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"Proponent": Dr. Alessandro Sarretta, researcher at Institute of Marine Sciences, National Research Council

Hosting Institute: The Australian Research Council's Centre of Excellence for Environmental Decisions, a multi-institution partnership and the world's leading research centre for solving environmental management problems and for evaluating the outcomes of environmental actions.

Title of the programme: "Knowledge-based Maritime Spatial Planning: supporting the decision-making process on marine conservation and aquaculture in the Adriatic-Ionian Region through the use of Marxan, a tool for planning scenario development and analysis"

Scientific Report of the Activity

INTRODUCTION

The proposed project has been developed in the context of the Maritime Spatial Planning (MSP) framework required by the EU MSP Directive 2014/89/UE of the European Parliament and of the Council of the 23 July 2014 establishing a framework for maritime spatial planning, where Member States need to establish and implement a maritime spatial plan by 2021. Guiding decision-makers towards scientifically based scenarios for the allocation of maritime uses requires the use of decision-support tools. MSP programmes globally rely on the use of Marxan (marxan.net) and its advanced version, Marxan with Zones, a mathematical software developed by the University of Queensland, in order to support and strengthen the science-to-policy relationship and deliver outcomes. The proposed project identifies a portfolio of prioritization scenarios for achieving both biodiversity conservation and aquaculture productivity for the Adriatic-Ionian region (AIR) and the subarea of the Emilia Romagna region (RER). This project aims to address socio-economic growth and environmental protection of the Adriatic-Ionian region, according to the regional strategies (EUSAIR Action Plan concerning the European Union Strategy for the Adriatic and Ionian Region).

OBJECTIVES

The main objective of the proposal, as pointed out in the application form, was to acquire knowledge on how to improve scientific support to MSP through the use of software Marxan. Specifically, how to use the tool to achieve our objectives, understand and communicate its outputs (zoning plans) and the data and statistical techniques required for the Adriatic-Ionian zoning process. A set of integrated planning scenarios for zoning the Adriatic-Ionian region and the sub-area of the Emilia Romagna region has been developed, aiming to identify priority areas to design networks of marine

protected areas for biodiversity conservation and identify suitable sites for aquaculture farms that will maximise growth and profits.

ACTIVITIES AND RESULTS ACHIEVED

During the visiting period at the Centre of Excellence for Environmental Decisions, the following activities were carried out:

- Marxan implementation analysis for both the Adriatic-Ionian region and the Emilia Romagna Region subarea (see Fig. 1). This activity included a pre-processing data analysis, software implementation, technical validation, calibration, sensitivity and gap analysis of the outputs as well as an expert evaluation to ensure the results were robust. This activity was important to evaluate the quality of solutions in terms of costs, objectives and level of conservation provided for each case study.
- Set up of the Marxan with Zones implementation analysis for an integrated multi-objective planning of the Emilia Romagna region. This activity consists on the 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 fish catch and both minimize the impacts on coastal environments (pollution impact, visual impact).
- Set up a communication strategy for stakeholders to explain how the zoning was conducted.
- Set up a plan for scientific publication of results.

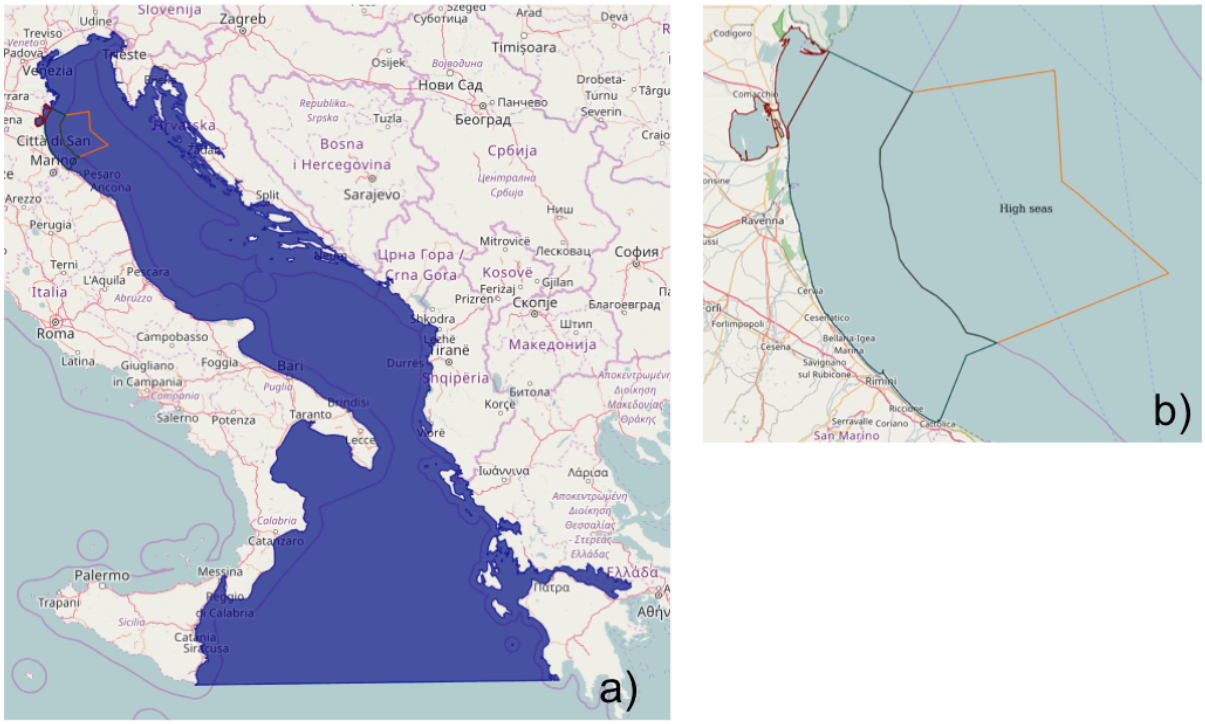

Figure 1. Maps of the study areas: (a) Adriatic-Ionian region and (b) Emilia Romagna region.

The first step consisted in the preparation of the input dataset for the implementation of the software, including a pre-processing data elaboration of the so-called "conservation features" (environmental components, such as spatial distribution of the seabed habitats, marine mammals, seabirds and turtles species distribution, nursery and spawning areas of commercially important fish species). The conservation features were selected and processed in order to have a rich and reliable data set for conserving biodiversity at both the Adriatic-Ionian Region and the Emilia Romagna Region scales. Then the creation of the planning grid required for the analysis (subdivision of the analysis domain in square sized cells of respectively 10km for the AIR and 1km for the RER), the set up of the biodiversity targets for the conservation features, according to international policies and national requirements, and the costs for the analysis have been performed.
After validation, calibration, sensitivities and gap analyses, different scenarios have been obtained according to the different inputs chosen.
A first baseline scenario was developed in order to identify priority sites for biodiversity with no other socio-economic considerations. Other scenarios were developed which considered socio-economic impacts including the number and spatial distribution of human uses for both the AIR scale and the RER scale. A further consideration for the case of the Emilia Romagna region, was an aquaculture profitability surface computed as a function of the distance from ports and calculated as:

$$P = 1 - \alpha \cdot d$$

Where:
α is an arbitrary parameter expressed as $\alpha = \frac{1}{distancewhennotprofitable}$ and d=distance to nearest port at PU centre. We considered the area outside of 12 nm (Nautical Miles) to be the distance where aquaculture zoning is not longer profitable.

An example of a couple of spatial biodiversity prioritization scenarios respectively for the Adriatic-Ionian Region and the Emilia Romagna Region are shown in the two images below.

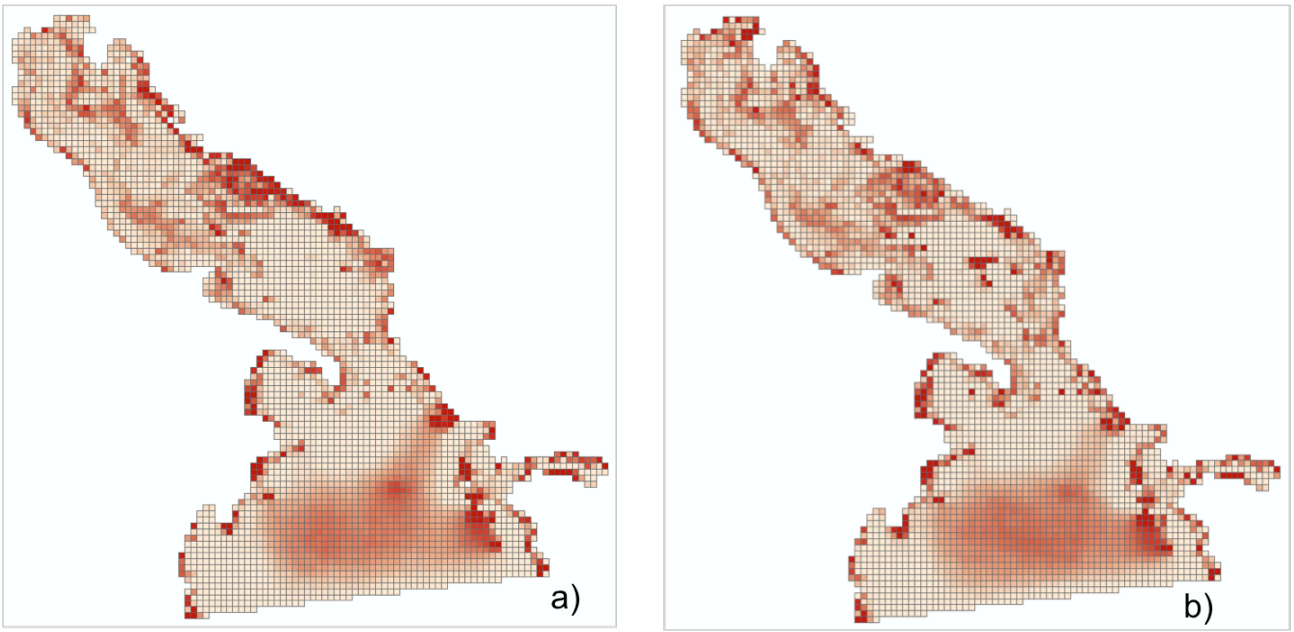

Figure 2. Spatial biodiversity prioritization scenarios for the Adriatic-Ionian Region with cost=area. In (a) the priority areas are computed setting a target for the whole Adriatic-Ionian Region, while in (b) the analysis is performed for each single country of the AIR and setting a target for each of them. The darker the colour, the more of a priority the site is prioritized for biodiversity conservation.

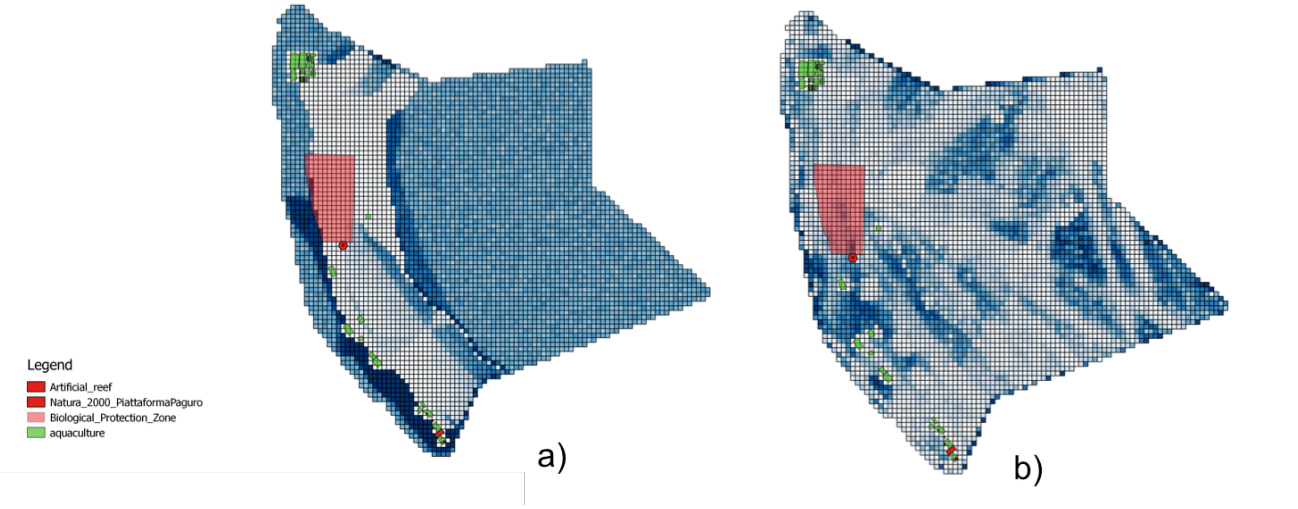

Figure 3. Spatial biodiversity prioritization scenarios for the Emilia Romagna Region with different input costs: (a) cost=profitability surface, (b) cost=the number of human uses present in the Region. The darker the colour, the more of a priority the site is prioritized for biodiversity conservation.

The resulting scenarios have been compared with the existing environmental protected and sensitive habitats for the two study domains. The preliminary results obtained at the RER scale in particular represent the propaedeutic step for the Marxan with Zones analysis, consisting in zoning simultaneously biodiversity conservation prioritization and maximizing the profitable expansion of aquaculture in the region. The next phase of the elaboration process will be the identification of the priority sites for balancing the objectives of the zones in order to satisfy the interest of multiple

stakeholders and thus contributing to the MSP process at the AIR and RER scales. The process will be replicable in other subareas and other zoning objectives.

The present activities have been carried out in collaboration with Elena Gissi, Assistant Professor at IUAV University in Venice, and her team.
These activities have given the opportunity to transfer knowledge and experience from the Centre of Excellence for Environmental Decisions of the University of Queensland, one of the world's leading spatial planning groups on the use of Marxan for MSP, as well as strengthen the collaboration with this group, in particular with Ms. Jennifer McGowan and Professor Hugh Possingham for the present project and future national and international projects on the MSP.

Venice 22/12/2016

Chiara Venier