

**MaPSIS 2017“International Conference Maritime Spatial Planning,
Ecosystem Approach and Supporting Information Systems”
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INTEGRATED ZONING FOR AQUACULTURE AND BIODIVERSITY USING A SPATIAL DECISION-SUPPORT TOOL

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In collaboration with

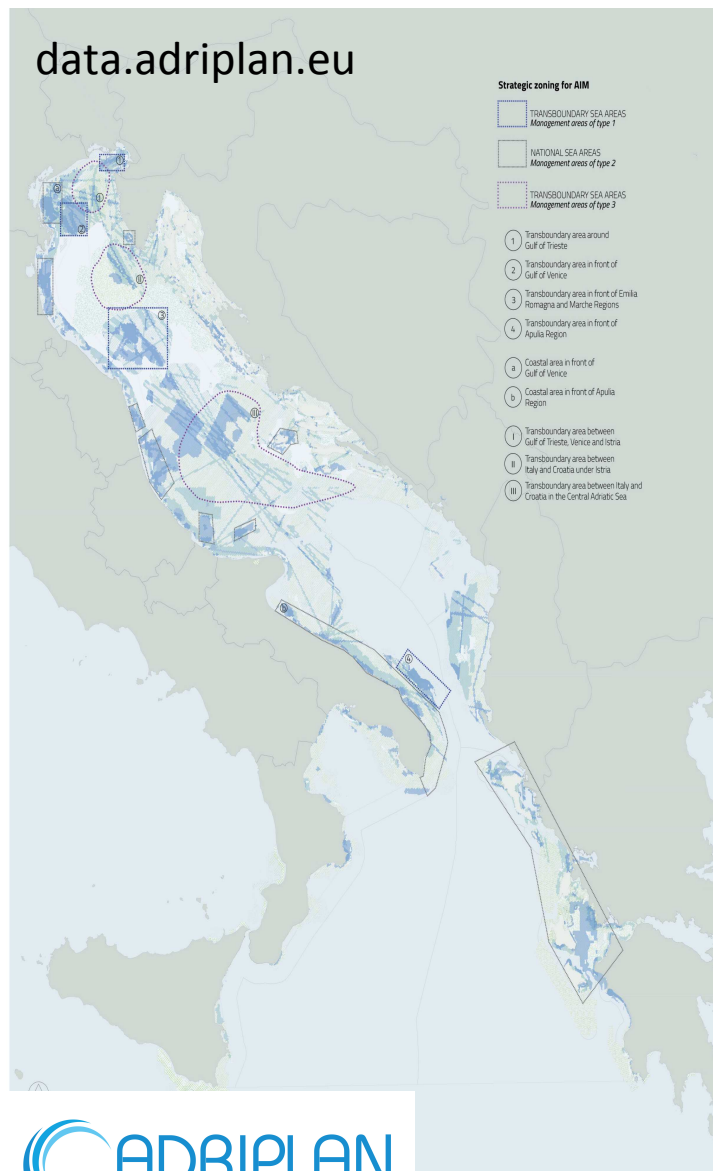


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OUTLINE

- Introduction and objectives
- Study area (spatial domain, main issues (on the basis of Adriplan results, issues, priorities and needs))
- Spatial data (data layers collected in Adriplan Data Portal)
- Methodology
 - #1 - Marxan for biodiversity conservation
 - #2 - Multicriteria analysis for aquaculture suitability surface
 - #3 - Marxan with Zones for the integrated zoning
 - step 4: pre-processing data layers
- Preliminary results
- Conclusions and Next steps

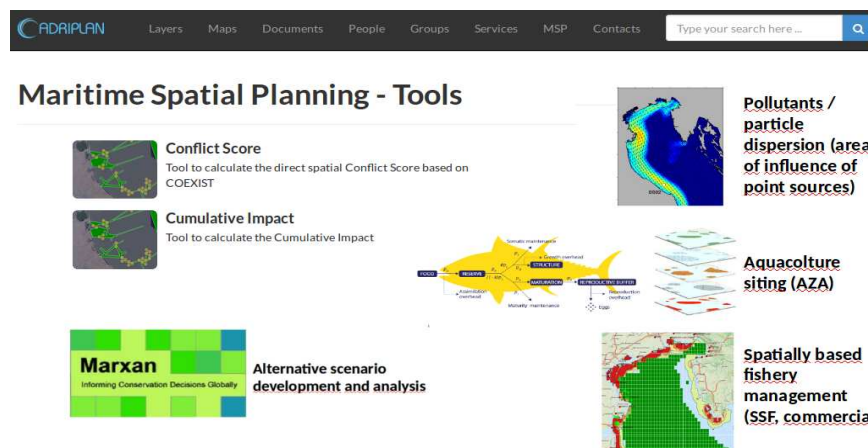
INTRODUCTION



European MSP Directive 2014/89/UE

Spatial decision-support tools can guide decision-makers towards knowledge-based spatial planning. Their application for multiple-objective zoning is beneficial for supporting the on-going **Maritime Spatial Planning (MSP) process**, in particular in areas of high density of uses like the Adriatic-Ionian region (AIR).

TOOLS FOR SUPPORTING MSP



Menegon et al., 2016. PeerJPreprint. Gissi et al., 2017 (under review) Gissi et al. (in prep.); Venier et al. (in prep.)

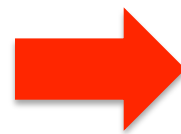
OBJECTIVE OF THE WORK

Sustainable development of the aquaculture

[EUSAIR Strategy Action Plan, COM(2014)357 final]

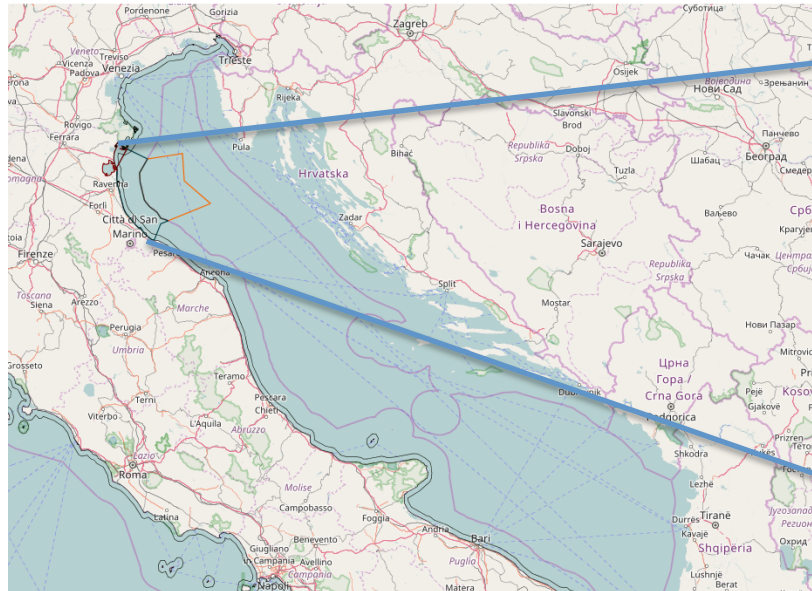
Pillar I -EUSAIR	Topics
Blue Growth	Blue technologies
	Fisheries and aquaculture
	Maritime and marine governance and services

Aquaculture expansion should occur alongside the **protection of biodiversity** and the conservation of sites where aquaculture and its synergic uses can coexist.



Operationalization of multi-objective zoning for aquaculture expansion and biodiversity protection
(seabed habitats, marine mammals, seabirds and turtles species distribution, nursery and spawning areas of commercially important fish species).

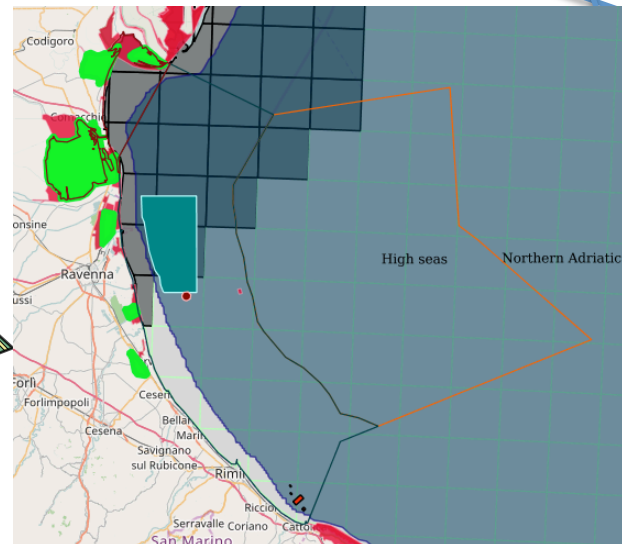
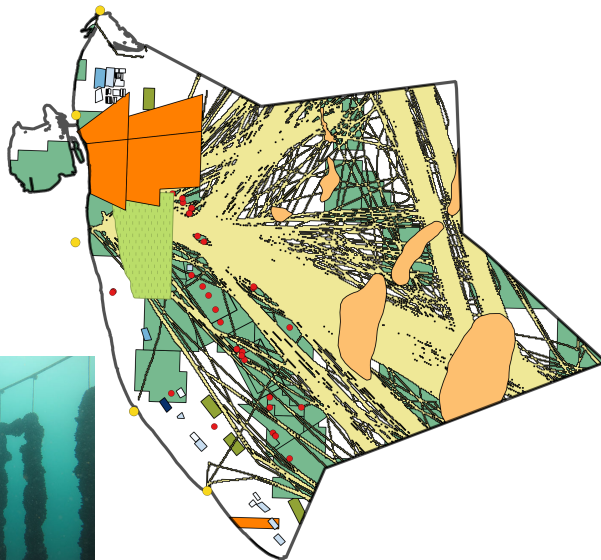
STUDY AREA: Emilia Romagna Region, Italy



120 km length of
the coast line

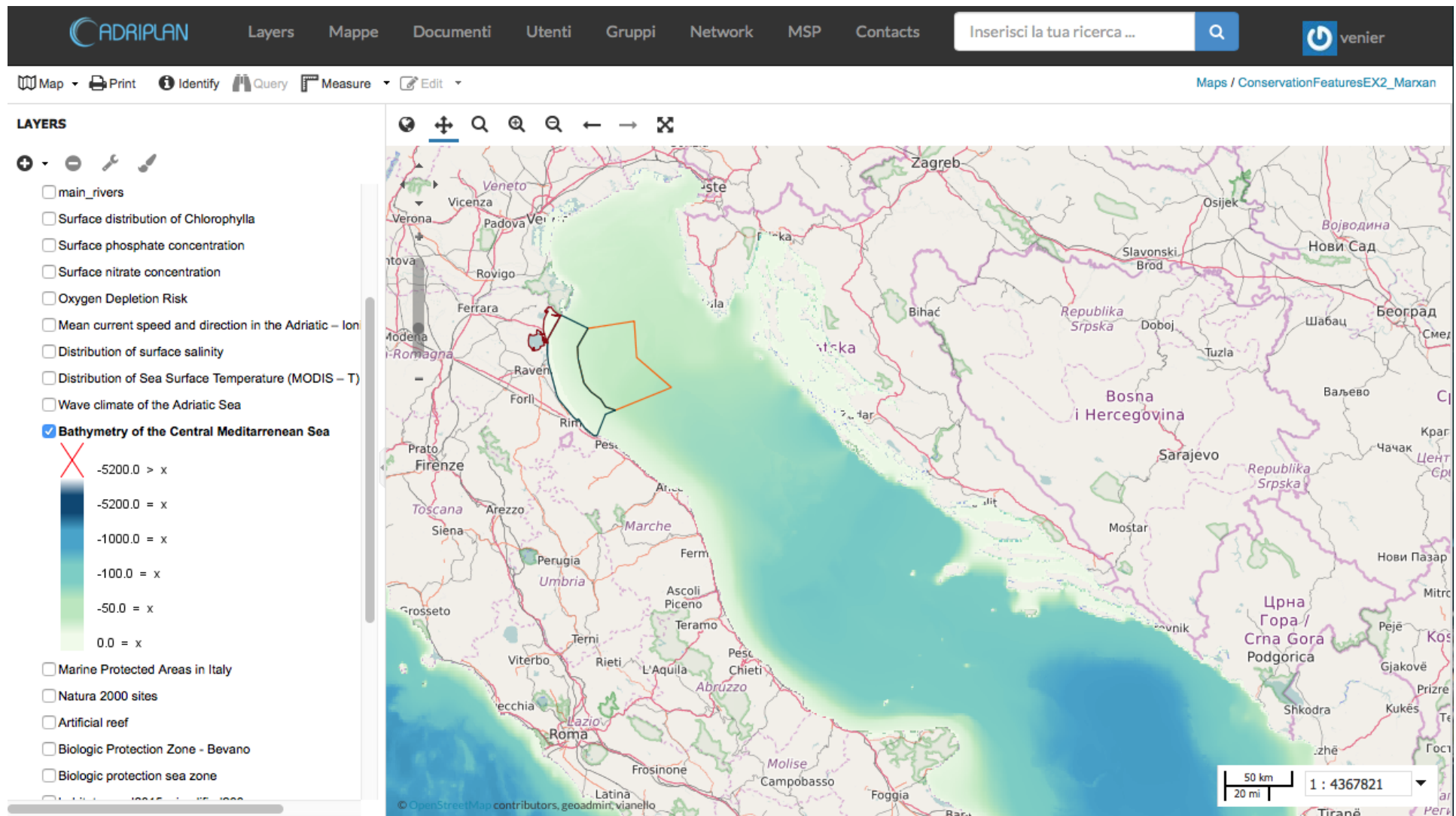
5256 km²

around 70 from coast
line to international
waters

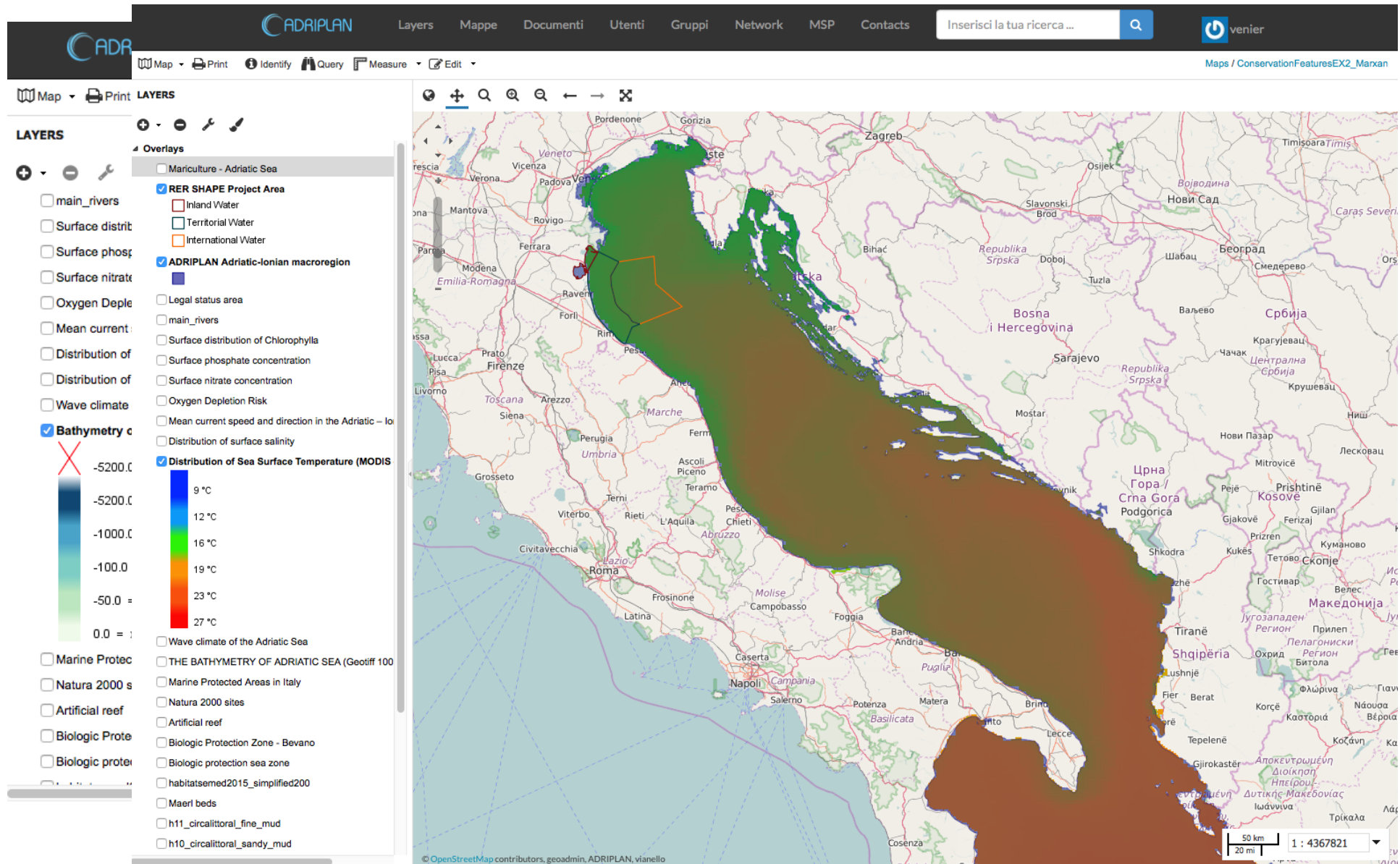


- Biological Protection Zone
- Natura 2000- Piattaforma Paguro
- Artificial Reef

SPATIAL DATA

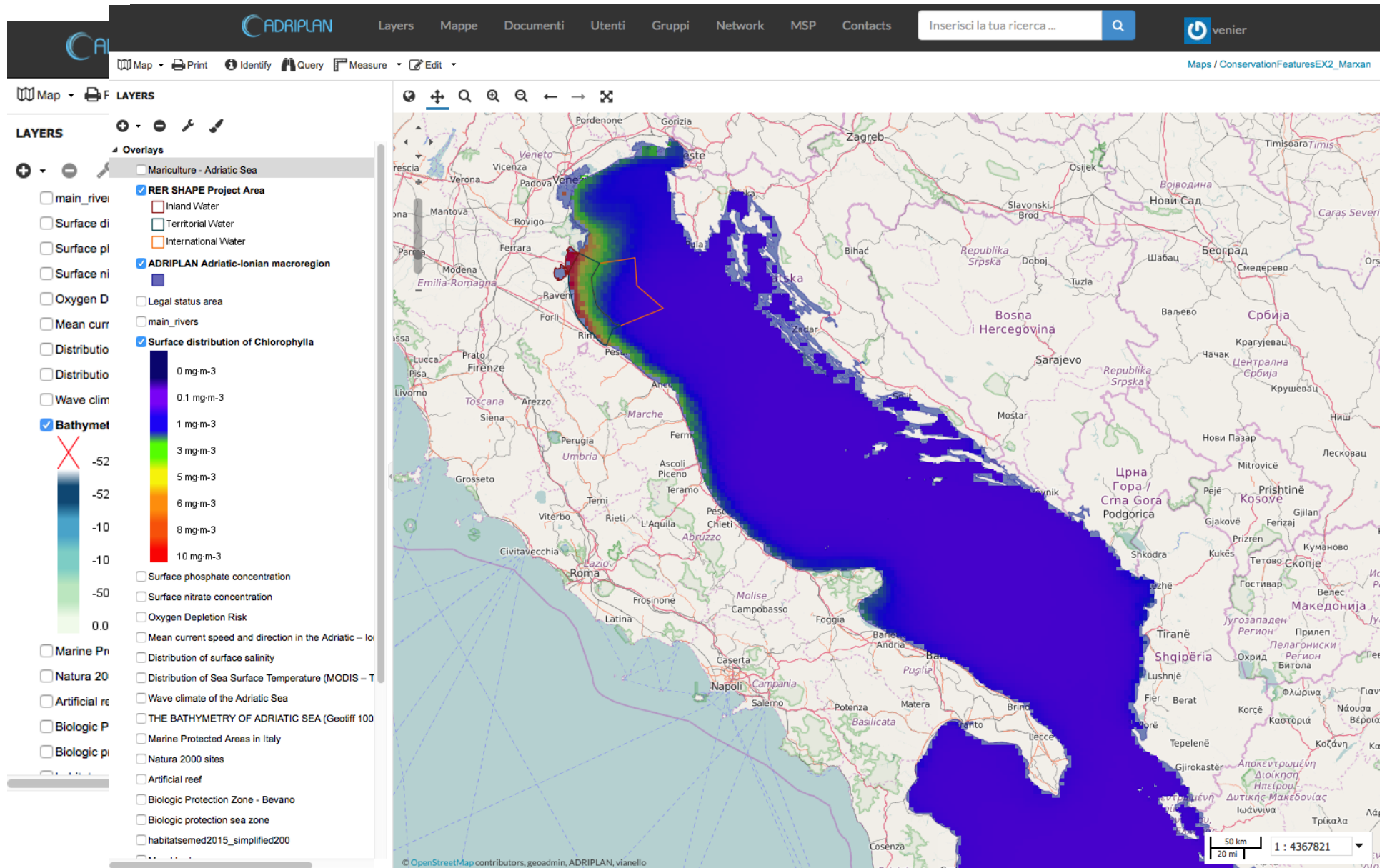


SPATIAL DATA



<http://data.adriplan.eu>

SPATIAL DATA



<http://data.adriplan.eu>

METHODOLOGY



**INTEGRATED MULTI-OBJECTIVE ZONING APPROACH
FOR AQUACULTURE AND BIODIVERSITY**
(Application of the decision support tools
Marxan and its advanced version **Marxan with Zones**
to develop planning scenarios)

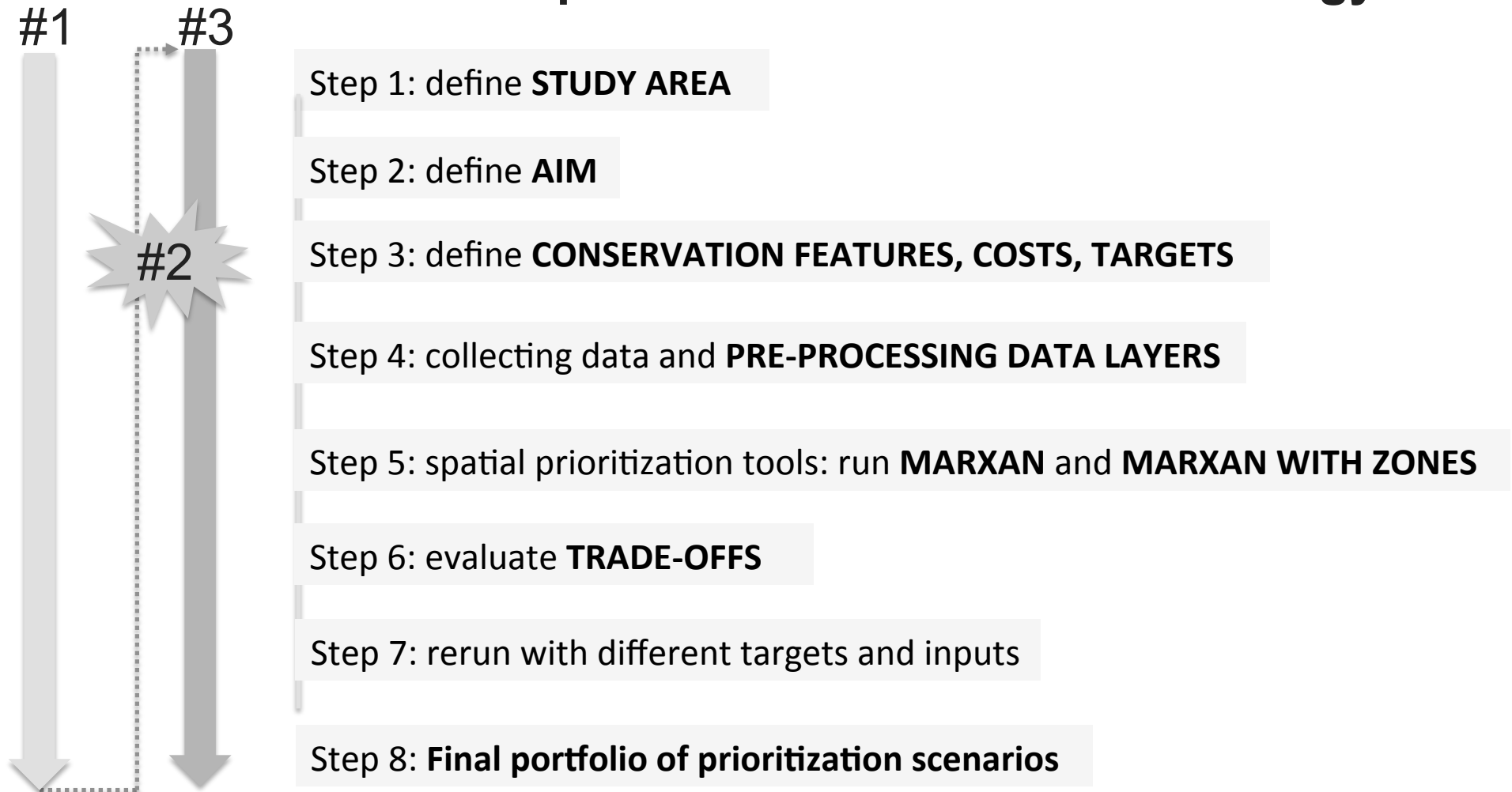


MARXAN
conservation solutions

- #1) SECTORAL PLANNING= BIODIVERSITY PRIORITIZATION** (MARXAN application to conserve biodiversity while minimizing conflicts with anthropic uses)
- #2) SECTORAL PLANNING = AQUACULTURE SUITABILITY ANALYSIS** (MULTI-CRITERIA EVALUATION ANALYSIS)
- #3) INTEGRATED MULTI-OBJECTIVE PLANNING: INTEGRATION OF THE PREVIOUS TWO AREAS** (MARXAN with ZONES application to **simultaneously zone biodiversity conservation** and **maximize the profitable expansion of aquaculture**)

METHODOLOGY

Workflow repeated for #1 and #3 methodology

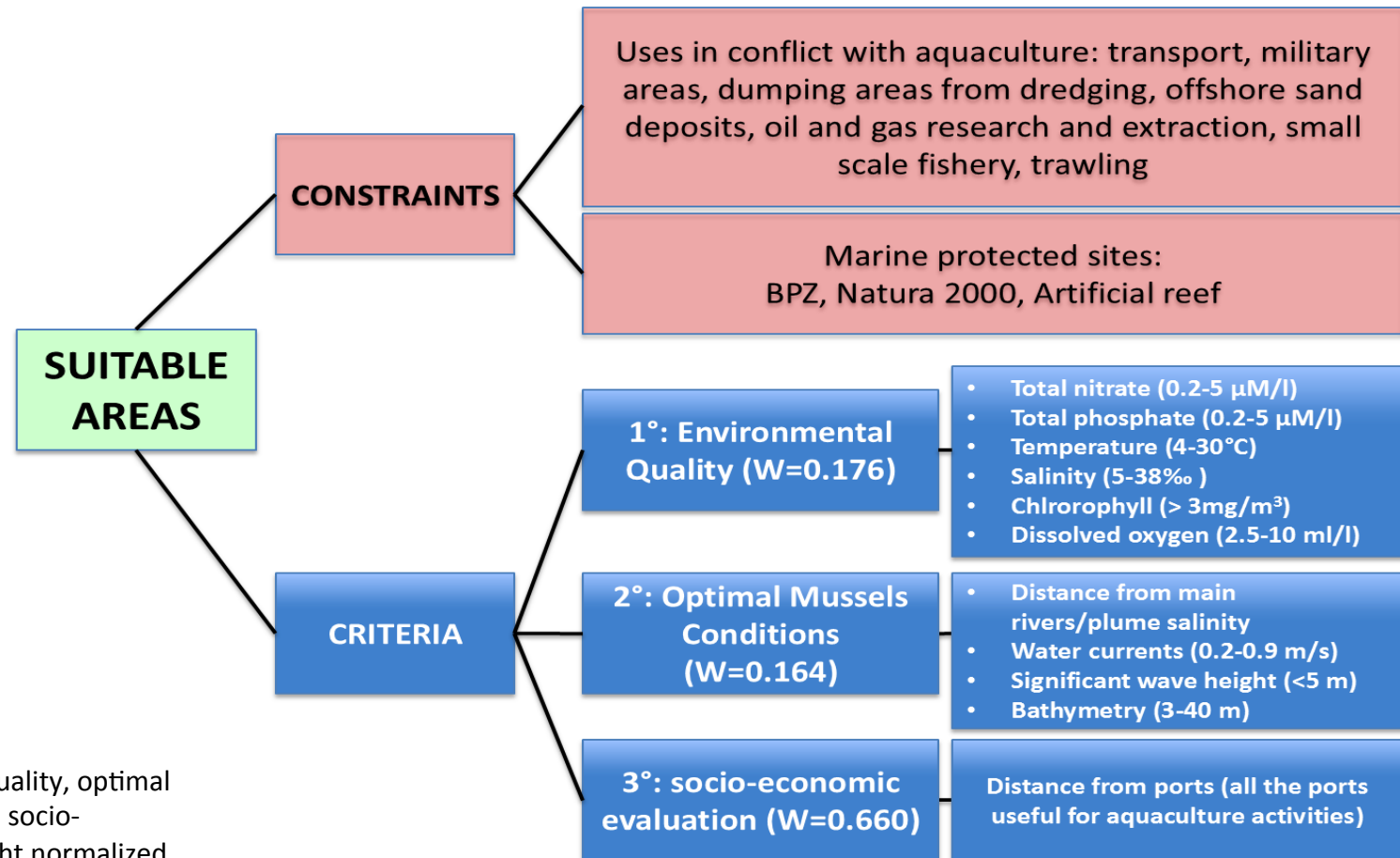


Specific framework for Marxan and Marxan with Zones analyses, adapted from Mazor et al., 2014.

METHODOLOGY

Workflow for #2 – Aquaculture Suitability Analysis

$$A_i = \sum_j w_j x_{ij}$$



A_i =suitability of the i-cell
 j =criteria (environmental quality, optimal mussels growth conditions, socio-economic evaluation)-weight normalized obtained by questionnaires
 W_{ij} =weight normalized of the kj -criteria
 X_{ij} =score standardized (we associate values from 0 to 1)

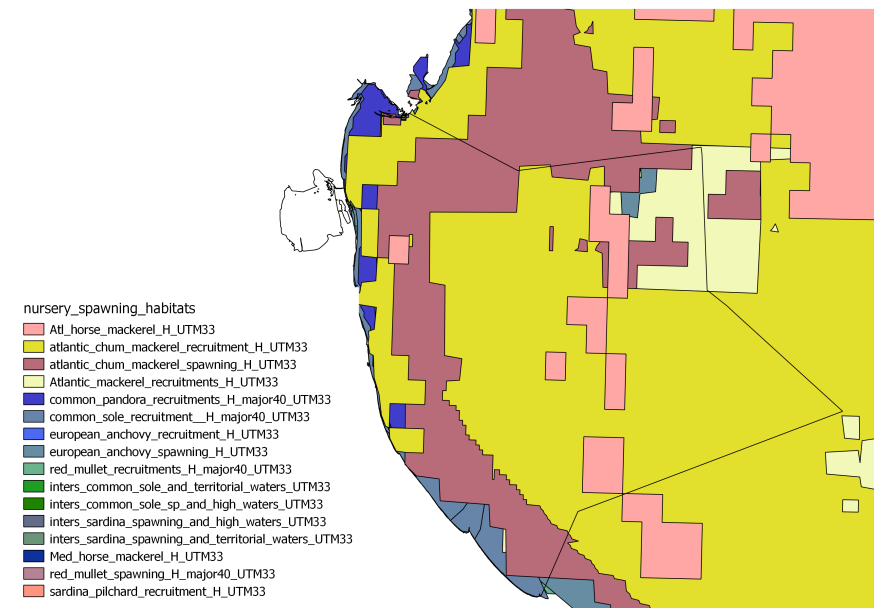
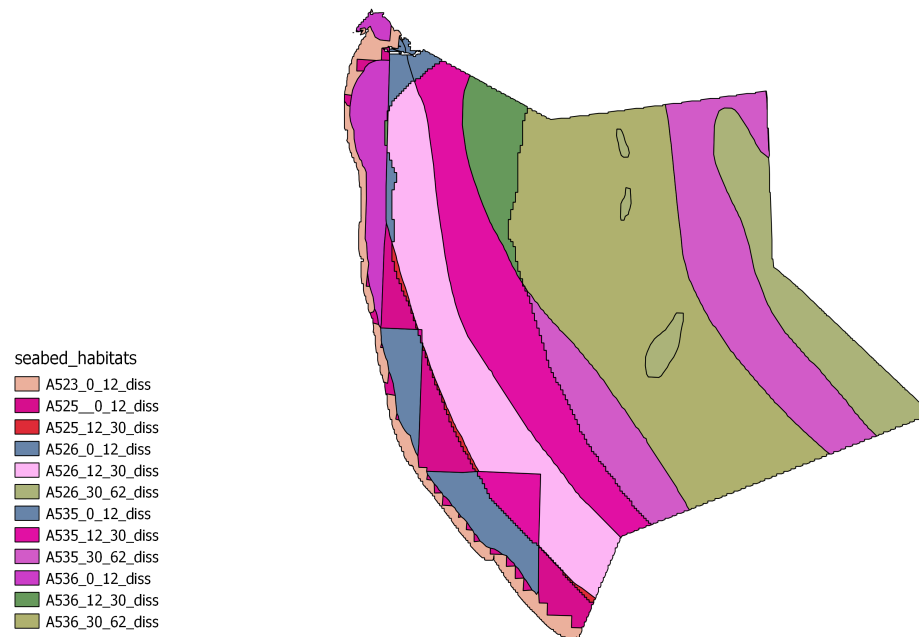
[adapted from Dapuerto et al., 2015]

METHODOLOGY

Step 4 – Pre-processing data layers (1/2)

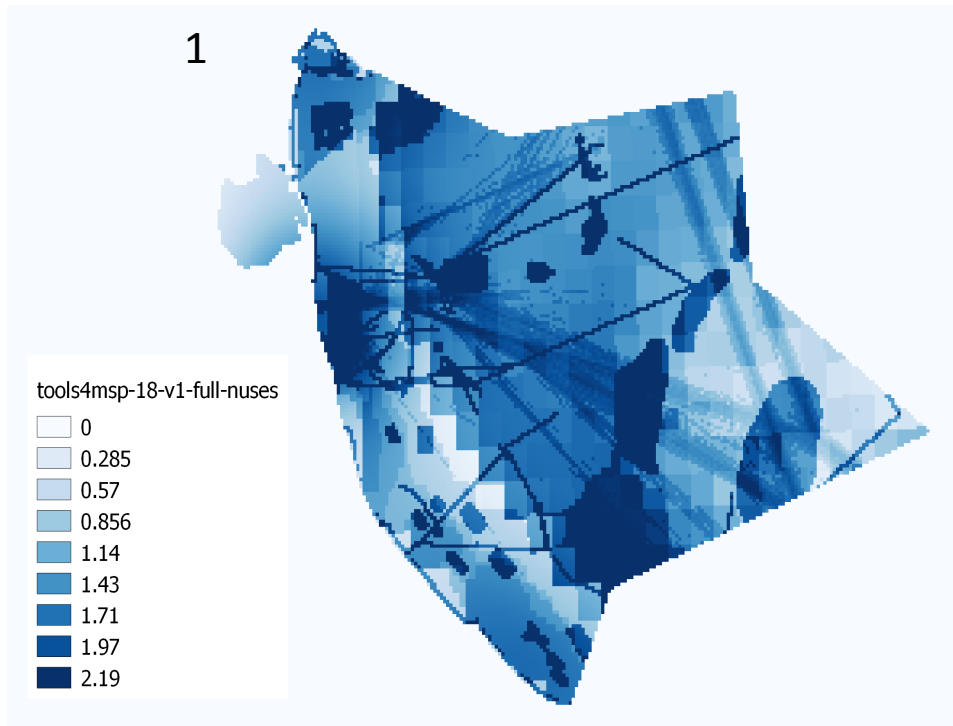
44 Conservation features for Marxan and Marxan with Zones analyses (steps # 1 and #3) elaborated on the basis of:

1. Stratification of Eunis seabed habitats according to bathymetry
2. High priority nursery and spawning (over 40% probability of presence or preferential habitat)
3. Number of sightings ≥ 3 marine mammals, turtles, seabirds

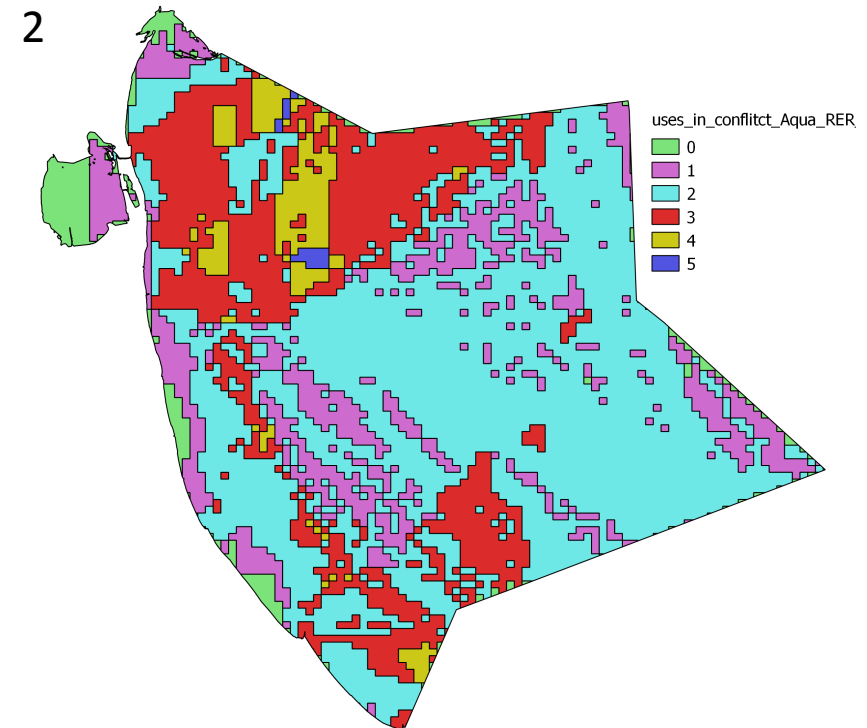


METHODOLOGY

Step 4 – Pre-processing data layers (2/2)



Cost: number of uses/availability







Cost: number of uses in conflict with aquaculture: Dumping area for dredging, Maritime Transport, Military areas, Off-shore sand deposit, Oil and Gas Research, Small scale Fishery, Trawling

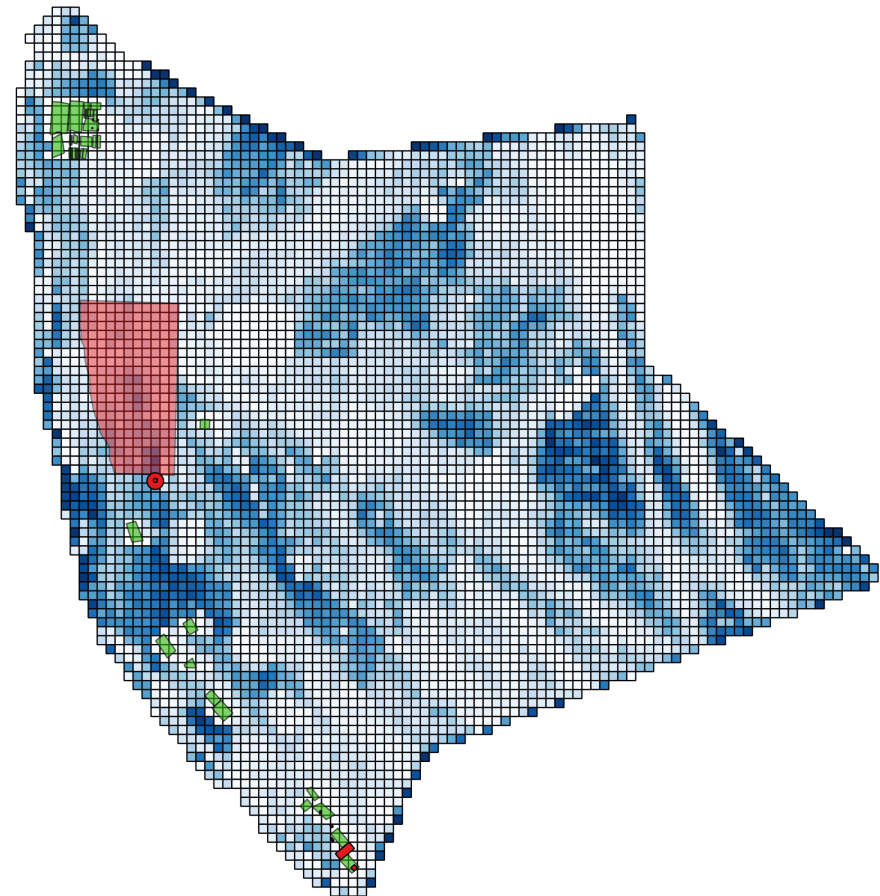
Preliminary results (1/3)

#1 - Prioritization of **biodiversity conservation**, through **Marxan**, while minimizing conflicts with other anthropic uses.

Biodiversity + Human Uses

Legend

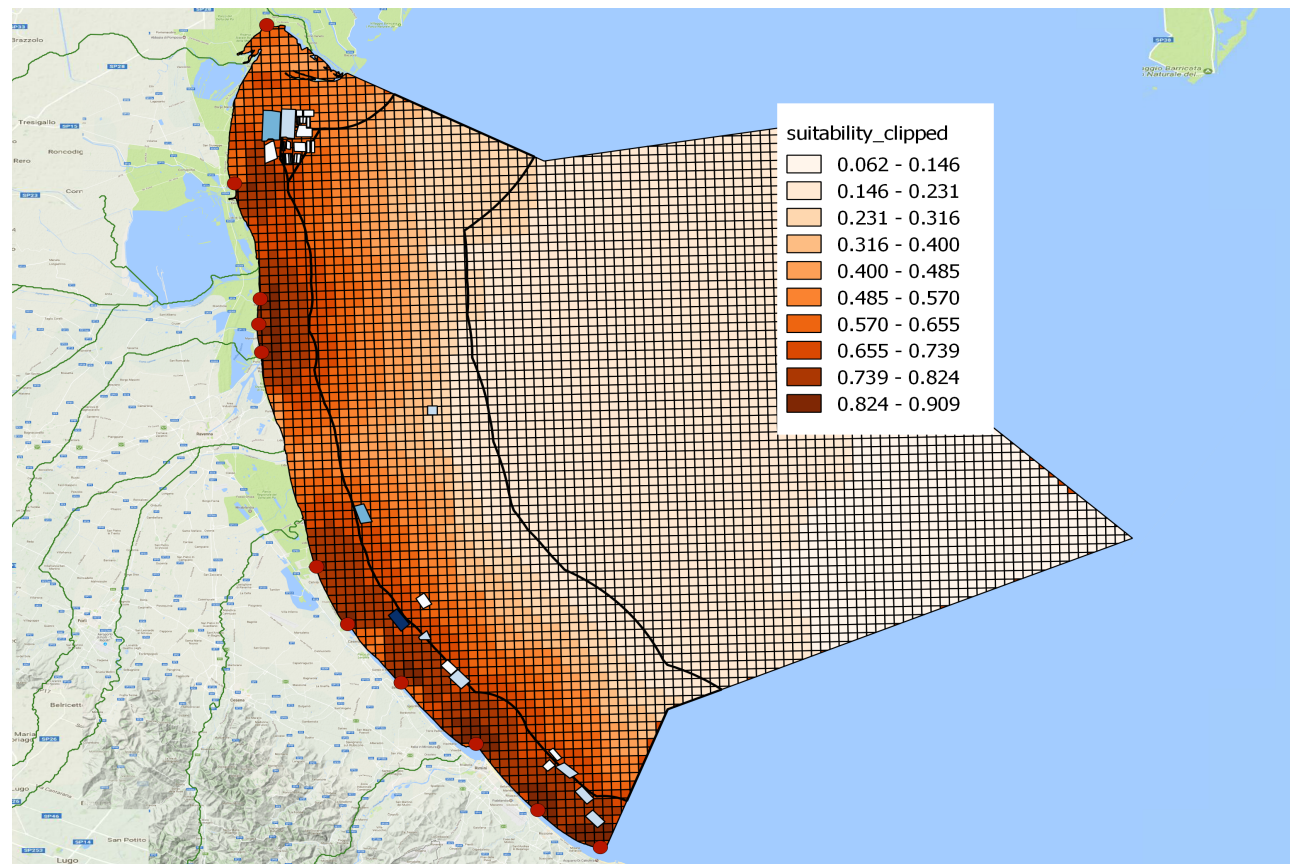
-  Artificial_reef
-  Natura_2000_PiattaformaPaguro
-  Biological_Protection_Zone
-  aquaculture



Preliminary results (2/3)

2# - Aquaculture suitability analysis using a multicriteria evaluation approach based on environmental, biological and socio-economic conditions.

$$A_i = \sum_j w_j x_{ij}$$

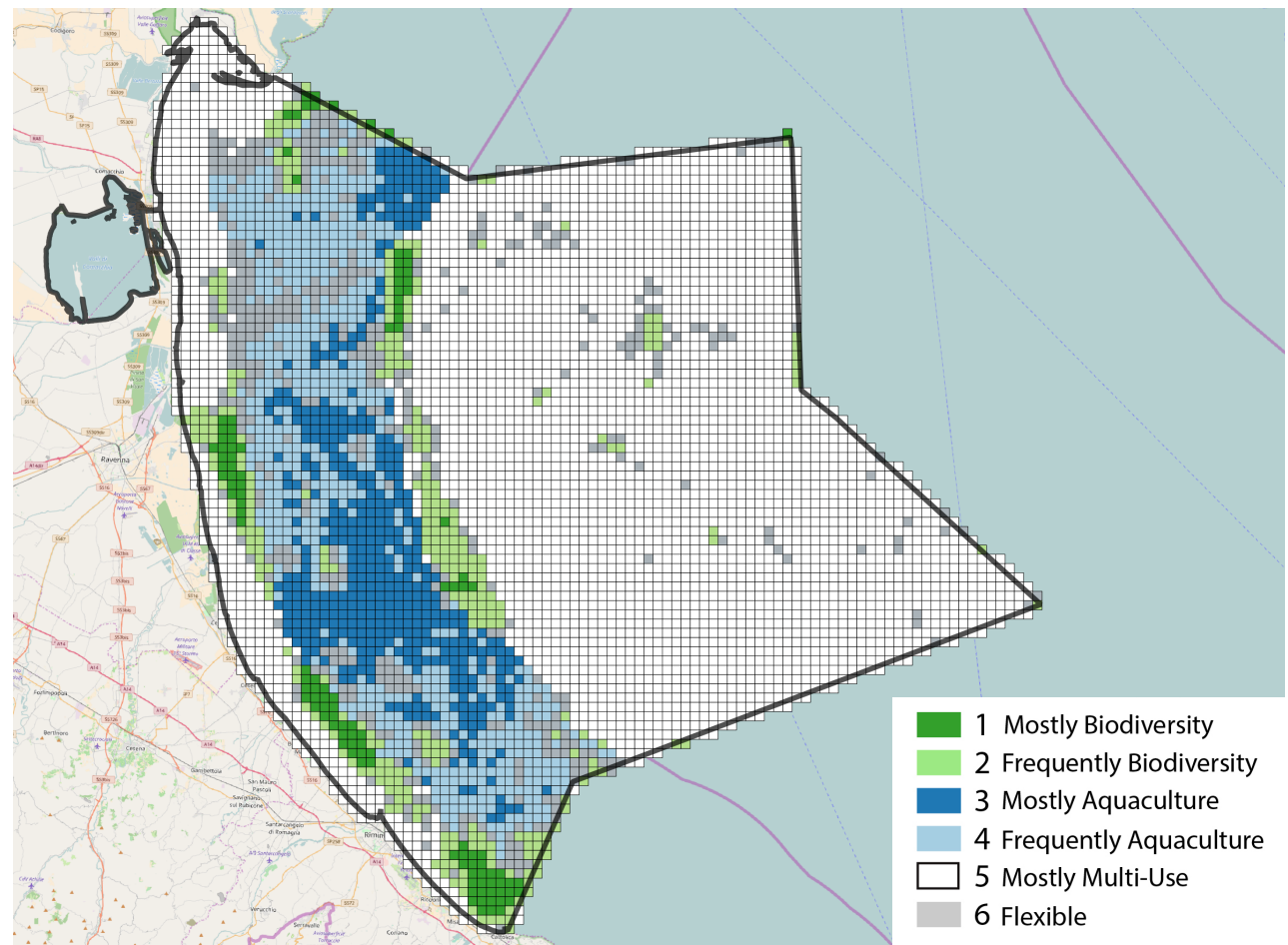


Preliminary results (3/3)

#3 - Prioritization of both aquaculture and biodiversity, through Marxan with Zones, while minimizing impacts on the other industries operating in the Emilia Romagna Region.

Three main zones:

1. **Biodiversity Zone**
(dark green)
2. **Aquaculture Zone**
(light blue)
1. **Multiple-Use Zone**
(white)



CONCLUSIONS & NEXT STEPS

- **Integrated zoning can ensure win-win outcomes for multiple objectives:** identification of priority sites to simultaneously reach biodiversity conservation and aquaculture maximization profit, favouring in particular aquaculture farms offshore in order to both allow the use of bigger technologies for mussel and both minimize the impacts on coastal environments (pollution impact, visual impact);
- Integrated result, which can be used by **multiple stakeholders and decision-makers** to get **cost-efficient solutions** that are **scientifically based**, thus contributing to the marine spatial planning process and sustainable growth in the Adriatic-Ionian region;
- We treat **costs**, including information on the **conflict with uses**;
- **Work in progress:** final scenarios ready for discussion with stakeholders and operative integration of the analysis in a decision support system.

Thank you for your attention!

Contacts

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