# Innovative methods and protocols, results and recommendations addressing the monitoring of Land-Sea Interactions

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## LAND-SEA INTERACTIONS

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**European Commission Directorate General Mare defines land-sea interactions (LSI) "as a complex phenomenon that involves both natural processes across the land-sea interface, as well as the impact of socio-economic human activities that take place in the coastal zone".**

**The Biodiversity protection community project PANACeA**, co-financed by the Interreg Med programme, aims at improving the conservation of Mediterranean biodiversity and natural ecosystems through strengthening the management and networking of protected areas and to ensure mechanisms for the implementation of ecosystem-based management (EBM) approaches.

Some of the community's modular projects such as AMAre, POSBEMED and MPA-Adapt aim at developing methods to foster integrated ecosystem monitoring and management. These projects tested practical solutions to take into account LSI in coastal and marine biodiversity conservation and planning. Some results of the ECOSUSTAIN project are included to integrate this document with further innovative methods for water quality control.

**Sustainable management of the Posidonia-beaches systems in the Mediterranean region project - POSBEMED** looks at the management of the Mediterranean coast, in protected areas including Natura 2000 areas, focusing on conflicts and opportunities, where interdependence between *Posidonia oceanica* meadows, coastal dunes and beaches occurs, with a view to provide a joint Mediterranean strategy and governance model for enhancing management effectiveness of these interconnected coastal ecosystems where major pressures from coastal and maritime tourism are on the rise.

**Guiding Mediterranean MPAs through the climate change era: building resilience and adaptation project - MPA-Adapt** project supports and promotes the role of Mediterranean MPAs as central tools for adaptation and mitigation to climate change and the implementation of the Ecosystem Approach (EcAp) roadmap[1]. This initiative has multiple objectives in line with the focus of this technical paper:

- improve knowledge about the inter-linkages of marine ecosystems with human activities confronted with the impacts of climate change;

1 http://www.rac-spa.org/fr/ecap

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• foster the implementation and development of standardized monitoring tools to build vulnerability assessment (e.g. characterize temperature regime and anomalies, monitor warming rates and mass mortality events, shifts in fish distribution and abundance) and define adaptation plans to Climate Change in Mediterranean Marine Protected Areas (MPAs) for the small-scale and recreational fishery sectors;

• promote stakeholder engagement through participatory approaches;

• strengthen and mainstream policies for Climate Change adaptation in the Mediterranean Sea.

**Ecological sustainable Governance of Mediterranean Protected Areas via Scientific, Technical and Managerial Knowledge Base - EcoSUSTAIN** project's aim is the maintenance of biodiversity and natural ecosystems, by means of stronger management and networking of protected areas through capacity building, innovative technologies and an improved management knowledge base. EcoSUSTAIN focus on water quality monitoring, promoting and developing:

• integrated management, cooperation and networking between protected areas;

• water quality monitoring systems in four locations;

• a water quality monitoring software (short and long term solutions);

• a real time alert system;

• guidelines and transferring plan.

Contrary to other projects, EcoSUSTAIN was implemented in freshwater areas.

# 1. METHODS

## 1.1. Tools developed and tested

### *1.1.1. Geospatial tools*

Web-based geoportals are intended to provide MPA managers, decision-makers, scientists and citizens with user-friendly platforms for sharing spatial data and information, which is key for taking informed decisions for MPA management.

**Coordinated strategies in support of sound Maritime Spatial Planning (MSP) in MPAs, and to address conflict "hotspots" that require scientific-based, informed management decisions.**

The AMAre WebGIS Geoportal is a platform dedicated to the following pilot areas :

• Alonissos Northern Sporades National Marine Park (Greece);

• Porto Cesareo Marine Protected Area (Italy);

• Torre Guaceto Marine Protected Area (Italy);

• The North-East Marine Protected Area – Maltese Islands (Malta);

• Freus d'Eivissa i Formentera – Balearic Islands (Spain).

The Geoportal is an HTML5 application (ArcGIS server + Moka kit) that allows sharing, integrating and displaying data, printing maps, and other functionalities. It combines intelligent web maps with graphs, charts, tables, and text to unlock, provide access to and re-use the data relevant for managing MPAs in a coordinated manner. The data layers are organised by themes and are described by proper metadata. Their accessibility and preservation will be guaranteed through the ISMAR Metadata Portal (ESRI Geoportal) and open to the public.

The project assessed the effect of the distribution and intensity of human pressures on the environmental status of marine waters, with a focus on vulnerable habitats of EU importance (e.g. coralligenous outcrops, *Posidonia oceanica* meadows).

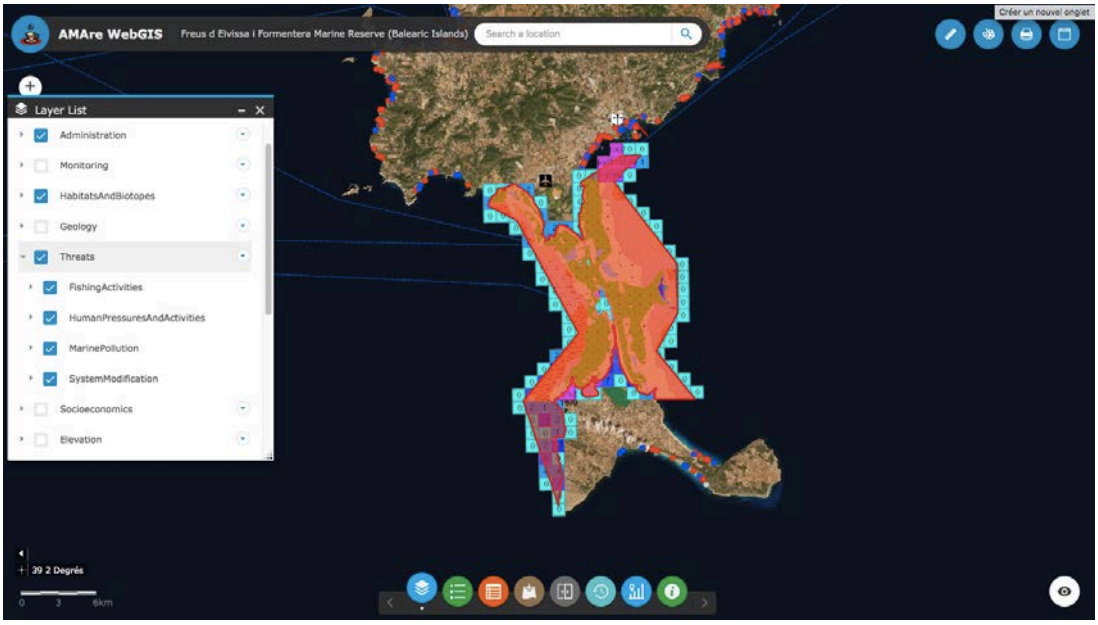


Figure 1. *AMAre WebGIS : Freus d'Eivissa i Formentera – Balearic Islands (Spain). Map of habitats and biotopes vs threats: fishing activities, human pressures, marine pollution, system modification. (Source: http://gismarblack.bo.ismar.cnr.it:8080/mokaApp/apps/AMAV3bi/index.html Consulted 03/09/2019)*

**The effects of climate change in the Mediterranean, such as shifts in species distribution and mass mortality events, have been related to seawater warming. At present, there is no comprehensive view on these effects, which hinders an in-depth analysis of climate change impacts on marine coastal biodiversity in the Mediterranean.**

The **T-MEDNET Platform** is intended to develop a network to observe the effects of climate change on marine coastal ecosystems by promoting large-scale and long-term data acquisition, using standard monitoring protocols on seawater temperature and biological indicators.

A display tool allows users to explore the trend in seawater temperature, temperature anomalies, and warming trends at the Mediterranean scale, both locally and in the different ecoregions. The platform also allows the user to share, access and display biological impacts, providing insights on mass mortality events affecting the coastal benthic biota over extensive spatial and temporal scales.

Moreover, it supports the analysis of the relationships between conditions and biological responses, including episodic events, in particular the onset of mass mortality events, but also changes in distribution, behaviour and phenology.

The database includes the network of monitoring sites and the data on the status of populations of macro invertebrates, collected mainly by MPA managers and scientific teams through a collaborative effort.

**T-MEDNet in numbers:**

The platform is continuously updated with new data coming from several users. Sustained monitoring efforts are being conducted in a growing number of sites:

- T-MEDNet involves 16 public research institutions and 23 MPAs from 7 Mediterranean countries, under the scientific coordination of the Institute of Marine Sciences (Spain);
- more than 70 sites in 2019;

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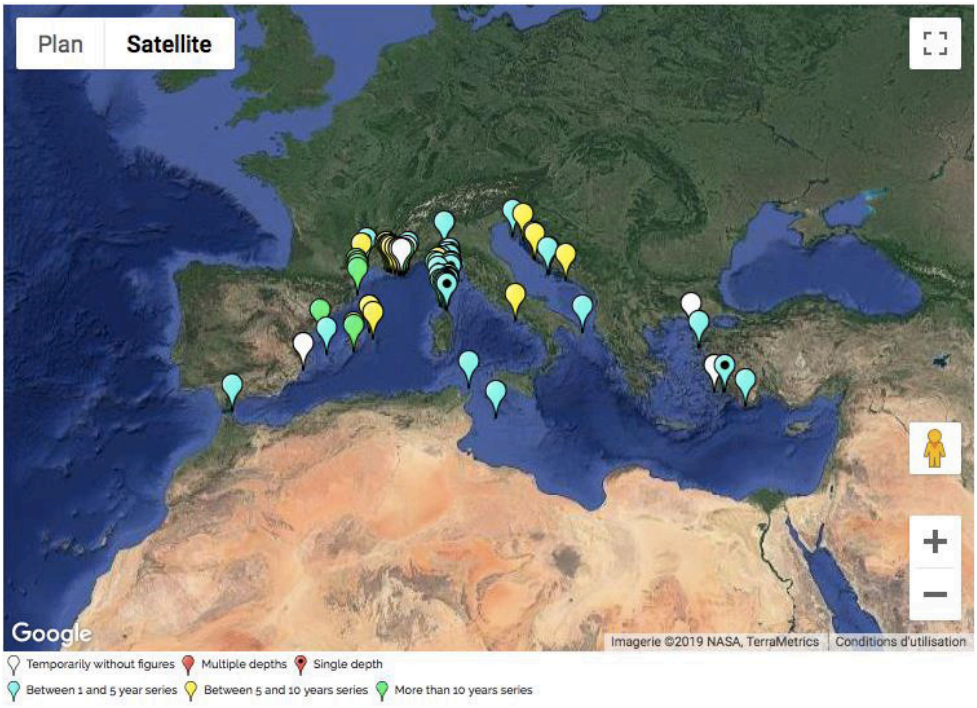


Figure 2. *T-MEDNet partners and MPAs. (Source: http://www.t-mednet.org/t-sites/t-figures. Consulted 03/09/2019).*

• the database helps analyze the inter-annual variability of the stratification dynamics of coastal waters (5-40 m) under climate forcing, including the regional heatwaves of the 2003 and 2006 summers (the warmest August and July in France since 1950 respectively) and recent marine heatwaves (2015-2018);

• supporting joint governance mechanisms amongst key local stakeholders.

• in 2019 there were about 200 temperature time series in the database, with almost 17 million temperature samples, for depths ranging from the surface to a depth of 67 m;

• the set-up of the new module on Mass Mortality Events is an important step forward for sharing information on over 600 Mass Mortality Events through 2017, and for fostering international collaboration on recent and ongoing events (http://t-mednet.org/mass-mortality/mass-mortality-events).

The development of a collaborative platform and the provision of data ingestion, quality control and data management services has resulted in unified databases on essential physical and biological variables for Mediterranean coastal waters. The data and information have been transferred in several ways: networking, at the national, European, and international level; data reporting (through the Digital CSIC); data sharing with EMODnet Physics (work in progress); and contributions to the Marine Copernicus Ocean State Report issue #3; and through various scientific publications.

The T-MEDNet initiative is an end-to-end[2], bottom-up collaborative initiative between marine scientists and marine protected area managers. The approach and the tools have been set with the aim of building a representative coastal network on a Mediterranean scale, which is why they can be easily implemented in other European and Regional Seas.

2 "End-to-end" describes a process that takes a system or service from beginning to end and delivers a complete functional solution, usually without needing to obtain anything from a third party.

**To go further…**

- training to use the geoportal and other associated tools could to be fostered, targeted especially to MPA managers;
- coverage of the tools may be extended to include relevant data and information to support the management of other Mediterranean MPAs and to share information between MPAs at the basin level;
- the lack of recurrent funding for long-term observation initiatives and network coordination is a serious emerging challenge.

In a similar way, the **EcoSUSTAIN** project developed a dedicated spatial platform to show data on fresh water quality acquired in four pilot sites:

- Krka National Park (Croatia)
- Mincio Regional Park (Italy)
- Una National park (Bosnia and Herzegovina)
- La Albufera Natural Park (Spain)

In addition to the location, for each site, the platform shows reports, real time values and graphs of measurements (water temperature, dissolved oxygen, turbidity, chlorophyll, blue-green algae, conductivity, coloured dissolved organic matter, fluorescent dissolved organic matter, pH) and the protected area websites. The EcoSUSTAIN platform allows to download all raw data.

This solution demonstrates how real-time multi-parameter monitoring could be implemented.


Figure 3. *EcoSUSTAIN spatial data portal. (Source: http://ecosustain.info)*

### *1.1.2. Monitoring protocols*

The **AMAre project** adopted a common monitoring approach to assess the effect of human stressors on three specific habitats: *Cystoseira* spp., *Posidonia oceanica*, and coralligenous formations. The challenge of AMAre was to go a step forward towards the implementation of a protected sites network that are monitored using the same approach to common response variables within the framework of the Marine Strategy Framework Directive (MSFD).

Monitoring is an integral component of marine area management because it provides the data required to evaluate changes in marine habitats and species as a result of the implementation of managed MPAs. All MPAs should have monitoring sites to track changes in vulnerable species and habitats, inside and outside MPAs. Methods should be consistent across MPAs to yield comparable results. Monitoring should not be confined to the biological components. It should be linked to environmental variables, human uses and to the socio-economic benefits coming from managing MPAs.

Among monitoring protocols, AMAre defined specific surveys to collect data on *Pinna nobilis*, to better understand the mass mortality event that affected this important endangered species.

**MPA-ADAPT on the other hand built a practical guide composed of 5 standard protocols to track climate-related impacts in Mediterranean MPAs and beyond,** following the requirements of the Ecosystem Approach and in the framework of the UNEP/MAP Barcelona Convention. The resulting outputs of the protocols provide key information to support mitigation strategies and effective adaptation plans in Mediterranean MPAs. The protocols serve to:

a) *Monitor temperature conditions* – temperature is recorded every hour in 5 pilot sites[3] using data loggers deployed every 5 m from surface to a depth of 40 m, and recovered on an annual or semi-annual basis. The resulting data series can be used to build robust baselines and track hydrological changes to better understand the impacts that climate warming has on marine coastal biodiversity.

b) *Assess the impact of mass mortality on macro-benthic* species dwelling in coastal waters. The aim of this protocol is to track the conservation status of benthic species populations.

c) *Explore Local Ecological Knowledge to reconstruct historical changes* (LEK-1) – this protocol can be used to interview experienced fishermen or other sea users, to gather information on historical changes in species abundance and distribution, and to detect new species.

d) *Explore Local Ecological Knowledge for periodical monitoring* (LEK-2) – this protocol can be used to interview experienced fishermen or other sea users, to regularly monitor climate-sensitive species of both native and exotic origin.

e) *Implement a fish visual census of climate change indicators* – this protocol can be used to assess the abundance and distribution of specific fish species, chosen as reliable indicators of climate change in Mediterranean MPAs. Local species targets can be added by MPAs, based on local monitoring needs, ease of recognition, interaction with fisheries, increase/decrease in the area, potential impacts on the environment/fisheries/human activities.

These protocols are inspired by the concept of Essential Climate Variables[4], and focus on a restricted set of simple measurements to capture greater aspects of environmental change. The indicators have been chosen on the basis of their scientific relevance, feasibility and cost effectiveness.

3 Brijuni National Park (Croatia), Pelagie Islands MPA (Italy), Portofino MPA (Italy), Bonifacio Strait Nature, Reserve (France), Port-Cros National Park (France)

4 https://public.wmo.int/en/programmes/global-climate-observing-system/essential-climate-variables

### *1.1.3. Guidelines*

The international context represented by the Convention on Biological Diversity (CBD) and the Barcelona Convention - SPAMI Protocol of the UNEP-Mediterranean Action Plan among others, requires that MPAs apply governance models that ensure their effectiveness in reaching the established conservation targets. The **AMAre project** has developed Guidelines to provide standard models for the governance and management of Mediterranean MPAs, to improve their effectiveness, as well as to support the establishment of a network of MPAs.

Standardization is the sharing of a common language between node managers (directors) and network managers (public administrations, consortia), to evaluate and compare the results of an action. It is not limited to the management action itself.

In fact, every single area is adaptively managed at the local level, but the distribution and dissemination of the results must necessarily operate in a standardized manner. This approach is looking to allow for biodiversity preservation by highlighting the conservation actions that are taking place.

At the heart of the Guidelines lies the Conceptual Model, which is a diagram that represents the relationships between the main drivers and pressures that have an impact on one or more identified key targets of conservation e.g., species, species groups, ecological systems such as habitats, or ecological or cultural processes. The first step is to identify the key targets, their pressures and drivers; strategies are then chosen, and actions are selected to reduce the risks to which key targets are exposed.

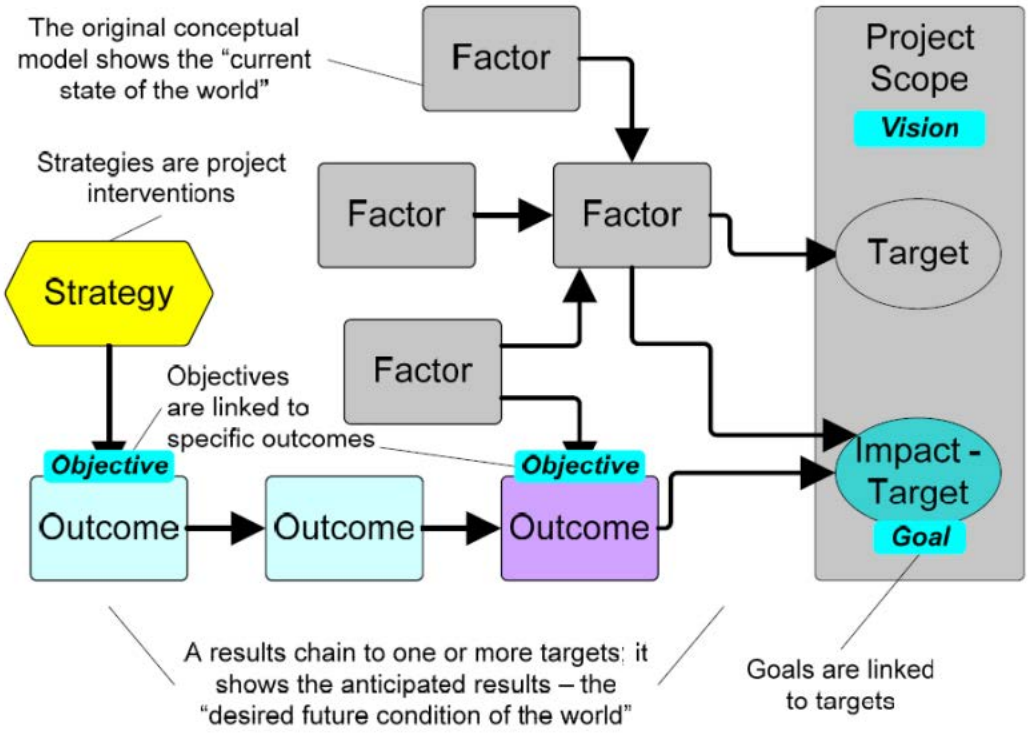


Figure 4. *Generic Conceptual Model with Action Plan Components (adapted from CMP Open Standards for the Practice of Conservation - http://cmp-openstandards.org/wp-content/uploads/2016/05/FichesOS_Paix.pdf)*

**The POSBEMED project** questioned the sustainable use of *Posidonia oceanica* banquettes and associated coastal dune systems, looking to enhance the sharing of good practices to steer joint protection actions of connected ecosystems under different protection regimes (e.g. posidonia meadows management practices, evaluation of ecosystem services, governance models).

POSBEMED is more specifically looking into the interaction of land-based activities, particularly coastal tourism, with the *Posidonia Oceanica* meadows along the coastline. Through a comparative study of legal frameworks, practices, tools and approaches in five EU Mediterranean countries (Spain, France, Italy, Greece, Cyprus), it established a Toolkit on existing methods and tools, providing practical examples to illustrate how conservation effectiveness can be enhanced regarding these key habitats in protected areas: for example, addressing the issue of Posidonia removal from the beach if it must occur, providing alternative solutions to the use of mechanical approaches.

International networking and synergies on sustainable beach management have been fostered with the implementation of the GIS database and capacity building events and workshops for local decision makers and protected area managers (e.g. natural beach nourishment, erosion mitigation techniques).

*Which indicators, by whom, at which cost?*

AMARE identified 6 elements and suggested six activities to assess the status of marine biodiversity:

- Estimate *Posidonia oceanica* status;
- Assess the ecological status of coralligenous habitats;
- Evaluate shallow-infralittoral assemblage conditions;
- Verify the presence of mass mortality events; and
- Register water temperatures.

These activities are necessary to collect data, essential to support marine sites management and Maritime Spatial Planning. The results allow to evaluate management activities and possibly adapt and re-arrange human uses. Networking reveals itself fundamental to transfer guidelines and to spread the MPAs role in Mediterranean Sea.

POSBEMED proposed a series of indicators to monitor the state of the coastal environment, particularly including the beaches and associated dunes. These indicators will be used in the re-evaluation of the benchmarking process by comparing the present status against the status of coastal areas without banquette removal and those sites where different interventions have been used. The collection of data on the total weight of the banquettes removed and the disposal methods used can provide very valuable information on trends in seagrass deposits, the conservation status of seagrass meadows and operational management costs. For this, POSBEMED recommend that data on erosion processes that might occur on beaches as well as sand nourishment practices (quantities and temporality) are gathered simultaneously to assess the results of management practices. Local authorities should also collect data on types and numbers of visitors as well as on their knowledge and perception of the management strategies. This information can help to test the effectiveness of existing or introduced regulations, awareness raising programmes and changes in visitors' perceptions.

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## 1.2. Methodological guidance to facilitate the implementation of the tools

A) Within the AMAre project the following steps were defined to support the implementation of its common monitoring approach:

**1. Technological infrastructure**

The common monitoring of the three habitats: *Cystoseira* spp., *Posidonia oceanica*, and coralligenous formations, does not require very expensive or significant technological infrastructures. In fact, well-trained MPA staff focusing on a few response variables, e.g. macroalgal and seagrass canopy cover, Posidonia shoot density, cover and number of conspicuous species and functional groups in coralligenous formations can provide the solution to ensure MPA monitoring. These response variables can be assessed by visual estimates, macro-photographic records and video by Remotely operated vehicle (ROV).

**2. Training**

Training activities are recommended for MPA staff to continue with the direct monitoring, based on continuous interactions with research institutions and environmental agencies that can also support data acquisition and analyses.

**3. Investment**

Recent large-scale assessments showed that MPAs often lack budget dedicated to monitoring. In the Management Plan, the costs of monitoring should be included and constant (operating) external financing should be ensured to support long-term monitoring. In addition, a greater exchange of information between MPA managers and MSFD managing authorities to be fully aware of each other's monitoring objectives, plans and actions is largely advised to optimize costs.

B) To assist the implementation of its practical guide to track climate-related impacts in Mediterranean MPAs and beyond, the MPA-ADAPT project clearly defined what is needed in terms of infrastructure and materials, competencies and resources. The conclusions can be summarized as follows:

**1. Technological infrastructure and materials**

a. Materials required to monitor temperature conditions:

- temperature data loggers HOBOTidbit v2 or HOBO-U22 and related software;
- a fastening kit (Colson rings, ankles Colson, putty for underwater sealing, plastic gloves, and bag);
- a tool to scratch the rock prior to attachment, and pliers or scissors for cutting.

b. Materials required to assess mass mortality events:

- a plastic board to collect data underwater;
- a diving computer to set the depth of the survey;
- a reference, such as a 50 x 50 cm quadrat, or a 50 cm bar.

c. Materials required for LEK-1 and LEK-2:

- printed copies of the questionnaire to do the interviews;
- a field guide or pictures of fish and other marine species, to assist in identifying the fish species;
- an Excel file for data collection.

d. Materials required for the fish visual census:

- a pre-printed board to collect data underwater;
- a diving computer to set the survey depth, measure transect time (5 minutes) and water temperature.

### 2. Training

Video tutorials are available in the T-MEDNet Platform on how to deploy temperature data loggers for monitoring seawater temperature, and on how to conduct mortality surveys. A video tutorial for fish visual census is also available in the MPA-ADAPT YouTube channel.

Temperature monitoring can be conducted by certified scuba divers, working in pairs. The mass mortality assessment and the fish census can also be performed by recreational divers with adequate training. For LEK-1 and LEK-2, interviewers should be practitioners skilled in species identification and with good knowledge of local fisheries

### 3. Timeline for the implementation

- Monitoring temperature conditions: data loggers should be set up and retrieved every 6 months, generally before and after the warm season. A yearly periodicity can be adopted for remote sites.
- Assessment and monitoring of mass mortality: mass mortality should be monitored every 12 months after summer, i.e. from mid-September to mid-October, or if mass mortality events are observed.
- LEK-1: interviews can be done at any time of the year.
- LEK-2: interviews should be done every 12 months; the respondents should ideally remain the same across time.
- Fish visual census: the fish census should be performed every 12 months, between August and October; for recreational divers, the census can be performed at any time of the year.

### 4. Investment

The necessary material to implement the protocols is estimated to cost 1,800 Euro per MPA.

## 2. IMPLEMENTED PROTOCOLS: WHAT HAS BEEN DONE?

During the **AMARE** project, the monitoring protocols developed by the project were implemented in the different pilot sites. In particular, the monitoring of *Posidonia oceanica*, of coralligenous formations, *Cystoseira canopy* and populations of *Pinna nobilis*.

Monitoring posidonia management practices and perception by beach users were the basis of **POSBEMED** main outcome: a transnational integrated strategy and action plan aiming to gear regional and national policies, funding bodies and research institutions towards creating suitable conditions for implementing sustainable beach and coastal management practices across Mediterranean areas. The strategy establishes a long-term vision "to manage the Mediterranean coastline by developing planning strategies that recognize the value of the Posidonia beach-dune environment and integrates them into the overall coastal strategy, while also addressing concerns and educating stakeholders"[5].

## 3. RESULTS OF PILOTS

**MPA-ADAPT** has been used to set up new sites for seawater temperature monitoring, and resulted in over 2 million new temperature data points from around 30 sites declared by new users along the coasts of Provence, Corsica, Sardinia, as well as in the Tyrrhenian, and in the central and southern Adriatic Sea (http://t-mednet.org/t-sites/t-figures).

The mass mortality monitoring protocols are currently being applied in several MPAs. The Fish Visual Census of climate change indicators has been applied in pilot actions with recreational divers, in collaboration with PADI (the largest recreational divers' organization), providing promising results. More than 200 censuses were conducted within the MPA-ADAPT project in the Portofino MPA and in the Isole Pelagie MPA.

5 Otero M.M., Simeone, S., Aljinovic, B., & al. 2018. *Governance and management of Posidonia beach-dune system*. POSBEMED Interreg Med Project. 66pp+ Annexes.

## 4. RECOMMENDATIONS

### AMAre

There is still a clear challenge in reaching a threshold between overall scientific relevance, the need for (EU) legislation, without compromising interoperability at the Mediterranean level and the feasibility when defining the variables to be monitored. The automatic acquisition of biological data by specific sensors and robots is under study in many EU projects and will be the future challenge in the framework of the Blue Growth, in keeping with the MSFD vision.

**Quantitative results.** At present, MPA managers are often not aware of the current status of their protected areas and the efficacy of conservation measures. Fine-scale, quantitative information provided through monitoring is crucial to inform management about the effects of protection and the sustainability of human uses. This quantitative information should be gathered by using appropriate sampling designs with the necessary statistical power to detect ecologically, economically and socially relevant changes compared to external, non-protected areas.

**Transfer potential.** The Interreg MED project AMAre is showing that close collaboration between scientists and MPA managers is leading to in-depth knowledge on the distribution of biodiversity and on the distribution of human uses through the creation of a spatial geoportal that can be used within each MPA and across MPAs.

The Guidelines defined by AMAre support the idea of the establishment of standard management plans across all Mediterranean MPAs, which could yield the following benefits:

- Assessment of biodiversity values and conservation status of habitats with common indicators;
- Clustering of main threats or pressure factors to implement regional mitigation strategies;
- Implementation of network strategies to increase effectiveness and optimize costs;
- Empowerment of management bodies - From public officials to practitioners;
- Persuading politicians, funders and stakeholders that the results are tangible;
- Increase the management effectiveness of regional networks by identifying improvement actions.

AMAre developed strategies and recommendations at transnational level, for the adoption of an EBM approach to MSP considering the goals of the MSFD. In 5 pilot sites, the project assessed the effect of the distribution and intensity of human pressures on the environmental status of marine waters, with a focus on vulnerable habitats of EU importance (e.g. coralligenous outcrops, *Posidonia oceanica* meadows). The project allowed for the exchange of large, multi-dimensional and harmonised datasets, whose integration supports potential ecosystem monitoring and management in broader areas across the Mediterranean. In the context of the Barcelona Convention, the project could support the UN Environment/MAP and its Southern Contracting Parties to implement the EcAp, providing guidance in establishing -when they don't exist- new Integrated Monitoring and Assessment Programmes (IMAP) and/or support countries to update their monitoring programmes in line with IMAP requirements[6].

### MPA-ADAPT

**Quantitative results.** By implementing the proposed protocols, important physical and biological data can be collected, data that are necessary to understand climate change and seawater warming in the Mediterranean, and to support the drafting and implementation of adequate management strategies by Mediterranean MPAs.

**Transfer potential.** The protocols can be shared, downloaded, and printed as needed by Mediterranean MPAs and for use in non-commercial products or services, provided that appropriate acknowledgment of the MPA-ADAPT project as the source and copyright holder is given.

6 IMAP Decision IG22/7: https://wedocs.unep.org/rest/bitstreams/8385/retrieve

## POSBEMED

As defined in the EC Water Framework Directive and UNEP/MAP system *Posidonia Oceanica* is an indicator of the quality of coastal waters and its meadows are key habitats under EC Habitat Directive, SAP/BIO Protocol and the Natura 2000 network of sites. Together with different types of coastal dunes (EC Habitat 1210, 2110 and 2120) the *Posidonia Oceanica* meadows often form a single ecosystem that needs to be managed as such. *Posidonia oceanica* is a Mediterranean endemic marine flowering plant (seagrass) forming extensive underwater meadows which contribute to the bioremediation of coastal waters and shoreline protection. Posidonia withered leaves, fibers and rhizomes found regularly stranded and beached ashore, help reduce swell wave energy and act as seed banks for dune formation, increasing thus the overall resilience of the coast to natural and climate change effects. POSBEMED developed a strategy for joint management of *Posidonia Oceanica* beaches and coastal dunes in the Mediterranean.

## ACRONYMS

CBD: Convention on Biological Diversity
EBM: Ecosystem-Based Management
EC: European Commission
EcAp: Ecosystem Approach
ESRI: Environmental Systems Research Institute
EU: European Union
FRA: Fisheries Restricted Areas
GIS: Geographic Information System
IMAP: Integrated Monitoring and Assessment Programme
ISMAR: Institute of Marine Sciences (Italy)
LSI: Land-Sea Interaction
MAP: Mediterranean Action Plan
MPA: Marine Protected Area
MSFD: Marine Strategy Framework Directive
MSP: Maritime Spatial Planning
SAP/BIO: Strategic Action Programme for the Conservation of Biological Diversity in the Mediterranean
UN: United Nations

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