PORTODIMARE

geo**POR**tal of **To**ols&**D**ata for sustainable **M**anagement of co**A**stal and marine **E**nvironment (ADRION205)

DT2.8.3 Action plansbased onoutcomes from the testing areas

Ver. 5

7 2020

Authors:
Vassiliki Vassilopoulou,
Maria Kikeri,
Dimitrios Politikos ,
Stefanos Kavadas

Project partner 5, HCMR

LIST OF ABBREVIATIONS/ACRONYMS

AIR	Adriatic-Ionian Region
AIS	Automatic Identification System
AP	Action Plan
AZA	Allocated Zones to Aquaculture
CEA	Cumulative Effects Assessment
CFP	Common Fisheries Policy
CS	Case Study
EEZ	Exclusive Economic Zone
EU	European Union
EUSAIR	European Union Strategy for the Adriatic-Ionian Region
GAIR	Geoportal of Adriatic-Ionian Region
GIS	Geographic Information System
HCMR	Hellenic Centre for Marine Research
HD	Habitats Directive
ICZM	Integrated Coastal Zone Management
IMBRIW	Institute of Marine Biological Resources and Inland Waters
IMMA	Important Marine Mammal Area
LSI	Land-Sea Interactions
MCDA	Multi-Criterial Decision Analysis
MPA	Marine Protected Areas
MSF	Medium Scale Fishery
MSFD	Marine Strategy Framework Directive
MSP	Maritime Spatial Planning
MSPD	Maritime Spatial Planning Directive
MUSC	Maritime Use Synergy and Conflict Analysis Tool
OTB	Bottom Trawlers
SMCE	Spatial Multi-Criteria Evaluation
SSF	Small Scale Fishery
VMS	Vessel Monitoring System
WFD	Water Framework Directive

Table of Contents

1. PORTODIMARE project

Almost all coastal and marine areas are under pressure by different human activities that try to fulfil all the demands modern society has. Climate changes and manmade and natural hazards are impacting marine and coastal resources and ecosystems even more. The Adriatic and Ionian seas are, because of their shallowness and semi-enclosed nature, particularly vulnerable to these threats. That is why the PORTODIMARE project is aimed at tackling environmental vulnerability, fragmentation, and the safeguarding of ecosystems in the Adriatic-Ionian Region (AIR). Efficient planning and management of the coastal and marine spaces in the AIR need to be done transnationally to avoid conflicts and support sustainable growth while preserving the ecosystem for the upcoming generations. PORTODIMARE project is in full compliance with the Integrated Coastal Zone Management (ICZM) and Maritime Spatial Planning (MSP) principles and policies and supports the implementation of the EUSAIR Action Plan.

The main output of the PORTODIMARE project is the Geoportal of Adriatic-Ionian Region (GAIR), which integrates and further develops existing databases, portals and tools that were developed within the previous EU project and other initiatives. In such a way, most of the available knowledge and resources are efficiently organized and made accessible through a single virtual space. The main components of the GAIR are shown in Figure 1 and briefly explained in the following paragraphs and next chapters.

The project prepared a series of modules used for analytical purposes, mainly to provide information for coastal and marine planning. The intended users groups include experts and decision makers either from spatial planning and environmental agencies or from public authorities as well as operators such as fishery managers and potential investors. Moreover, research groups and students are invited particularly to build a knowledge base, which could be offered to other users via the GAIR. The use of GAIR's modules was tested in six pilot sites as a support for the development of action plans for four countries: Croatia, Greece, Italy, and Slovenia.

PORTODIMARE project includes the following activities: preparation, management, implementation, and communication of the GAIR. The implementation is divided in two parts. The first part encompasses a definition and implementation of the architecture and main components of the GAIR- the GAIR's modules. The second part encompasses efforts on the coordination of the training, the testing activities and the elaboration of the GAIR maintenance and transferability plan, GAIR Practical Guide and Action plans for the countries.

The formerone is elaborated in this document. It describes specific action plan as a contribution of the Portodimare project to national/regional MSP process. As well as for the maintenance of the Geoportal datasets and tools and transfer the use of its modules to target groups within its pilot area and in the country as a whole.

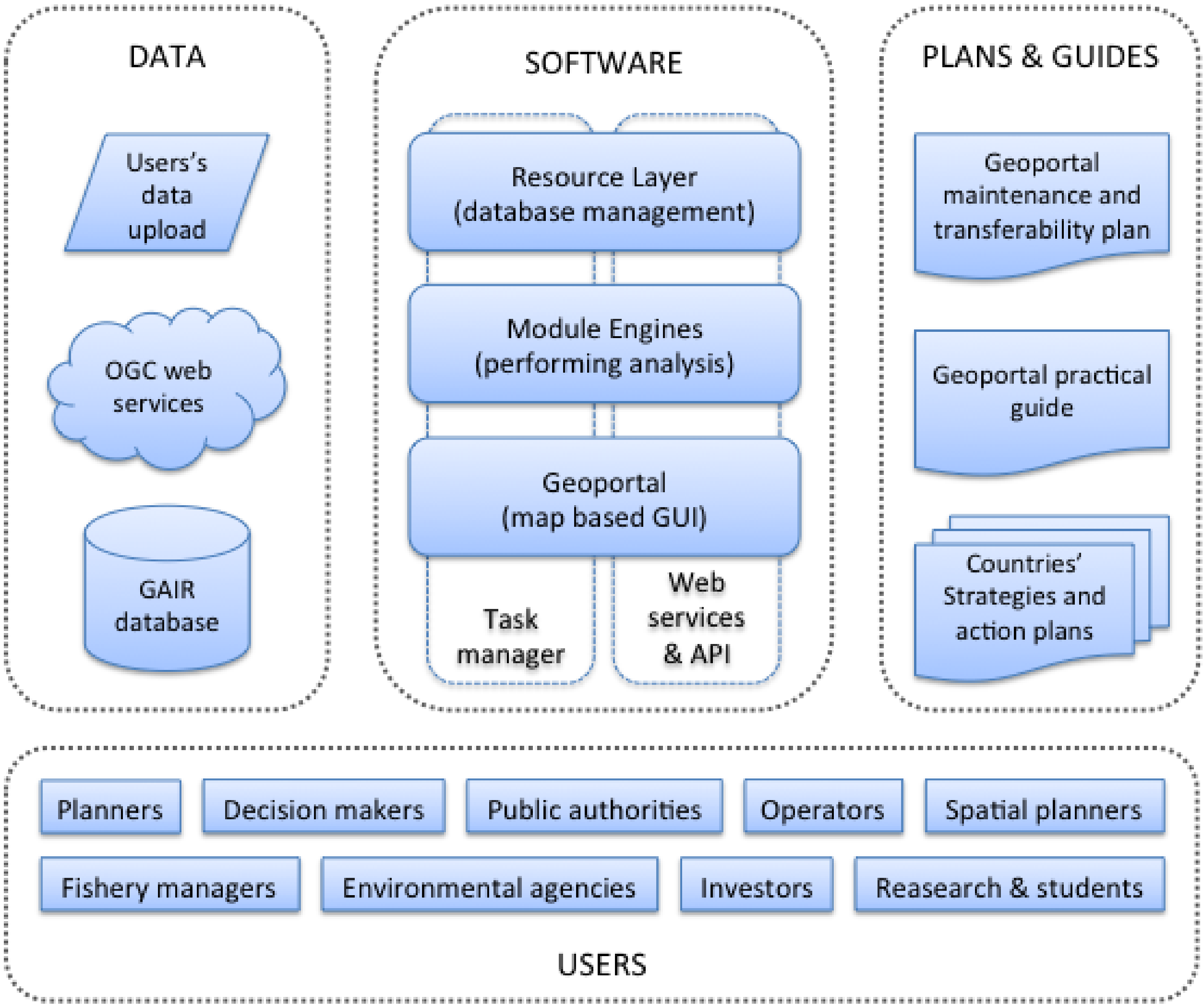

Figure 1: Components of the Geoportal of Adriatic-Ionian Region (GAIR)

1.1. GAIR development

The GAIR Report on system architecture and design, describes the system architecture that was used to develop the GAIR. Some of the main purposes of the GAIR are: to guarantee an operational use to public administrations, as well as to scientific and research bodies and civil society; to develop an effective and integrated environment between data and tools; to be well connected to other sources of information; to integrate data and information that are adequately controlled and validated; to be user-friendly for non-technical experts, etc.

GAIR follows the MSP implementation process and modular approach that means that GAIR implements multiple modules that will enable integrated and sectorial geospatial modelling. Each of the modules has single or multiple objectives and is spatially scalable, that is, they are applicable on local, regional, and on the scale of the Adriatic-Ionian Region. GAIR is based on free and open-source software approach, it is targeting the multi-level community, ranging from students, open public, research/academics, sectorial actors, planners, and decision-makers. The results of each module run will be available within the GAIR, thus allowing sharing knowledge within the community.

GAIR's MSP-driven approach consists of six steps that ensure full support for planning and iteration. Those six steps are the following: the definition of the goals of the tool application and definition of which module to use for the analysis; definition of the spatial extent of the study area; definition of the module workflow with present or/and future conditions; valuation of module results by analysis of the result summary on the user's personal computer and GIS software; and sharing the results with the PORTODIMARE community through GAIR. Module run can be based on geospatial layers that are already incorporated in the GAIR and also on multiple geospatial layers that can be uploaded by users.

The content in the GAIR is coming from different sources which include links to existing data already published or accessible through standard OGC web services, geographical datasets that partners have uploaded directly through the Geoportal interface, and geographical datasets that are part of deliverables of past projects (Figure 1).

GAIR is based on the GeoNode platform. PORTODIMARE specific applications were built in Django, Python web development framework. Other software solutions that have been used to build GAIR include PostgreSQL with PostGIS, GeoServer, Swagger, Celery, GeoExt, OpenLayers, Leaflet, Wagtail, and others.

The GAIR's system architecture consists of five main components (Figure 1): Resource Layer (database management systems and facilities to store datasets, information, metadata, and other resources); Module Engines (for performing module/tool analysis); Task Manager middleware (for orchestrating the GAIR's tasks and processes); Web services and API (for publishing the API and for the web services for interaction with resources); and the Geoportal (graphical user interface, tools to search, visualize, explore, and analyse resources, and also for downloading geospatial layers, maps, and PORTODIMARE model outputs).

Different user profiles with different, hierarchically organized, privileges are defined within GAIR. The authentication layer supports a single sign-on mechanism and is equipped with security precautions, such as automatic password expiring after 180 days.

1.2. GAIR modules

The PORTODIMARE project prepared seven modules. Modules differ according to adopted programming languages (Python and R), user interaction level, and level of long-term support perspective. Because of these differences, two different module integration patterns have been designed. They include direct integration (GAIR API directly execute the module engine) and API-based integration (GAIR API performs machine-to-machine communication with an external module/tool). Module T1.10 does not require real-time analysis and users can use pre-processed layers and pre-configured maps. Interfaces are input forms with different components and options that can be defined, or are map-based. Graphical user interfaces for the output of each module are map-based, where the main part of the interface is a map on which the output layer is loaded (Figure 2). Other results, like graphs and links to reports, are shown in a side panel.

Module: Maritime Use Synergy and Conflict Analysis Tool (MUSC)

Because of the strong human influence on the Adriatic-Ionian sea region, geospatial tools that are enabling the analysis of the multi-sector interactions are needed to support Blue Growth and planning strategies and scenarios for conflict mitigation (Depellegrin et al., 2018). This tool allows the assessment and mapping of maritime use conflicts (constraints that are creating disadvantages to maritime activities) and synergies (multi-use potential).

Planners and planning teams, decision-makers, environmental agencies, and research institutions can use MUSC. Module inputs are study area boundary, 15 spatial raster datasets about human activities, and 6 spatial raster datasets about environmental components. Module outputs are 6 spatial raster datasets, one summary report, and one table of data.

Module: Cumulative Effects Assessment (CEA)

To reach ecological targets in the Adriatic-Ionian Sea region, sustainability goals can only be reached through smart and efficient allocation of the sea space. Geospatial tools supported by the Cumulative Effects Assessment (CEA) can help decision-makers in sea space to choose from different planning options and drive ecosystem-based management(Menegon et al., 2018). CEA is a tool for analysis and mapping the effects of single or multiple human activities on the sea space.

Planners and planning teams, decision-makers, environmental agencies, and research institutions can again use this module. Module inputs are study area boundaries and Marine Reporting Unit (polygon), 15 spatial raster datasets about human activities, and 6-10 spatial raster datasets about environmental components. Module outputs are 3-5 spatial raster datasets, one uncertainty raster map, one summary report, and one table of data.

Module: Supporting Allocated Zone to Aquaculture (AZA) identification

EU Blue Growth initiative identified Aquaculture as one of the key sectors with high potential for sustainable jobs and growth. This module implements the Spatial Multi-Criteria Evaluation (SMCE) methodology for identifying Allocated Zone to Aquaculture (AZA), i.e. marine areas where the development of aquaculture has priority before other uses.

This module is intended for public authorities, current operators, and investors. Module inputs are user-defined location or area on the map, optimal growth model, and about 10-30 geospatial remotely sensed and site-specific datasets about constraints, socioeconomic and environmental data. Outputs are three geospatial layers (criteria map, constraints, and suitability map), four raw datasets, and one report.

Module: Particle/conservative contaminants dispersion

This module is a tool that can be used to calculate the area of influence of a source of contamination by simulating the dispersion of particles. Users can select location, intensity, and inner behaviour of the particles. It is also possible to characterize the particles by a decay time, life duration, and sinking velocity(Ghezzo et al., 2018).

Planners and planning teams, decision-makers, environmental agencies, and research institutions can use this module. Module inputs are user-defined location or area on the map and hydrodynamic field model targeted for the area of interest and/or season. Outputs are dispersion simulation, influence area map, and summary report warnings and information about reliability of the results.

Module: Coastal Oil Spill Vulnerability Assessment

One of the biggest risk factor in the Adriatic-Ionian Sea is represented by the transit of the tanker ships that are carrying hydrocarbons and toxic substances. The pollution of the coastline caused by the spilling of the substances that are being transported would cause environmental and economic damage (Caputo & Natrella, 2018). This module can perform oil spill simulations in any area of the Adriatic-Ionian Sea to understand the risk scenarios and conduct a risk assessment.

The module is intended for institutions that deal with the management policies of economic, commercial, or tourism activities in the Adriatic-Ionian Region, emergency management institutions, and citizens and students. Inputs are a user-defined area of interest, geospatial layers about coastal vulnerability, simplified hydrodynamic field, and data about ships and weather data. Module outputs are 3-5 geospatial layers, one animation of oil spill simulation, and 1-5 plots with statistical analysis.

Module: Small Scale Fishery (SSF) Footprint

Most of the professional fishing vessels are not equipped with location monitoring systems (VMS – Vessel Monitoring System or AIS – Automatic Identification System) so it is not possible to map their footprints using those systems(Kavadas et al., 2018). Module for Small Scale Fishery (SSF) Footprint implements an MCDA (Multi-Criterial Decision Analysis) to assess and map fisheries' spatial footprint for SSF and a tool for their visualization.

Users of this module can be fishery managers, scientists, spatial planning managers, and scientific groups. Inputs are up to 9 geospatial layers and weights assigned by the user or by default. Outputs are two geospatial layers and a summary report.

Module: Medium Scale Fishery (MSF) Footprint and Cumulative Effects Assessment on SSF and MSF

This module implements a tool for visualization of fisheries' spatial footprint for MSD, including trawlers, and purse seines. It also includes the estimation of the cumulative additive fishing pressure index (SSF+MSF). Medium scale fisheries are, unlike the small-scale fisheries, usually equipped with VMS and AIS monitoring systems that allow mapping their footprints. In cases where VMS and/or AIS are not available for all spatial and temporal scales, GIS-MCDA based approach is employed.

This module is intended for fishery managers, researchers, spatial planning managers, and scientific groups. As input, the module uses up to 10 geospatial layers that are already stored in the GAIR. Outputs are three geospatial layers, summary reports, and raw data.

2. Maritime Spatial Planning (MSP) and Integrated Coastal Zone Management (ICZM) process and planning steps

2.1. Objectives and principles

Today, the increasing demand for coastal and maritime space for different human activities, and as a consequence, the increasing pressures on the coastal and maritime ecosystems and resources, require an integrated planning and management approach. There are several pillars on which such planning and management should be developed. From the EU Integrated Maritime Policy for the European Union, proposed methodologies such as the UNEP/MAP conceptual framework for marine spatial planning (UN Environment/MAP, 2018) to technical tools developed by several projects such as the GAIR tool developed by the PORTODIMARE project.

The following paragraphs briefly elaboratethe main legal documents on which integrated coastal and maritime planning and management shell be based: a Protocol on Integrated Coastal Zone Management in the Mediterranean (hereinafter ICZM Protocol) (UNEP/MAP/PAP, 2008) and Directive 2014/89/EU on establishing a framework for maritime spatial planning (Directive, 2014). Considering the nature of coastal zones and seas, planning and management processes should take into account land-sea interactions, but also cooperation among countries sharing the same coastal and sea ecosystems. Thus, two more issues are elaborated briefly: a land-sea interaction and a transnational cooperation.

ICZM Protocol

As an international legal document, ICZM Protocol drives the Mediterranean countries to better manage and protect their coastal zones. It complements the existing set of Protocols of the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean. 'Integrated coastal zone management' means a sustainable management and use of coastal zones. Costal zone is defined as the geomorphologic area either side of the seashore on which the interaction between the marine and land parts occurs. For the management purposes, coastal zone is defined with the external limit of the territorial seas and with the land limit of the administrative costal units.

The objectives of the ICZM are to:

- Facilitate, through the rational planning of activities, the sustainable development of coastal zones by ensuring that the environment and landscapes are taken into account in harmony with economic, social and cultural development;
- Preserve coastal zones for the benefit of current and future generations;
- Ensure the sustainable use of natural resources, particularly with regard to water use;
- Ensure preservation of the integrity of coastal ecosystems, landscapes and geomorphology;
- Prevent and/or reduce the effects of natural hazards and in particular of climate change, which can be induced by natural or human activities; and
- Achieve coherence between public and private initiatives and between all decisions by the public authorities, at the national, regional and local levels, which affect the use

of the coastal zone.

In the process of implementing, the several principles should be considered:

- The terrestrial and maritime part of the coastal zone should be considered as a single entity;
- All the coastal elements (hydrological, geomorphological, climatic, ecological, socio-economic, cultural systems) shell be taken into account in an integrated manner;
- The ecosystem-based approach shall be applied (taking into account all the coastal elements but also their continuous interactions);
- Appropriate governance allowing participation of stakeholders shell be ensured;
- Cross-sector institutional coordination shall be required;
- Development of land use strategies, plans and programmes shall be required;
- The multiplicity and diversity of activities in coastal zones shall be taken into account, and priority shall be given, where necessary, to public services and activities requiring, in terms of use and location, the immediate proximity of the sea;
- The allocation of uses/activities in coastal zones should be balanced and unnecessary concentration and urban sprawl should be avoided;
- Preliminary assessments shall be made of the risks posted on coastal zones; and
- Damage to the coastal environment shall be prevented, and where it occurs, appropriately restored.

Some other considerations proposed by the ICZM Protocol are as follow. Economic activities in the coastal zones that are highlighted are: agriculture and industry; fishing; aquaculture; tourism, sporting and recreational activities; utilization of natural resources; infrastructure, energy, ports and maritime works and structures; and maritime activities. The specific coastal systems to be protected are wetlands and estuaries and marine habitats. Also, special consideration to protection shell be given to coastal landscapes, islands and cultural heritage. As coastal zones are contiguous and stretches across national boundaries, national strategies shell be coordinated with the neighbouring ones. Finally, as ICZM instruments, the ICZM Protocol envisage monitoring and observation activities, national and regional strategies and actions plans for ICZM, environmental assessments, as well as definition of indicators in order to evaluate the effectiveness of ICZM strategies and plans.

To implement the ICZM Protocol, the ICZM Process is designed and is intended to guide the implementation of the ICZM Protocol (PAP/RAC, 2012). There are 5 key stages further structured into key tasks for each stage as the following:

1. Establishment
   (EstablishingCoordinationMechanisms, DefiningTerritorialScope, DefiningGovernanceContext, Scoping, EngagingStakeholders, Proposing a Vision, Deciding on StrategicEnvironmentalAssesssment);
2. Analysis and futures
   (Building theEvidence, IdentifyingFutures);
3. Setting the vision
   (Building Consensus, SettingtheDirection, MeasuringSuccess);
4. Designing the future

(Formulating ICZM Strategies, PlansorProgrammes, Establishing Management Structure, Embedding); and
5. Realising the vision
(Implementating, Acting, Monitoring andReviewing).

The working outputs of the ICZM Process are: Inception Report, The Work Plan, Scoping Report, Communication Strategy, Diagnostic Report, Alternative Scenarios and Vision Statement. The final and main output is an ICZM Integrated Plan accompanied with an Implementation Programme/Roadmap. While ICZM Integrated Plan sets the objectives that shall be achieved together with long-term governance and implementation structures, the Programme/Roadmap aims at securing the materialisation of the Plan by definition of actions, responsibilities, costs, timeframes etc. The ICZM plans and programmes are either self-standing documents or integrated in other plans and programmes. They could provide support to the spatial planning process by giving recommendations for policies and the instruments for monitoring and evaluation.

Some examples could be found on the following link:

Coastal Plan for the Šibenik-Knin County (2015, PAP/RAC)
http://iczmplatform.org//storage/documents/pEoju2FqfXjzPoYBLsKZiD3o6ONBXxJ44RTWFt7P.pdf

Maritime spatial planning (Directive 2014/89/EU)

Maritime spatial planning (MSP) is defined as "a process by which the relevant authorities analyse and organise human activities in marine areas to achieve ecological, economic and social objectives" (Directive, 2014). It is imposed across the EU countries by the Directive 2014/89/EU defining a framework for MSP and obligations to EU countries to establish a maritime planning process. MSP results in a maritime spatial plan. Responsibilities for designing the formats and contents of such plans, including institutional arrangements and allocation of maritime activities, are left to EU member countries. In other Mediterranean countries, non-EU states, the UNEP/MAP Conceptual framework for marine spatial planning is a tool/instrument for the implementation of MSP,is considered as a tool of the ICZM Protocol.

The main MSP objectiveis to promote sustainable development and growth in the maritime sector considering economic, social and environmental aspects as well as long-term changes due to climate change. Today, main economic sectors at sea are within energy, maritime transport, fisheries, aquaculture and tourism sectors.MSP should manage spatial uses and conflicts in marine areas and encourage multi-purpose uses.

The minimum requirements for MSP are the following:

- To take into account land-sea interactions;
- To take into account environmental, economic and social aspects, as well as safety aspects;
- To promote coherence between maritime spatial planning and the resulting

plan and other processes, such as integrated coastal management or equivalent formal or informal practices;

- To ensure the involvement of stakeholders;
- To organize the use of the best available data;
- To ensure trans-boundary cooperation between Member States; and
- To promote cooperation with third countries in accordance.

The Directive stresses the application of an ecosystem-based approach aiming to sustainable development of the maritime and coastal activities but also ensuring the sustainable use of marine and coastal resources.

A comprehensive guide how to put MSP in practice could be found in a document "A Step-by-Step Approach Toward Ecosystem-Based Management" published by UNESCO (Ehler and Douvere, 2009). The guide identifies ten steps and describes their tasks and outputs, together with lessons learned from already developed maritime spatial plans.

Another guiding reference, intended to be short and easy-to-use, is the 'Conceptual framework for MSP in the Mediterranean"(UN Environment/MAP, 2018). The document elaborates common principles to be used in the maritime spatial planning process:

- *Adaptive approach*
  MSP is a continuing iterative process that adapts over time: plans are developed and implemented, conditions monitored, results evaluated and plans improved, and so on in the planning cycles.

- *Multi-scale approach*
  MSP includes Mediterranean, regional, national and local scales, combining top-down and bottom-up perspectives.

- *Integration*
  Integration among themes, sectors, vertical-horizontal cooperation, marine and land based planning.

- *Land-sea interactions*
  Land-sea interaction could be related to land-sea natural processes, among land-sea uses and activities and among land-sea planning and management processes.

- *Four dimension of MSP*
  Maritime space comprises sea surface, water columns and seabed, thus three-dimensional space. Activities could share the same space but in different time, thus the fourth dimension is necessary to enable temporal zoning.

- *Knowledge based project*
  MSP must be based on high-quality data and best available knowledge.

- *Suitability and spatial efficiency*
  Key guiding concepts to achieve sustainability of marine resources, minimize

conflicts and maximize synergies.

- *Connectivity*
  Connections between elements should be considered such as shipping lines, areas of similar uses, between protected habitats forming a network, among MSP participants in terms of knowledge sharing and cooperation.

- *Cross-border cooperation*
  An essential principle to ensure coherent and coordinated MSP plans across the seas, implying cooperation at the methodological, strategic and implementation levels.

The same document proposes the following steps in the development of maritime spatial plans:

1. Starting the process and getting organized;
2. Assessing the context and defining a vision;
3. Analyzing existing conditions;
4. Analyzing future conditions;
5. Identifying key issues;
6. Design phase
   a. Elaboration of MSP plans;
   b. Strategic Environmental Assessment;
7. Adopting the plan and organizing the implementation;
8. Implementing, monitoring and evaluating the plan; and
9. Cross-step activity: stakeholder consultation.

The above steps need to be tailored to the specifics of the marine area and the specific objectives of the maritime plan.

Main MSP output is a comprehensive spatial management plan for a marine area including zoning, priorities in time and space and covering 10-20 year time horizon. The plan could include a zoning map and a permit system, to be used as management measures (e.g. permits for fisheries or tourism are issued based on the plan and zoning map).

Some examples can be found on the following link: https://www.msp-platform.eu

2.2. Importance of land-sea interactions

Land-sea interaction (LSI) is highlighted by the ICZM Protocol, EU MSP Directive and other MSP documents as an essential aspect that should be taken into account when planning and managing coastal and marine areas. LSI is defined *"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"* (EC DG MARE, 2017) and could have double direction: land toward sea and sea toward land. Planning maritime space implies allocation of land space to some maritime activities while planning land-use implies allocation of maritime space to some land-based activities.

LSI could be classified into the following groups:

- *Land-sea natural processes*
  (Such as flow of water and movement of organisms between land and sea ecosystems);

- *Land and sea uses and activities*
  (Almost all maritime uses need supporting structures on land (e.g. ports for ships)while some of the land uses need sea such (e.g. tourism);

- *Land and sea planning and management processes*
  (Land and sea activities should be planned in harmonized manner considering the land-sea continuum – implying alignment of the methodologies used); and

- *Land-sea socioeconomic interactions*
  (People living at the coast are driving land-sea processes; furthermore people exchange their experiences, knowledge and culture).

All these interactions shall be identified and assessed in order to include them into the planning and management processes, either in planning maritime space or land space. LSI analysis is necessary for a harmonized planning and management of the coastal zone, its maritime and land parts.

An example of identified LSI-samong land and sea uses is given in Figure 4.

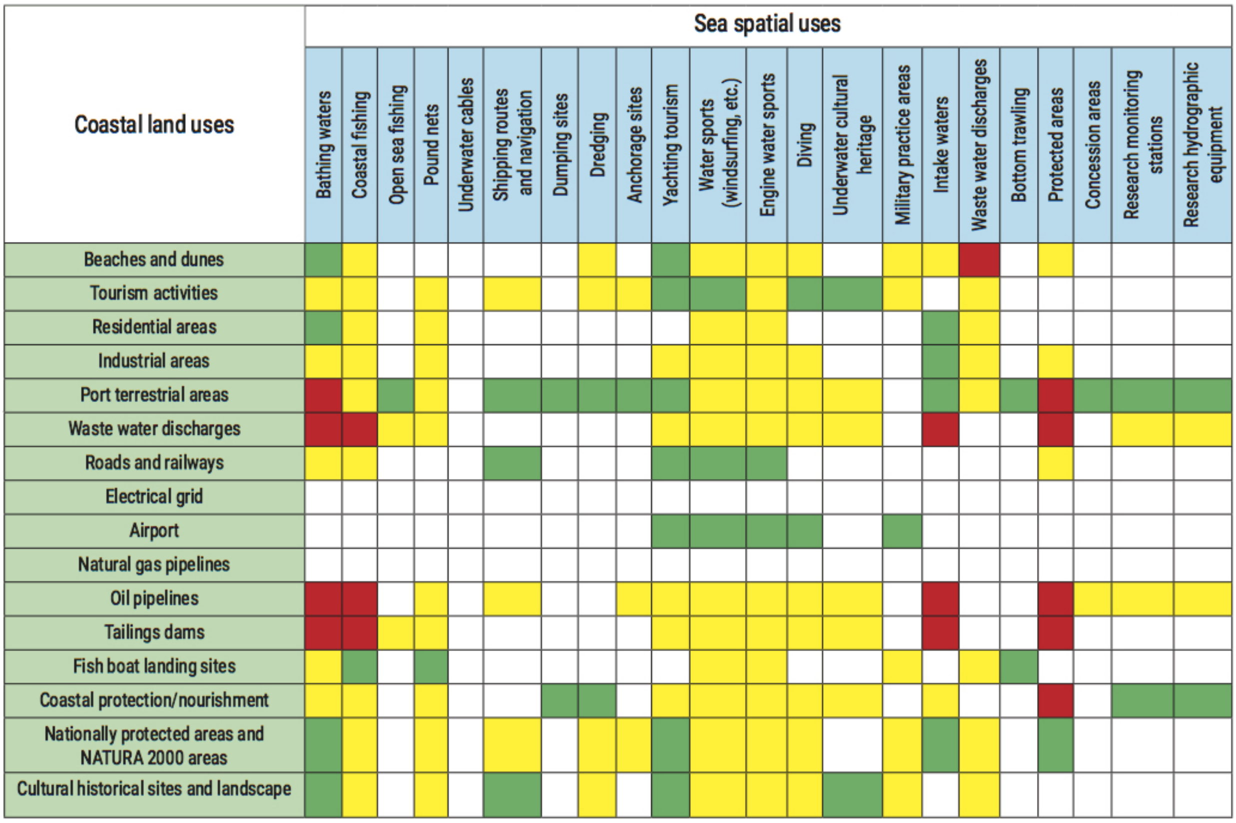

Figure 4. Matrix of land-sea interactions among uses for Burgas study area (Ramieri et al, 2019)

To integrate LSI into any planning process, three phases are proposed (ref LSI document):

1. Scoping (setting the context),
2. Analysis (evaluating LSI using selected methodology), and
3. Incorporating into plans.

Within MSP, the above phases are elaborated in more details forming a guideline to perform LSI as follow (Ramieri et al, 2019):

1. Scoping - LSI interaction stocktaking

(Define the spatial domain, Identify interactions, Localize interactions, Describe and qualify interactions, Identify key policy – legislative – planning aspects, Identify key governance aspects, Identify and engage stakeholders)

2. Analysis - LSI interaction in-depth analysis

(Pathways of interactions, Spatialize interactions, Quantify interactions, Analyze temporal dimension)

3. Incorporating into plan - Inform the plan about LSI analysis outcomes

(Identify LSI hot-spot areas, Identify key messages from LSI analysis)

Some examples could be found on the following links:

http://iczmplatform.org//storage/documents/taFUAsAqp9pOnvq8F4zQmNIhMWBTEvocP0qncF2C.pdf
https://www.msp-platform.eu/sites/default/files/marsplan-bs-burgas_lsi.pdf

2.3. GAIR – a tool supporting MSP processes

Summarizing the above explained concepts involved in the MSP, Figure 4 explains their relations. While Ecosystem-based approach represents a management methodology that takes into account all the system's elements but also their continuous interactions, ICZM Protocol legally enforces but also proposes a specific methodological guidelines for integrated coastal zone planning and management. MSP could be seen as a tool for coastal zone management, for its maritime part. Land-sea interactions, their identification and analysis are a prerequisite for coherent land and maritime spatial planning and thus a required part of the both. Finally, the GAIRisa tool supporting the MSP processes including land-sea interactions analysis. What are the MSP's requirement and steps the GAIR supports?

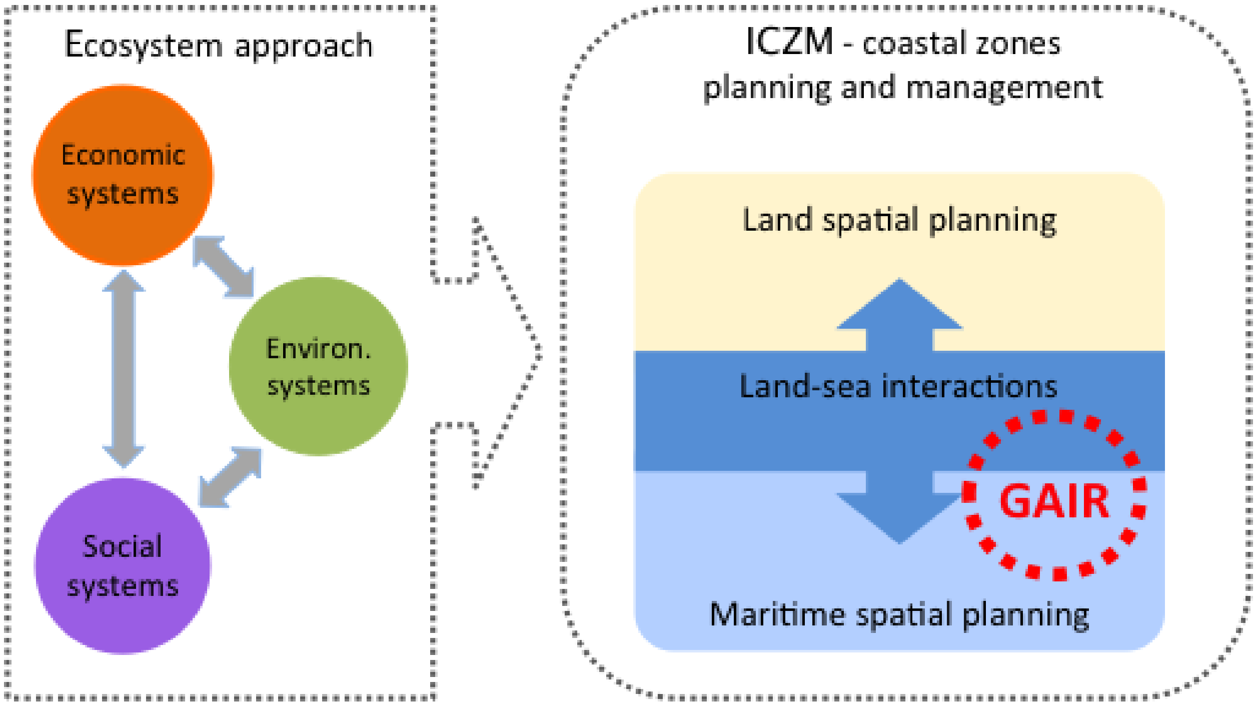

Figure 5. GAIR's support in managing coastal and maritime spaces

MSP should ensure several requirements as stated in the previous sub-chapter. The GAIR offers support to all of them. Namely, the GAIR Resource layer ensures use and organisation of data across the borders and stakeholders, Module engines provide analytical tools for land-sea interactions' analysis and other analytical tasks such as modelling and development of scenarios, and Geoportal facilities stakeholders participation and trans-boundary cooperation.

Regarding MSP steps, Table 1 points out the supporting functions of the GAIR.

Table 1: the GAIR supporting function to MSP steps

MSP steps	**The GAIR's support**
1. Starting the process and getting organized	Resource layer (data collection and management – OGC services and data import functions)
2. Assessing the context and defining a vision	Geoportal (visualising data on maps, tables and charts)
3. Analyzing existing conditions	Module engines (various spatial analysis)
4. Analyzing future conditions	Module engines (various spatial analysis)

5. Identifying key issues	Geoportal (visualising data on maps, tables and charts)
6a. Design phase - Elaboration of MSP plans	Module engines (various spatial analysis) Geoportal (visualising data on maps, tables and charts)
6b. Design phase - Strategic Environmental Assessment	Module engines (various spatial analysis) Geoportal (visualising data on maps, tables and charts)
7. Adopting the plan and organizing the implementation	Resource layer (OGC web services and data export functions) Geoportal (visualising data on maps, tables and charts)
8. Implementing, monitoring and evaluating the plan	Resource layer (data management, OGC web services) Module engines (various spatial analysis) Geoportal (visualising data on maps, tables and charts)
9. Cross-step activity: stakeholder consultation	Geoportal (visualising data on maps, tables and charts)

2.4. Transnational cooperation

MSP EU Directive (Directive, 2014) recognises the necessity for cross-border cooperation between countries, as a part of the planning and management process. The aim is to ensure a coherent and coordinated management across the marine regions.

The cross-border cooperation shell be established between EU Member countries and with neighbouring third countries, hereafter called transnational cooperation because such cooperation should take into account issues of transnational nature. The EUSAIR is a mechanism that supports and enables such cooperation between the AI countries, as one of the four main sub-regions of the Mediterranean.

The Directive stipulates that each EU Member country shell designate the authority responsible for the implementation of the Directive including the responsibility for transnational cooperation. The forms of cooperation are not prescribed into details, but the Directive suggests the following cooperation approaches through the following:

- Existing regional institutional cooperation structures such as Regional Sea Conventions (Barcelona Convention in the case of AIR);
- Networks or structures of Member States' competent authorities;
- Any other method, for example in the context of sea-basin strategies (EUSAIR).

Today, countries are preparing national and sub-national MSPs covering their sea space and governed by national laws and regulations. The MSP development process includes the consultations with countries that share a maritime border (consulting maritime activities and spatial plans of neighbouring countries and negotiate across borders), but finally, the maritime space is governed by different set of rules.

Although EU Member states are cooperating via international sectorial agreements, there is a need for supra-national instrument (such as EUSAIR) or body dealing with cross-border aspects of MSP. It is particularly important in Europe where seas are increasingly congested. There are several MSP instruments that should enhance transnational MSP. Among the others, the ones in the line with EUSAIR Plan is the following:

- Creation of macro-regional or regional actions as the starting point for successful transnational MSP practices (such as EUSAIR Plan for Adriatic-Ionian Region);
- Creation of international/regional sea basins serving as the basis for transnational cooperation (analogue to river basins and sub-basins used by The Water Framework Directive), and
- Creation of forum, place to discuss and develop approaches to the management of maritime activities in the sea basins (such as EU MSP Forum[1]).

One of the GAIR tool 's achievements is providing support for transnational cooperation in the Adriatic-Ionian Region. It is realised through enabling data and knowledge sharing, and applying the same methodologies and analytical tools among the countries.

- [1]https://www.msp-platform.eu/type-event/forum

3. MSP and ICZM in Greece

3.1. Legal framework and responsible institutions and stakeholders

Greece is located in southeastern Europe and at the northeastern corner of the Mediterranean Sea. The country has an extensive coastline of about 15000 kilometres, and around 6000 islands and islets that constitute the unique Greek archipelago. Over the 70% of Greece's population is concentrated in the country's coastal zone. The Territorial Waters of Greece are set up to 6 n.m. The country has recently signed an agreement on maritime boundaries with Italy, delimiting an exclusive economic zone (EEZ) between the two neighbouring nations, aiming also to resolve longstanding issues over fishing rights in the Ionian Sea, and then another agreement with Egypt designating an EEZ in eastern Mediterranean waters.

Greece is a maritime nation by tradition, and shipping and maritime trade have been key elements of the Greek economy since the antiquity. Then, fisheries have been also an activity of vital importance for the communities of the island and coastal regions of Greece for thousands of years. In the last few decades tourism, and particularly maritime/coastal tourism, has been one of the main contributors to the country's economy, while marine aquaculture is also considered as a success story in Greece's Blue Growth agenda. As a consequence, there is an increasing demand for marine space, particularly in specific areas, which is currently allocated on a single-sector basis without a plan-based approach. The latter may subsequently lead to conflicts among uses as well as with the natural environment. Indeed there are a number of risks and challenges that need to be taken into account during the blue growth planning in the country that aside from conflicts between different sea uses resulting in depletion and/or degradation of natural and cultural resources and biodiversity, include also the institutional fragmentation and ineffective marine management/governance and the risk of the low-level knowledge and information diffusion at a local level related to blue economy and blue growth (Kyvelou&Ierapetritis, 2019).In this vein, marine spatial planning (MSP), aiming to balance ecological, economic and social interests, is a process that has become increasingly important for the management of maritime activities in the last decade and may also substantially contribute to tackling the aforementioned challenges and facilitate Blue Growth. It In this vein, in the European Union (EU) Seas, planning of the maritime space is gradually following the provisions of the EU Maritime Spatial Planning Directive (MSPD) that has been adopted by the European Commission in 2014, and has been transposed to the Greek legal system in 2018 (Law 4546), constituting the key policy document for the future of MSP in Greece.

The competent authority for the implementation of the MSPD in Greece is the Ministry of Environment and Energy, which will have the ultimate responsibility for MSP's implementation at all levels of policy, and has the following responsibilities:

1. designs, within marine waters and coastal zones, the extent and content of maritime spatial planning,
2. ensures the preparation of the national spatial strategy for the maritime space and maritime spatial plans
3. evaluates the implementation of the maritime spatial plan

4. consults with the relevant authorities of other Member States of the European Union and third countries for the formation of cooperation and a common approach, as well as the coordination of their actions concerning maritime spatial planning guidelines. national maritime space strategy,
5. ensures any appropriate way, process, mechanism or program
6. takes all necessary measures to ensure the coordinated implementation of maritime spatial planning by the involved public authorities at all levels of government (national, regional and international or transnational level),
7. is a point of contact with the European Union and its competent members for matters related to the implementation of Directive 2014/89 / EU,
8. participates in national, transnational and cross-border programs, within the framework of its responsibilities
9. supervise and coordinates programs and studies related to spatial planning and implemented in the national maritime and coastal area
10. must inform the European Commission of changes in the information concerning its legal and administrative status.

However, in order to develop an appropriate maritime planning and governance framework in Greece, and as each marine sector has its own consideration for spatial allocation of its activities which are usually governed by different authorities (e.g. fisheries and aquaculture by the Ministry of Rural Development, shipping by the Ministry of Maritime Affairs and Insular Policy), the MSP competent authority (i.e. the Ministry of the Environment and Energy) will have to promote the coordinated integration of individual ministerial sectorial policies and action plans.

Then, as the MSP process should aim at allocating the different marine uses following a transparent participatory approach, including also a strong socio-cultural dimension (Papageorgiou and Kyvelou 2018), special emphasis needs to be placed in Greek coastal and mainly island communities that depend on sustainable maritime activities to ensure inclusive prosperity goals. The latter is also linked with provisions of the EU Cohesion Policy, that aims to reduce disparities between regions by encompassing the identification of place-based niche areas of competitive strategic potential; such place-based outcomes should be one of the key ingredients of the MSP processes developed in the different regions. In this sense, multi-stakeholder governance mechanisms acting as enablers to the development of smart specialization strategies (RIS3) that focus on solving major societal challenges at regional/local scales, should be directly linked to strategic and forward-thinking MSP efforts. Hence, effective governance interventions are needed for mainstreaming efforts and outcomes of relevant stakeholder working groups under different policy agendas (e.g. cohesion, environmental, planning) with the aim to link considerations of MSP issues, as the planning process should not only reflect place-identities but actually it should be based on the natural and social capital characteristics of the different marine areas/regions. Due to the heterogeneity of marine space, in terms of the high diversity of its natural capital and the socio-economic opportunities in the different regions of the country, the country will benefit from tailor-made MSP implementation approaches at regional (and if needed at local) scale. Indeed, according to Papageorgiou and Kyvelou (2018), MSP should pave the way for practical tailor-made planning taking into account the characteristics of the different marine/coastal social-ecological systems. In order to accommodate the aforementioned challenges, an effective MSP governance system is thus needed in the country, that will consider efficient collaboration and integration at a horizontal level (e.g. interministerial),as well as vertically, between national, regional and local administration levels. The above are in accordance with Kelly et al. (2018) suggesting that institutional and legal frameworks for marine governance, involving transformative change of institution values and practices, need to be developed in order for the countries to achieve an integrated management of their maritime space. At the moment, EU countries have adopted a variety of approaches and strategic options, that depend greatly on geopolitical circumstances, regional commitments and domestic policies which may constitute the basis for improving existing MSP governance systems (Casimiro&Guerreiro, 2019).

3.2. Preparation of maritime spatial plans or coastal management plans

Greece is in the process of preparing its maritime spatial plans, that need to be adopted on the basis of the provisions of the EU MSPD by 2021. Up to now MSP issues are addressed in sectoral plans, that have been elaborated so far for aquaculture, tourism, industry and renewable energy, and include spatial planning guidelines for the land-based, coastal and marine segments of each sector. Furthermore, there are Spatial Plans at the regional level, which however focus on the spatial management of land activities and coastal areas. Indeed due to the great importance of the coastal zone in Greece, important national legislation on coastal management has been introduced since the 1980s, which however is rather fragmented and often has contradictory objectives (Simboura *et al*., 2018). Although the integrated coastal zone planning/management remains a complex issue requiring systematic approach and data gathering (Beriatos&Papageorgiou, 2011), the Integrated Coastal Zone Management (ICZM) Protocol that was adopted in 2008 by the contracting parties to the Barcelona Convention, aiming specifically to address the impacts of coastal development, is yet to be ratified by the country. The only, truly marine spatial plans in Greece are the Framework for Common Spatial Planning for Aquaculture (Common Ministerial Decision No 31722/2011). This framework promoting zoning of the sea allocated to aquaculture (allocated zones to aquaculture (AZA)) with the aim to avoid interference between possibly conflicting activities, has received a lot of criticism by stakeholders representing the fisheries (mainly small-scale) and tourism sectors during the consultation process that took place at the beginning of the testing phase. Then, the Special Framework for Tourism spatially distinguishes coastal areas into Developing and Developed ones. A number of prohibitions exist for the fisheries sector, mainly for trawlers and purse-seiners which vary from no-take areas to spatio-temporal bans. Finally, there are spatial management plans for the two marine protected areas (MPAs); the Zakynthos Park in the Ionian (Presidential Decree (P.D.) 906 D'/21.12.1999) established for the protection of the marine turtle *Caretta caretta*, and the Alonissos Park in the Aegean (Common Ministerial Decision 621/23537/2003) for the conservation of the Mediterranean monk seal *Monachus monachus*. In the latter two MPA plans there is explicit zoning of specific marine activities referring to varying protection levels in accordance to the foreseen biodiversity conservation objectives. In 2018, Greece has also increased the designation of its Natura 2000 marine space, however, as up to now Natura sites are in many cases all over Europe considered as "paper parks" (WWF, 2017) and the same is true for the Greek Network, it seems crucial that the designation of protected areas in the European seas should be based on systematic conservation planning principles that need to be embedded in the MSP process (Fraschetti et al., 2018). Finally, a number of MSP related projects have taken place that have shed light on issues of concern that will need to be addressed to proceed with effective planning strategies, and certain projects in which the MSP competent authority was involved led to the development of pilot plans in different areas of the country(https://www.msp-platform.eu/countries/greece).

As for the Greek case study area of the PORTODIMARE project, which is located at the western part of Greece, in the Ionian Sea, the existing spatial management provisions refer once again to fishery-related spatial prohibitions in designated areas/periods, while there are also a number of Natura 2000 sites for which no spatial management schemes exist, and there are both developing and developed coastal touristic areas as appearing in the national strategy for tourism, and although the latter information does not refer to marine planning, it definitely affects land-sea interactions. Last but not least, the Sectoral National Spatial Plan for the aquaculture is particularly relevant for the Greek case study area, as fish farming units there yield about 30% of the total fish farming production in Greece, and within the latter Plan there are also provisions for the further development (including the spatial expansion) of the sector within the boundaries of the area under study. On the basis of the above, and as the MSP competent authority was not involved in the project, the scientific team took the initiative and has decided to focus the testing effort for the Greek case study on interactions between aquaculture activities, considering also the provisions of the relevant legal document, and fisheries and tourism. As for the conservation priority ecosystem components, seagrass (*Posidonia oceanica*) meadows, the common dolphin (*Delphinus delphis*) and the monk seal (*Monachus monachus*) have been selected to be included in the analysis of Testing phase of the GAIR modules.

The objective of the study was to use the GAIR applications for analyzing existing and future conditions in the study area, with the aim to contribute with new knowledge on the aforementioned step, being of crucial importance in the MSP process, and evaluate outcomes from the testing exercise. The ultimate goal was to identify possible barriers and challenges that need to be addressed to improve approaches related to the MSP step "analysis of existing and future conditions", and in line with the latter provide suggested actions (i.e. a proposed Action Plan (AP)). Finally, following the presentation of the legal aspects related to MSP in Greece, proposed actions related to governance issues and stakeholder engagement have been also drafted and were included in the AP section of the present deliverable.

4. Testing area

4.1. Presentation of the testing area

Testing of selected spatial modules developed within PORTODIMARE was carried out in a well defined area in the Ionian Sea, Western Greece (Figure 1). The Greek Case Study is located between the western coasts of the country and the islands of Lefkada, Ithaca and Kephalonia, and includes the Inner Ionian Archipelagos, which is an important marine mammal area (IMMA), and the outer part of the Patraikos gulf. In the coastal zone there is a relatively increased urbanization, and the aforementioned islands constitute important touristic destinations hosting relevant infrastructure facilities (hotels, marinas etc). The most important, truly marine, activities that take place in the study area are fisheries and aquaculture while there is also increased maritime traffic. Consultation with local stakeholders has revealed spatial conflicts between aquaculture and mainly small scale fisheries, and then aquaculture and coastal tourism.

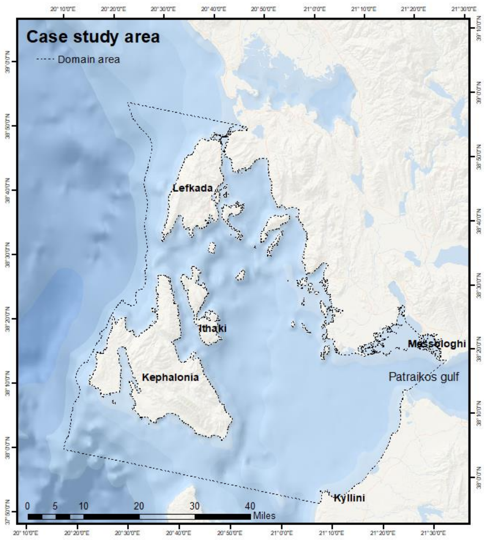

Figure 1 Case study –Ionian Sea/Western Greek waters

In the frame of PORTODIMARE, spatial data for the major human activities taking place in the marine part of the case study area, and for three ecosystem components, that are described briefly below, as they are presented in more detail in DT2.4.1, have been compiled from various sources and were stored in the GAIR.

Human activities

In relation to marine activities/uses, the following ones have been taken into account in the Greek case study area and are visualized in Figure 2, except for fisheries; the spatial distribution of the latter sector was studied in the frame of two modules (SSF and MSF) presented in DT2.4.1, and has been also addressed in section 4.2 of this report.

- **Aquaculture**

The only aquaculture type in the study site is fish farming, and the area yields about 30% of the total fish farming production in Greece. The main cultured species in the 55 farms of the study area are the sea bream (*Sparus aurata*) and the sea bass (*Dicentrarchus labrax*).

- **Fishing Ports**

There are 13active fishing ports with a maximum capacity of 5402 GT.

- **Marinas**

There are four marinas, the biggest one, with total capacity of 620 yachts up to 45 m in length, located at the island of Lefkada.

- **Cables**

A number of underwater cables are laid on sea bed of the study area.

- **Shipping**

Important maritime traffic also takes place in the study area.

- **Fisheries**

Three subsectors are included: small scale fisheries (SSF), bottom trawlers (OTB) and purse seiners, the latter two comprising the medium scale fisheries (MSF). The spatial distribution of the three subsectors is presented in section 4.2 (Modules SSF and MSF).

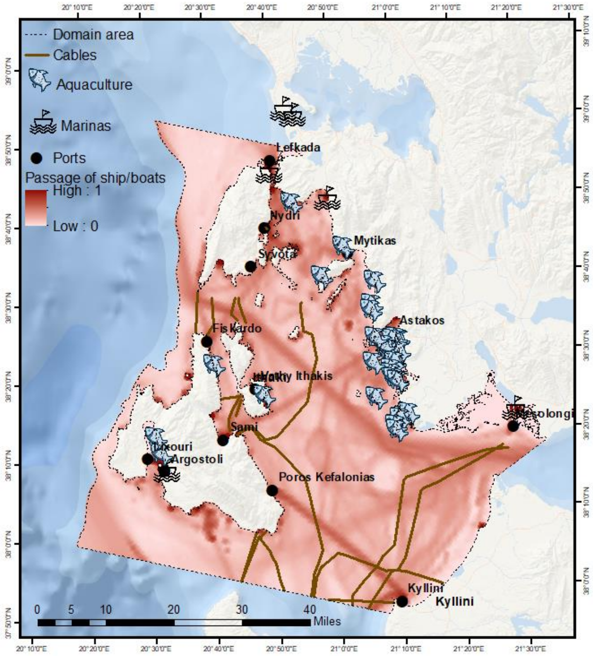

Figure 2 Marine activities/uses (aquaculture, ports, marinas, cables, shipping routes) in the case study area

Ecosystem components

Three conservation priority ecosystem components, the Neptune's sea grass (*Posidonia oceanica*), the common dolphin (*Delphinus delphis*) and the monk seal (*Monachus monachus*) have been selected to be further analysed in the frame of the Greek case study, and particularly for the application of the cumulative effects analysis (CEA) module. Figure 4 visualizes the existing spatial information on the distribution of the three ecosystem components in the Ionian Sea CS area.

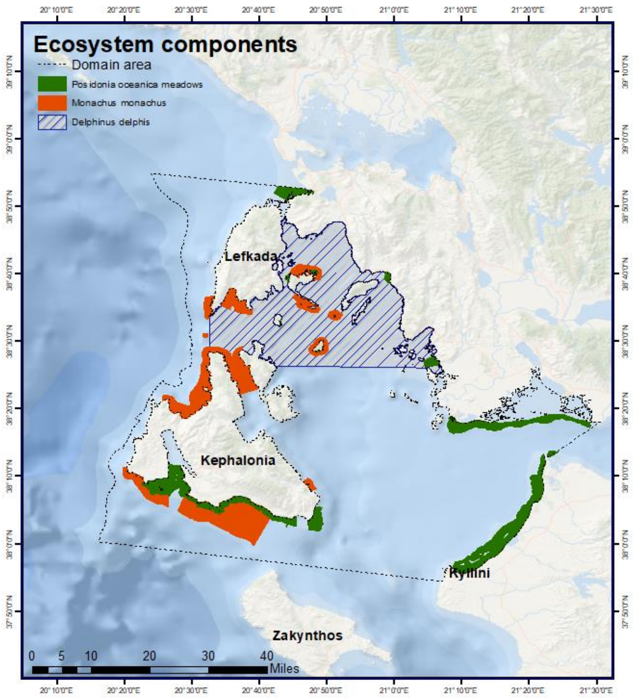

Figure 2 Spatial distribution of the selected ecosystem components in the Greek CS

4.2. Modules tested

The following modules implemented in the frame of PORTODIMARE and tested in the Greek case study are:

- **The Module on Small Scale Fisheries (SSF) and Medium Scale Fisheries (MSF) footprint.**

HCMR was responsible for the implementation of modules SSF and MSF (Deliverables 1.11.2, 1.11.3, 1.12.2, 1.12.3).The SSF module integrates the most influential components and criteria affecting small scale fisheries combining Multi-Criteria Decision Analysis methods and geospatial techniques. This module was used to estimate a spatial fishing pressure index for SSF in the study area. Then, the seven-steps methodological process described in detail in DT1.12.2, was used to estimate fishing effort from MSF in the Greek case study.

The output layers of SSF and MSF modules are presented below (Figures 5 & 6). The two maps respectively visualize areas with varying levels of fishing pressure exerted by SSF and MSF in the case study area.

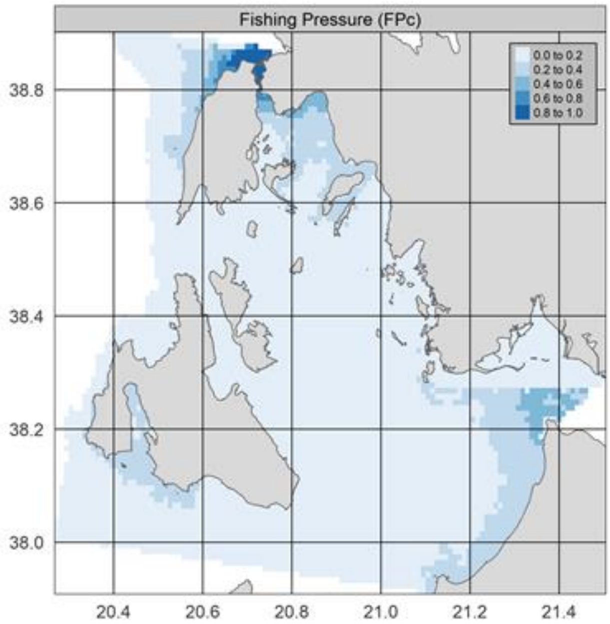

Figure 5 Fishing pressure index for Small Scale Fisheries

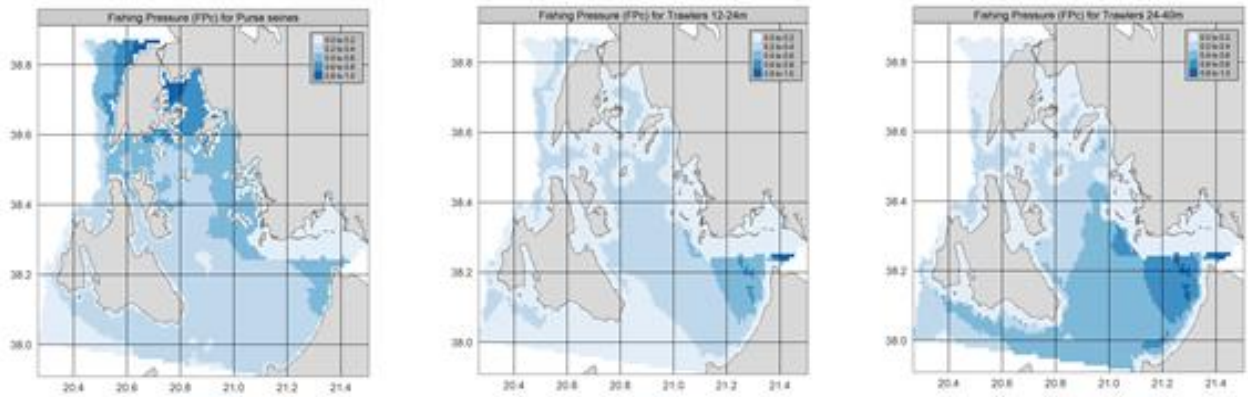

Figure 6 Fishing pressure index for Medium Scale Fisheries

- **The Module of mapping Allocated Zones to Aquaculture (AZA).**

The module for mapping Allocated Zones to Aquaculture was implemented for the Ionian Greek waters by CORILA (Deliverable 1.8.1). The AZA module implemented a spatially explicit Multi-Criteria methodology in order to define marine areas where the development of aquaculture may be suitable. For the analysis, the criteria that have been used were finfish optimal growth, wave height, and distance to harbour. The AZA module was tested for the most important farmed species of the study area, the european seabass and the gilthead seabream.

The main output from the application of the AZA module is a raster map visualizing sites that seem to be suitable for finfish aquaculture development in the case study area. In Figure 7 aside from the suitable areas identified by the AZA module, the zones proposed by the Framework for Common Spatial Planning for Aquaculture in Greece are also depicted, showing a relatively good agreement with the AZA module results.

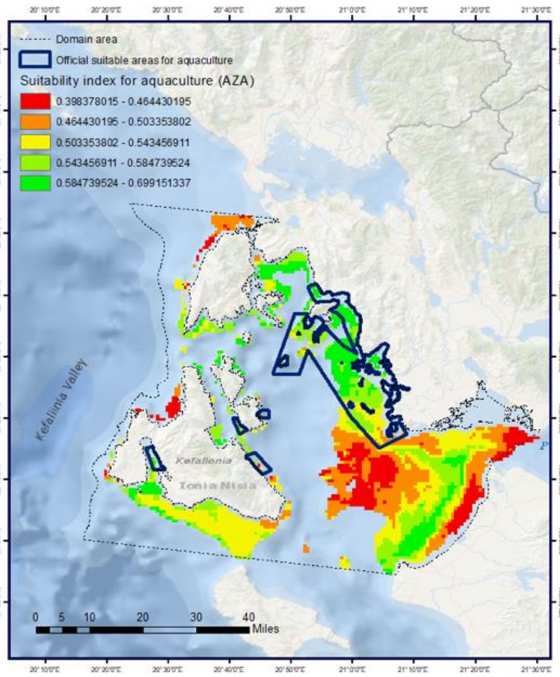

Figure 7 Map of suitability index for aquaculture development based on the AZA module, and zones officially proposed as AZA by the Greek Framework for Common Spatial Planning for Aquaculture

- **Module for the analysis of the cumulative impacts of anthropogenic pressures on ecosystem components (CEA).**

In the Ionian Sea case study, the Cumulative Effects application of the Tools4MSP Modelling Framework was also tested (see DT1.7.3 and DT2.4.1 for more details). The CEA has been performed in order to elucidate the propagation of pressures generated by the activities taking place in the Greek study area and to assess the spatial distribution of impacts exerted by these pressures on the selected ecosystem components.

The module of CEA applied to the Greek case study has produced a number of outputs included in DT2.4.1, and selected outcomes are presented below (Figures 8 and 9).

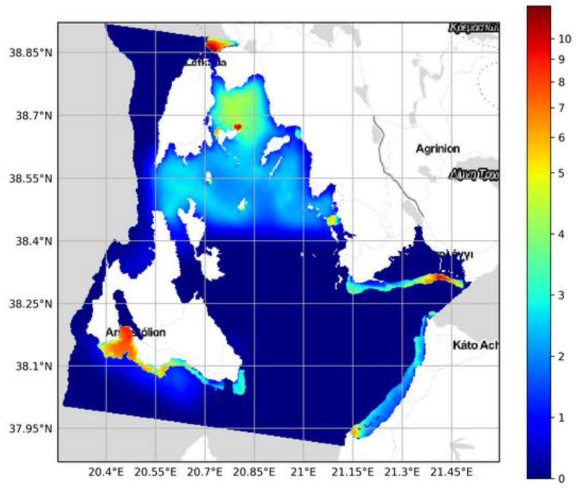

Figure 8 Geospatial distribution of CEA scores in the Greek CS

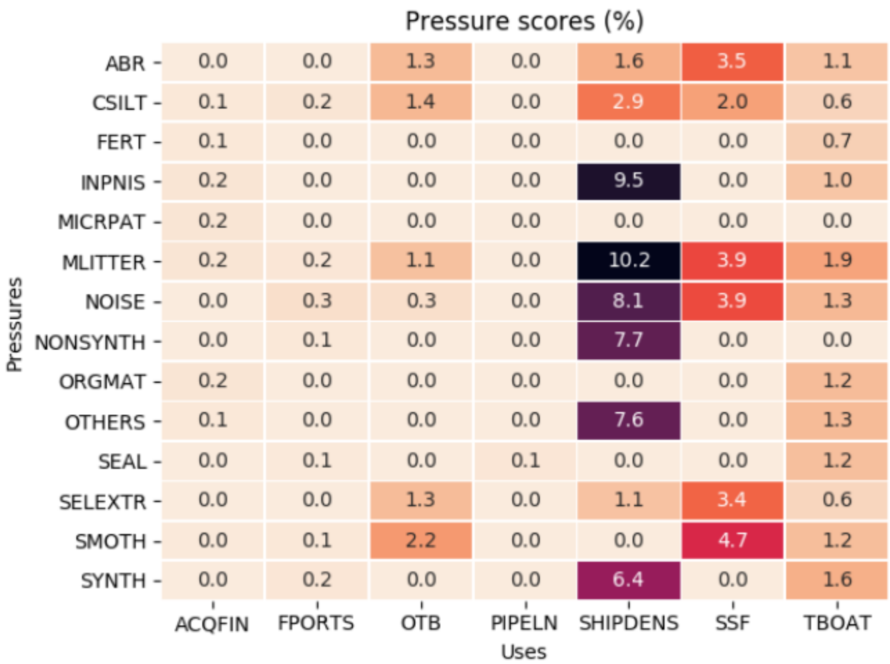

Figure 9. Matrix representing the contribution of the single pairwise combination of human use and pressure to the total CEA score

Outputs suggested that there is high conflict between litter and marine mammals, particularly in areas with high shipping density, while noise and pollution linked also with shipping activities seem also to exert important pressures particularly on the dolphin populations of the study area. Then, SSF appear to be the sector affecting mainly the status of sea grass meadows in the Greek CS mainly due to littering from abandoned fishing gears (nets, longlines).

It should be pointed out, however, that as the main goal herein was the testing of the respective GAIR module, outcomes from this exercise should be considered as preliminary and indicative as they refer to impacts on selected environmental components, assessed on the basis of the available data. Indeed, the application of CEA should include comprehensive data and assessment of environmental impacts to visualize the complexities of how multiple pressures from different activities affect marine ecosystems and how this impact can be altered by different planning solutions.

4.3. Preliminary effort to integrate results from different modules

As according to local stakeholders, the main spatial interactions between the human activities in the study area seem to exist between aquaculture and small scale fisheries, and then aquaculture and coastal tourism, the spatial distribution of aquaculture units and tourism-related facilities in the study area were combined with outcomes of the SSF module to visualize existing spatial conflicts. What is more, outcomes from the AZA module were also included in the CEA module to identify areas where future conflicts with conservation objectives may arise due to the possible expansion of aquaculture activities. Outcomes indicated that the area proposed by the Aquaculture Framework in the marine territory of the Region of Western Greece seems to be the most suitable one for the further development of the sector, as spatial conflicts with other prevailing activities seem to be rather restricted there. Indeed, as certain coastal parts of the latter area have been categorized by the Special Tourism Framework as zones for the development of mild and alternative forms of tourism, potential synergies between aquaculture and tourism activities may be explored, with farmers offering touristic and educative activities (MUSES, 2018). On the other hand, in two sites of the Ionian Islands region not included in the Aquaculture Framework, but identified as suitable by the AZA module, conflicts would have been intense with both tourism and fishery related activities in case fish farming would have been considered for development there (Fig. 10).

The latter constitutes a preliminary effort to integrate outcomes from different modules, as well as spatially explicit information hosted in the GAIR, to better understand the prevailing conditions in the study area; such information in cases it is based on robust data and assessments constitutes valuable advice for effective planning decisions.

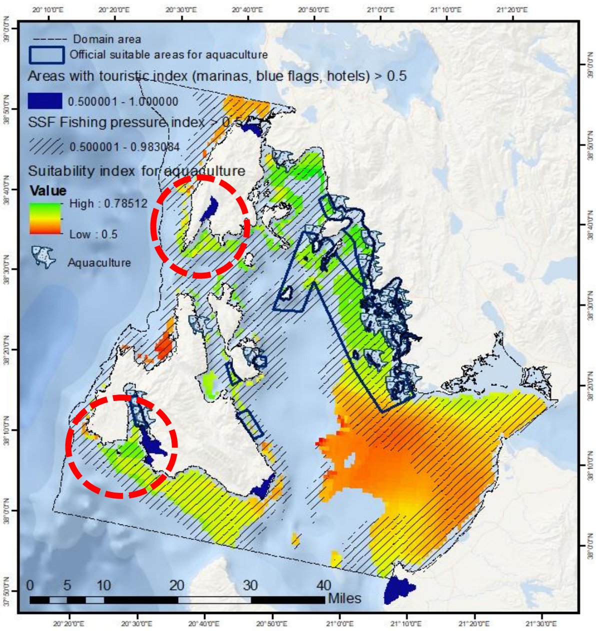

Figure 10 Map highlighting conflicting hotspots with coastal tourism and SSF in areas identified as suitable by the AZA module. The officialy designated zones for aquaculture development are indicated, and the one across the coastal area of the Region of Western Greece seems to be the best option as spatial conflicts are at a minimum

5. Action plan for MSP and/or coastal management plans based on the testing site in Greek waters

The GAIR constitutes an 'all-in-one toolbox', that may provide significant feedback to be used by planners in the AIR for MSP implementation. The considerable data gaps that exist in the Greek case study area regarding the ecological and economic parameters, however, restricted the reliability of the outcomes, which should be considered as indicative. Furthermore, from the presentation of the legal framework in Greece, it seems that institutional fragmentation and ineffective marine management/governance constitute barriers that need to be addressed to enable effective MSP implementation. Hence, the following Action Plan includes actions suggested by the HCMR research team with the aim to contribute with addressing challenges identified in the frame of the Testing process of the PORTODIMARE Greek CS to improve the analysis of existing and future conditions in a planning area, being one of the key steps of the MSP process. Then, a number of proposed actions that refer to governance and stakeholder issues are also included. Having said that, it should be underlined, that the information contained herein reflects the views only of the authors, and although it may be potentially useful in MSP efforts in Greek waters, it has not been endorsed either by the HCMR administration, or the MSP competent authority in the country.

Challenges

Experience gained from the GAIR applications in the testing area highlighted the scarcity and fragmentation of the compiled spatial data, with few exceptions (eg data on commercial fisheries derived from the IMBRIW HCMR data base). Data and knowledge gaps restricted the overall quality of outcomes. Then, a point that may enable the continuation of conflicts between different sea uses and the natural resources in Greek waters seems to be institutional fragmentation.

- **Suggested Actions**

  1. MSP plans should consider impact assessments based on optimal data aggregations and sound scientific interpretations, including confidence intervals /approaches to evaluate uncertainty of the model outputs.
  2. Monitoring efforts are needed to fill the important data gaps particularly in areas that seem to constitute hot spots of conflicts with conservation priority species as well as between uses competing for the limited marine space.
  3. Further research should be streamlined towards improved understanding of the links between ecosystem pressures, impacts, status and the capacity of the ecosystem

to deliver ecosystem services, and such efforts should be linked particularly with WFD and MSFD ones.

4. Effective horizontal and vertical integration of governance approaches need to be adopted as there is a number of different authorities and at different government levels (national, regional, local) dealing with the management of the coastal and marine space.
5. Promote tailor-made MSP taking into account the characteristics of the different marine/coastal social-ecological systems streamlined with smart specialization strategies (RIS3) at regional/local scales.
6. Establishment of key stakeholder platforms and development of an effective stakeholder engagement strategy mainstreaming efforts and outcomes of relevant stakeholder working groups under different policy agendas which feed into the MSP process
7. Enhancement of knowledge, skills and capacity of key MSP actors with relevant concepts and tools (eg the GAIR), to deliver truly participatory multi-sector planning scenarios supporting ecosystem-based decision-making.

- **Lessons learnt towards adopting an integrated approach for analyzing existing and future conditions to contribute to MSP implementation**

In the following section a sequence of steps are described to improve the overall validity of scientific out comes referring to the MSP step on the "analysis of existing and future conditions", in order to provide more robust scientific advice to be potentially used in real planning efforts.

Main ecosystem components and human activities that are relevant to the operational objectives defined in the beginning of the MSP process under the responsibility of the MSP competent authority, need to be identified, and information regarding their spatial distribution should be collected. As the process of spatial data visualization is considered crucial for the implementation of the planning procedures, a robust methodological process should guide the appropriate scale and cell size selection. Following this, a detailed description of data sources and data quality should be provided. Compiling spatial data into a Geographic Information System (GIS) database is the most effective way to store, analyze and map relevant information (e.g. human uses and conservation priority ecosystem components). Then, the assessment of potential conflicts and compatibilities between existing human uses as well as with the selected ecosystem components should take place using appropriate analysis tools, such as those included in the GAIR, to identify possible issues and constraints, that should be tackled using the MSP process. An important point related to the analysis phase deals with the need to address and communicate uncertainty and risks issues, not only related to data and knowledge used to analyze existing conditions, but mainly for future ones, as only assumptions or possibilities can be explored while forecasting future conditions. The latter phase of the analysis should aim to balance multiple objectives through appropriate trade-offs, and key stakeholders should play a crucial role by providing spatial data and information on a wide range of expectations, opportunities and conflicts that take place in a specific area, which will advise on the special characteristics of the different marine/coastal social-ecological systems and considering also efforts on RIS3 at regional/local scales.

Hence, MSP plans should consider spatial interactions and impact assessments based on optimal data aggregations and sound scientific interpretations, and confidence intervals /approaches to evaluate uncertainty of the model outputs should be also provided. Although a number of decision support tools may be used, such as those included in the GAIR, data but also knowledge gaps, usually create important barriers towards proceeding with efficient planning proposals. Thus, monitoring efforts are needed to fill the important data gaps and further research should be streamlined towards improved understanding of the links between pressures, impacts and environmental status; such monitoring and research efforts should be linked with those already taking place under the implementation of other policies (e.g. HD, WFD, MSFD, CFP) identifying synergies with MSP data and knowledge needs. The latter is also linked with the fact that the MSP process should be based on integrated governance approaches, as there is a number of different authorities dealing with the management of coastal and marine space, which are responsible for the implementation of the aforementioned policies. Integrated governance will also promote enhanced cooperation between sectors and with research centers/academia and will enable the establishment of key stakeholder platforms. Indeed, the development of an effective stakeholder engagement strategy, promoting at the same time their capacity building with MSP tools is crucial in order to deliver truly participatory multi-sector planning, however, a successful participatory approach can be guaranteed only if it is properly organized by the national (or regional) competent authority in the country/region. Finally, the competent authority should facilitate transfer of good practices from other countries, and provide funding for interdisciplinary research, tackling environmental, economic, socio-cultural, policy issues, to ensure credible advice supporting integrated MSP.

4. References

Beriatos, E., & M. Papageorgiou, 2011. Maritime and coastal spatial planning: the case of Greece and the Mediterranean. WIT Transactions on Ecology and the Environment, Vol 150, doi:10.2495/SDP110011

CAMP Italy Project, 2017. Significance of the CAMP Italy Project regarding Maritime Spatial Planning (MSP) – Integrated Coastal Zone Management (ICZM) – Land-Sea Interactions (LSI).

Casimiro, D. and Guerreiro, J. (2019) Trends in Maritime Spatial Planning in Europe: An Approach to Governance Models. Journal of Environmental Protection, 10, 1677-1698. doi: 10.4236/jep.2019.1012100.

Caputo, I., L. Natrella. 2018. "Module for Oil-spill coastal vulnerability assessment." presented at the PORTODIMARE International Conference on ICZM & MSP 2018, Budva, November, 14-15.

Depellegrin, D., S. Menegon, A. Fadini, E. Gissi, E. Manea, A. Sarretta, and A. Barbanti. 2018. "Maritime Use Synergy & Conflict Module MUSC." presented at the PORTODIMARE International Conference on ICZM & MSP 2018, Budva, November, 14-15.

Directive 2014/89/EU of the European Parliament and of the Council, 2014. Establishing a framework for maritime spatial planning.
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0089.

EC DG MARE, 2017. Maritime Spatial Planning Conference: Addressing Land-Sea Interactions –

Conference Report. 15-16 June 2017, St. Julian's Malta. Available at: http://msp-platform.eu/events/msp-conference-addressing-land- sea-interactions; accessed in September 2018.

Ehler, C.N., Douvere, F., 2009. Marine Spatial Planning: A Step-by-Step Approach Toward Ecosystem-Based Management January, UNESCO IOC.

Fraschetti, S., C. Pipitone, A. D. Mazaris, G. Rilov,.., and S. Katsanevakis, 2018. Light and Shade in Marine Conservation Across European and Contiguous Seas. Front. Mar. Sci., https://doi.org/10.3389/fmars.2018.00420

Ghezzo, M., C. Ferrarin, D. Depellegrin, S. Menegon, S. Carniel, and A. Barbanti. 2018. "Module for particle contaminants dispersion." presented at the PORTODIMARE International Conference on ICZM & MSP 2018, Budva, November, 14-15.

Hammar, L., Molander, S., Palsson, J., … & J. H.Andersen, 2020. Cumulative impact assessment for ecosystem-based marine spatial planning. Science of the Total Environment, 734, 139024 https://doi.org/10.1016/j.scitotenv.2020.139024

Kavadas, S., D. Politikos, M. Kikeri, I. Maina, and C. Vasilopoulou. 2018. "T1.11: Module on small scale fisheries (SSF) footprint." presented at the PORTODIMARE International Conference on ICZM & MSP 2018, Budva, November, 14-15.

Kelly, C., Ellis, G. and Flannery, W. (2018) Conceptualising Change in Marine Governance: Learning from Transition Management. Marine Policy, 95, 24-35.

Kyvelou S. & D. Ierapetritis, 2019. How to make blue growth operational? A local and regional stakeholders perspective in Greece. WMU Journal of Maritime Affairs, 18:249–280.

Menegon, S., D. Depellegrin, A. Fadini, E. Gissi, E. Manea, A. Sarretta, and A. Barbanti. 2018. "Cumulative Effects Assessment Module (CEA)." presented at the PORTODIMARE International Conference on ICZM & MSP 2018, Budva, November, 14-15.

Angela Schultz-Zehden, Ivana Lukic, …, Vassiliki Vassilopoulou, .. and Bruce Buchanan (2018). Ocean Multi-Use Action Plan, MUSES project. Edinburgh. https://www.submariner-network.eu/images/projects/MUSES/MUSES_Multi-Use_Action_Plan.pdf

PAP/RAC 2012. The ICZM Process: A Roadmap towards Coastal Sustainability, Split, Croatia. https://www.pap-thecoastcentre.org/pdfs/ICZM%20Process.pdf

Papageorgiou, M and S. Kyvelou, 2018. Aspects of marine spatial planning and governance: adapting to the transboundary nature and the special conditions of the sea. European Journal of Environmental Sciences 8 (1), 31-37

Ramieri, E., Bocci, M., Marković, M., 2019. Land Sea Interactions in the framework of ICZM and MSP, PAP/RAC, Split, Croatia.

Seaenergy project, 2012. Final project report - Delivering offshore electricity to the EU: spatial planning of offshore renewable energies and electricity grid infrastructures in an integrated EU maritime policy.

Simboura, N., Maragou, P., Paximadis, G., Kapiris, K., Papadopoulos, V.P., Sakellariou, D., Pavlidou, A., Hatzianestis, I. ,Salomidi, M., Arvanitidis, C.,Panayotidis, P. 2018. World Seas. An Environmental Evaluation, vol.1 Europe, The Americas and West Africa, Elsevier Academic Press, Chapter 9 – Greece.UN Environment/MAP, 2018. Conceptual framework for marine spatial planning in the Mediterranean, Athens, Greece.

UNEP/MAP/PAP, 2008. Protocol on Integrated Coastal Zone Management in the Mediterranean, Priority Actions Programme, Split, Croatia.http://iczmplatform.org//storage/documents/sewmrXIR9gTwfvBgjJ4SAjhvqsLrBF6qB0B89xK8.pdf

WWF, 2017. Preventing paper parks: how to make the EU nature laws work., 68pp.