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Institute of the "Beneficiary" Researcher: 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.

Hosting Institute: Institute of Marine Sciences, National Research Council - Venice.

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 where Member State 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. Globally, MSP programmes rely on the use of Marxan and its advanced version, Marxan with Zones- a mathematical software developed by the University of Queensland to support and strengthen science-to-policy relationships and deliver planning 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).

OBJECTIVES

The main objectives of the proposal were to: 1) further develop and refine an existing Marxan analysis which identified priority areas for biodiversity conservation in the Adriatic-Ionian region. 2) execute the technically advanced software Marxan with Zones to the subarea of the Emilia Romagna region for the identification of priority sites that achieve objectives for biodiversity conservation and aquacultural expansion simultaneously. Here we are favouring offshore aquaculture farms in order to expand the sector while minimize the impacts on coastal environments (pollution impact, visual impact); and 3) demonstrate how the use of the tool can achieve our

objectives for MSP; understand and communicate its spatial outputs (priority areas and/or zoning plans); and analyze the data and statistical techniques required for the Adriatic-Ionian zoning process.

ACTIVITIES AND RESULTS ACHIEVED
During the 10 days visiting period at the Institute of Marine Science, the following activities have been carried out:

- Interpretation and refining of the outputs of the Marxan analysis for both the Adriatic-Ionian region and the Emilia Romagna Region. This includes both a validation, technical calibration, sensitivity and gap analysis of the outputs, as well as an expert evaluation to ensure the results are robust. It also includes a post-hoc analysis carried out on the basis of statistical techniques developed by The University of Queensland in order to help data visualization and interpretation.
- Implementation of the Marxan with Zones software for an integrated multi-objective planning study of the Emilia Romagna region consisting on the identification of priority sites to simultaneously achieve biodiversity conservation and aquacultural expansion objectives while minimzing impacts on important human uses in the region (shipping, oil and gas, etc). We also identified synergistic areas where aquaculture and other economic activities may co-occur.
- Set up a communication strategy for stakeholders to explain how the zoning was conducted.
- Outlined academic publications.

The implementation of the Marxan with Zones software has been built on the basis of the previous step consisting of the biodiversity prioritization of the Emilia Romagna region through Marxan software. Marxan with Zones analysis aims to zone multiple objectives simultaneously, such as biodiversity conservation prioritization and maximizing the profitable expansion of aquaculture in the Emilia Romagna region. For this purpose three main zones have been set up:

1. Biodiversity Zone to conserve biodiversity
2. Aquaculture Zone to identify priority sites for aquaculture
3. Multiple-Use Zone to allow the other activities in the region to persist with minimal impacts, such as tourism, maritime transport, commercial and small scale fishery, dumping area for dredging, military areas, off-shore sand deposit, oil and Gas Research and exploitation.

The preparation of the input dataset has been carried out in a previous step. During the short-term visiting period, an aquaculture suitability surface was developed, to be considered as input in the Marxan with Zones analysis. This was based on a previously detailed literature analysis and stakeholder communication.
The Marxan with Zones analysis developed several scenarios to identify priority sites for balancing the objectives of the three main zones (Biodiversity Zone, Aquaculture Zone and Multiple-Use Zone) in order to satisfy the interest of multiple stakeholders. The scenarios met 30% and 10% targets for Biodiversity Conservation (30% for the spatial distribution of the seabed habitats and nursery and spawning areas of commercially important fish species and 10% for marine mammals, seabirds and turtles species distribution), while maintaining 60% of the most suitable aquaculture areas for expansion of the sector. An example of the Marxan with Zones output is below.
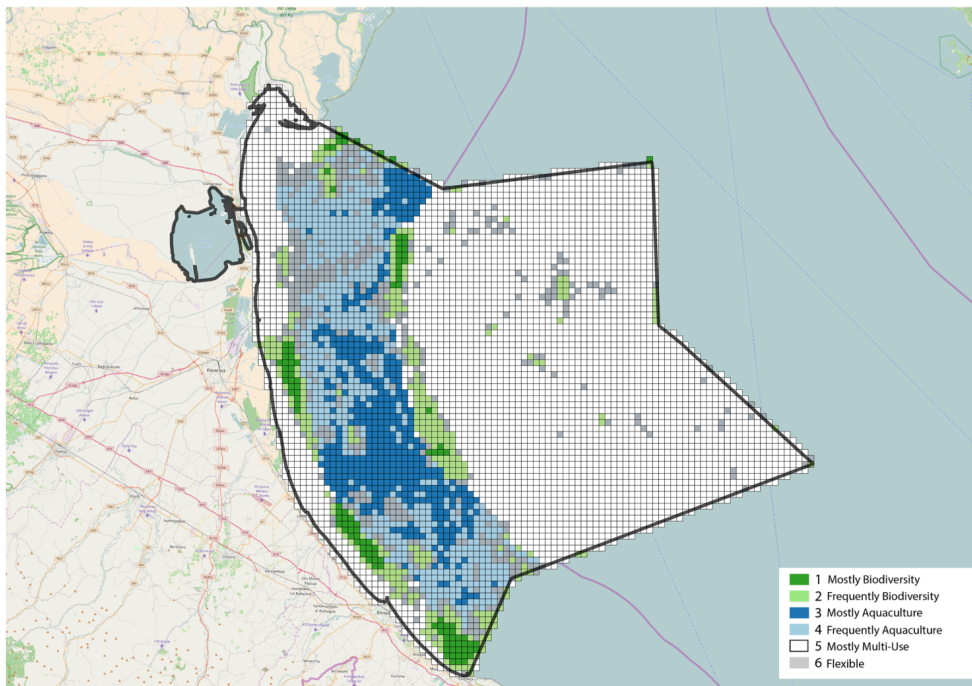
Figure 1. An example of resulting scenario from Marxan with Zones analysis applied to the Emilia Romagna region. The darker the color, the more of a priority it is for the respective zones Green=Biodiversity, Blue= Aquaculture, Grey = Flexible areas, White= Multiple Use.

The resulting scenarios have been compared with the existing environmental protected and sensitive habitats for the study domain and analysed in detail with the maritime uses and activities present in the area.

These preliminary results are going to be further improved and developed, as well as share with stakeholders in order to achieve final zoning plans able to satisfy the interest of multiple stakeholders and thus contributing to the MSP process at the RER scale and subsequently contributing to the MSP process at the AIR scale. The process will be repeatable for other subareas and other zoning objectives.

The present activities gave the opportunity to transfer knowledge and experience from the Centre of Excellence of Environmental Decisions, which is one of the world's leading spatial planning groups in using Marxan for MSP, as well as strengthen the collaboration with CNR-ISMAR for the present project and future national and international projects on the MSP.

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