ecological Objective 6 on sea-floor integrity under the Barcelona Convention. Report prepared by David Connor under Contract No. 01_2022_SPA/RAC (ABIOMMED project), 80pp. (UNEP/MED WG.458/Inf.12).

Paramana T. (2023) Integrated Marine Policy in view of Good Environmental Status (GES) Effective Management and Sustainability of the Marine Environment based on Biogeochemical Indicators. *Doctoral Thesis*, National and Kapodistrian University of Athens, December 2023, 270p.

Paramana, T., Dassenakis, M., Paraskevopoulou, V., Papadopoulou, N., Smith, C., Reizopoulou, S., et al. (2024). Screening and assessing physical pressures affecting seafloor integrity in the Mediterranean region. *OCEAN & COASTAL MANAGEMENT*, 251 [10.1016/j.ocecoaman.2024.107046].

Alice Sbrana, Simone Galli, Michele Casini, Roberto Carlucci, Manos Dassenakis, Fabio Fiorentino, Maria Cristina Follesa, Germana Garofalo, Vincent Georges, Igor Isajlovic, Katja Klancnik, Valentina Lauria, Porzia Maiorano, Chiara Manfredi, Borut Mavric, Popi Pagou, Nadia Papadopoulou, Theodora Paramana, Vasiliki Paraskevopoulou, Marina Pulcini, Arnold Rakaj, Francesca Ronchi, Evelina Sabatella, Giuseppe Scarcella, Christopher J. Smith, Matteo Stefani, Nikos Streftaris , Anna Nora Tassetti, Asma Yahyaoui, Nedo Vrgoc, Sasa Raicevich, Tommaso Russo (2024). *One size does not fit all: exploring different spatial-based management scenarios to protect the seafloor in different areas of the Mediterranean Sea,* submitted to ICES JMS journal.

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SUPPORT COHERENT AND COORDINATED ASSESSMENT OF BIODIVERSITY AND MEASURES ACROSS MEDITERRANEAN FOR THE NEXT 6-YEAR CYCLE OF MSFD IMPLEMENTATION