Interreg Italy - Croatia ARGOS
European Regional Development Fund

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REGIONE AUTONOMA FRIULI VENEZIA GIULIA

MARITIME SPATIAL PLANNING PROGRAMME FINAL DOCUMENT

emerging from the results of specific MSP studies carried out by each partner

June 2023

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Report	Maritime spatial planning programme final document
Description	This deliverable contains the results of all studies carried out within the Act. 3.2 and concerning various aspects of MSP. For each document, the main conclusions are reported and at the end, a summary is made gathering all the indications that emerged and analysing how fishery and aquaculture can be integrated into MSP.
Version	V.1
Author	Agriteco – PP1 Veneto Region

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1 Introduction

Maritime Spatial Planning is a planning methodology aimed at a more rational use of the maritime space and of the interactions between the various uses, with the aim of guaranteeing the protection of marine ecosystems but also of the activities that develop in the maritime space such as fishery and aquaculture, maritime transport, land protection and tourism without forgetting the potential linked to the energy sector both as extractions and as energy production. The multiplicity of these uses necessitates well-defined areas of use so as not to run into conflicts linked to a use that is skewed more towards one sector than another.

The Marine Strategy Framework Directive 2008/56/EU, the environmental pillar of the European Union's Integrated Maritime Policy (IMP), establishes common principles for Member States to promote the sustainable development of the seas and maritime and coastal economies and develops a coordinated decision-making process to achieve good environmental status of marine waters. This was followed by Directive No 2014/89/EU establishing a framework for maritime spatial planning with the aim of promoting the sustainable growth of maritime economies (blue economy), the sustainable development of marine areas and the sustainable use of marine resources.

The ecosystem approach of these planning tools, in order to achieve the sustainability targets required by the Marine Strategy Framework Directive (MSFD) and the new EU Biodiversity Strategy 2030, becomes indispensable to ensure a sustainable balance between the marine environment and all man-made activities; this is the starting point for ensuring social and economic sustainability. For these reasons, in the spirit of a bottom-up approach that also takes into account the contribution made by local stakeholders, it is necessary in the planning process to have moments of confrontation that can allow for a correct projection of future scenarios of both biodiversity protection and socio-economic sustainability in the short and long term.

This approach must allow for a vision for the future by directing planning choices, a vision that as defined by Lukic et al., (2018) represents "the preferred evolution of developments in maritime activities over a given time horizon, which has been generally agreed upon among those developing the vision or with various stakeholders. In some cases, a vision is considered the best agreed evolutionary scenario, which implies that

different scenarios must have been developed and discussed before the actual adoption of the vision'.

Activities, uses and interests to be considered include:

- aquaculture zones;
- fishing areas;
- installations and infrastructures for the exploration, exploitation and extraction of oil, gas and other resources
- energy, minerals and aggregates and the production of energy from renewable sources;
- maritime transport routes and traffic flows;
- military training areas;
- nature and species conservation sites and protected areas
- areas for the extraction of raw materials
- scientific research;
- submarine cable and pipeline routes;
- tourism;
- underwater cultural heritage.

Fishery and aquaculture areas represent only a few of the activities that insist on and utilise marine space and resources, and it can be argued that they are not among the most significant in terms of profitability, even though they are often among the most affected by the various regulations that are applied in the planning and management of maritime space and resources. European and national fisheries policy guidelines aim to restore the sustainable exploitation of fishery resources, ensuring the medium- and long-term economic and social sustainability of fishing activities (Art. 2 EU Reg. 1380/2013).

The main marine activities for inclusion in marine spatial planning. (From Marine spatial planning for enhanced fisheries and aquaculture sustainability FAO 2016)

2 The ARGOS approach

The ARGOS project sought to mix the idea of shared governance with that of maritime spatial planning by carrying out specific studies to obtain different information aimed at proposals for maritime spatial planning to be considered at the level of the Adriatic Sea. Both aspects directly related to fishery and aquaculture activities and those related to environmental protection were analysed, limited to the eligible areas of the project but with a view to extending it to the whole Adriatic basin, proposing the possibility to involve also other EU or non-EU partners. The studies and analyses carried out have highlighted existing synergies, potential integrations and competition in the use of marine space (MSP). More specifically, the surveys explored different topics, all related to different aspects of MSP, which, as a whole, contribute to describe the current state of the MSP process related to fisheries and aquaculture in the Adriatic area of the partnership, according to the priority aspects emerging from the marine space of each partner.

The projects developed within the WP3 Act. 3.2 Maritime Spatial Planning assessment were:

- D3.2.1 comparative analysis by Marche Region for the harmonisation of legal framework between the regulation on fisheries and aquaculture between Italy and Croatia, within the general EU regulatory framework;
- D3.2.2 comprehensive study by Istria Region, County of Primorje and Gorski Kotar and RERA s.d on aquaculture development study in the area of Istarska, Primorsko-Goranska and Splitsko-dalmatinska Counties;
- D3.2.3 study by Veneto Region on maritime intra-sectorial interactions analysis as a deepening of the spill over effects of the establishment of Natura 2000 areas in the upper Adriatic sea;
- D3.2.4 study by Emilia Romagna Region on the evaluation of the consequences on the vitality of North Adriatic fish-related chains and fisheries communities following restrictions of fishing effort derived from the establishment of new protected marine areas;

- D3.2.5 analysis by Zadar County of interactions between different typologies of aquaculture practices and the trends of Adriatic fish stocks, highlighting both positive and unwanted effects of aquaculture on marine habitats and species;
- D3.2.6 study by Friuli Venezia Giulia Region on recent trends in nutrients levels in the upper Adriatic sea and how trends are linked to the sea primary production;
- D3.2.7 analysis by CNR National Resarch Council - IRBIM Institute for the Biological Resources and Marine Biotechnologies on how different fishery methods and linked management measures interfere each other, both at biological and socio-economic level.

The evidence that emerged from all these studies and also from the discussions during the AAC meetings made it possible to codify what has been defined as the 6-item ARGOS approach:

- **Regional approach**: decentralisation of fisheries policy in the Adriatic. The ARGOS approach aims at the creation of a permanent table that can bring the real local needs of the Adriatic states closer to the operators in a bottom-up approach. This can also be a way to educate all stakeholders to cooperate for the best results.
- **Adaptive management**: rapid harmonization of management measures depending on stock status. Some degree of local autonomy must be given to give ready responses to sudden environmental changes.
- **- Responsibility sharing:** responsible approach in taking measures and burden sharing. Many times management measures are directly or indirectly reflected on certain categories by placing the burdens of management choices on them alone. The Argos approach suggests sharing these responsibilities by not leaving them solely and exclusively on the fishing or aquaculture sector.
- **Introduction of the principle of proportionality**: management measures should be proportionated to the responsibilities of individual fishing fleet, tuned with concomitant socio-economic impact.
- **Ecosystem approach to fisheries**: apply as much as possible, especially in protected areas, Natura 2000 sites. The aim of ecosystem approach is to maintain

an ecosystem in a healthy, productive and resilient condition so that it can provide humans with the goods and services they want and need. Unlike current approaches, which usually target a single species, activity, sector or problem, ecosystem approach considers the cumulative impacts of multiple sectors.

- **Protection of critical areas**: spawning and nursery areas, migration routes of certain species. Protecting specific areas to ensure an increase in biomass is one of the findings that emerged in ARGOS since it is more important the quality of what you protect than the quantity. A good example is the Pomo pit area where even fishermen are now realizing the importance of medium-term measures.

This document reports the summary indications that emerged from the analysis of the individual contributions of the various partners in order to propose common guidelines for maritime spatial planning in the Adriatic area with respect to the fishery and aquaculture component.

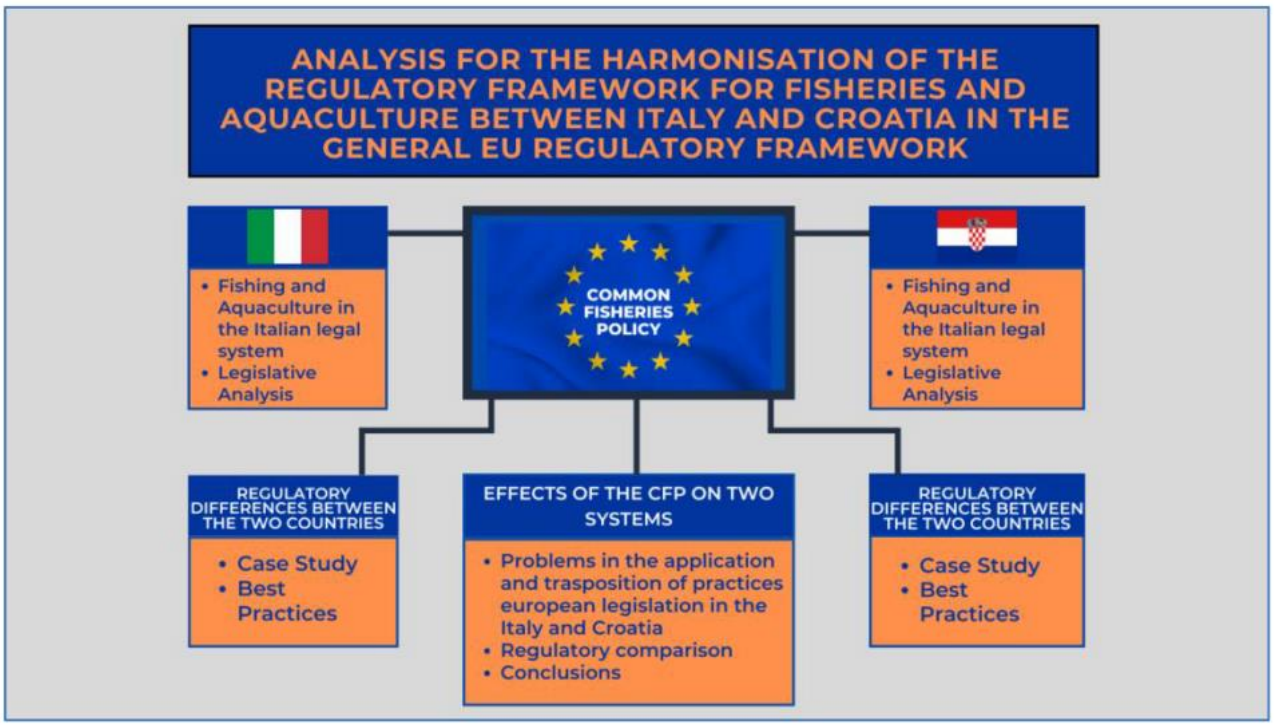
3 D3.2.1 by Marche Region

Concerning a comparative analysis for the harmonisation of legal framework between the regulation on fisheries and aquaculture between Italy and Croatia, within the general EU regulatory framework

The activity of the Marche region, which analysed the different Italian and Croatian national regulations, drew attention to the need for a common regulation that would cover the entire Adriatic area (perhaps with the involvement of the other countries bordering the Adriatic in this process of harmonising management rules). The basis on which to build a possible Adriatic regulatory code must necessarily be the EU regulations to which the non-EU states would also have to comply, but they could bring their contribution to an ad hoc regulation that, for certain and specific Adriatic peculiarities, could contain less restrictive indications compared to the European rules.

The advantage of a unitary regulation at the level of the Adriatic basin could also be a stimulus for a revision of some licensing procedures for aquaculture that currently suffer from overlapping competences or responsibilities that lengthen the time it takes to issue them. Similarly, an overall view of the problems of fishery resources would allow a better planning of the activities of all the operators working in the Adriatic Sea.

Finally, a common regulation could also allow a better planning of the whole maritime space, giving an Adriatic and not only a local-state vision of the perspectives of the fishery and aquaculture sectors; this information should be interfaced with the other sectors of the use of the maritime space, allowing the non-overlapping and a harmonious development of the spaces.



Methodological diagram of how deliverable 3.2.1 was developed

4 D3.2.2 by Istria Region, County of Primorje and Gorski Kotar and RERA SD – D3.2.5 by Zadar County

Concerning aquaculture development study in the area of Istarska, Primorsko-Goranska and Splitsko-dalmatinska Counties and analysis of interactions between different typologies of aquaculture practices and the trends of Adriatic fish stocks, highlighting both positive and unwanted effects of aquaculture on marine habitats and species

The partners P6 Istria Region, P7 COUNTY OF PRIMORJE AND GORSKI KOTAR and P10 Rera SD and P8 Zadar County have developed two different deliverables that allow to deepen the topic of the possible planning/expansion of aquaculture facilities starting from the Croatian reality but with the possibility of extending the indications that emerged from their detailed analysis to the entire Adriatic Sea.

The two studies highlighted complementary aspects related to aquaculture activities concerning

- The interactions of the various types of aquaculture with respect to the environment and other species present outside
- The importance in the spatial planning of aquaculture industries not only of the spaces in the sea where production takes place but also of the logistical part on land, which becomes strategic for the management and subsequent processing of production

The County of Zadar has analysed different aspects related to the choice of the site focusing on the abiotic aspects that are binding for the correct location of the so-called AZAs; a similar indication is also given in the ISPRA technical guide "Allocation of marine areas for aquaculture". The long experience that the County of Zadar has with regard to the issue of floating cages (given that over 50% of Croatian facilities fall within their territorial jurisdiction) has allowed them to carry out careful evaluations concerning both the choice of the site and especially in the subsequent monitoring of the effects that these facilities have and the problems to be faced deriving from the anthropization of part of the marine environment with the breeding facilities.

The initial phase of site selection becomes fundamental both for the correct success of the installations and for a subsequent guarantee of product quality that is not affected by problems related to particular sanitary aspects. Therefore, the abiotic aspects to be observed are mainly temperature and oxygen as possible limiting factors for the correct development of aquaculture activities; these two parameters also become very important in correlation with the decomposition of faecal excretions that could lead to hypoxic or anoxic phenomena, particularly in the bottom sediments under the rearing structures; this particular aspect was monitored by measuring the redox potential in the sediments under the plants where negative redox potential was found.

There are also biotic factors that may have negative effects on aquaculture production, which are represented by:

- Predators (both marine and ichthyophagous birds)
- Fouling
- Changes in plankton availability (shellfish)
- Disease
- Presence of biotoxins

Finally, there are the components most related to anthropic impact, ranging from nautical tourism to pollution, from predator deterrent systems (which can also have a stressful effect on farmed fish) to limitations related to the preservation of Natura 2000 habitats.

In addition to being limited by various parameters, an aquaculture ground is itself a factor that generates impacts on the environment, humans and living beings. The first obvious effect is that facilities in the sea, even if limited in size, generate a visual impact that may be evident in particular environments. Technological developments, however, are mitigating this component by proposing structures that can submerge and be visually almost neutral.

Instead, the maritime space allocated to these areas is 'taken away' from other services such as maritime transport or recreational activities that can no longer traverse that area and must therefore change their routes. There are also impacts directly generated by the facility or its use such as anchoring structures that can damage marine environments and bottom-dwelling specimens, sedimentation of debris, faecal secretions or leftover food

that can alter oxygen availability and create areas of increased fouling or generate waste from their management.

Finally, the management of the facilities can produce microplastics that are released into the sea through fouling, release of antibiotics into the environment and generate chemical processes due to the substances used. The last risk analysed focused on the side effects that a fish farm could have with respect to the escape of reared product by attracting predators or in the opposite case the recall of adult wild specimens for reproductive purposes attracted by the reared product.

The study also suggests how spaces dedicated to aquaculture can be transformed into co-siting areas on which several compatible activities insist, giving the example of how offshore wind energy facilities can coexist with mariculture facilities indirectly providing a kind of shelter.

The three partners Istria Region, Primorje and Gorski Kotar County and Rera SD focused their study on a component that, although not directly related to marine spatial planning, becomes important in the perspective of an expansion process of aquaculture and concerns land-based logistics.

On-shore facilities must necessarily include

- storage of equipment, food and consumables
- reception of caught fish, sorting and packaging for sale
- service workshops for equipment repair and maintenance
- ice production facilities
- processing capacity (when the investor is a fish farmer)
- contents for temporary storage of waste

In addition, a suitable dock for boat storage must be provided on land.

The study then shifts the focus to:

- Criteria for the placement/location of operational coastal infrastructure for mariculture
- Criteria for positioning of auxiliary coastal infrastructure,mooring
- Criteria for the dimensions of operational coastal infrastructure

identifying for different volumes of reared product the characteristics necessary for that specific mariculture to develop properly.

Therefore, certain characteristics become essential:

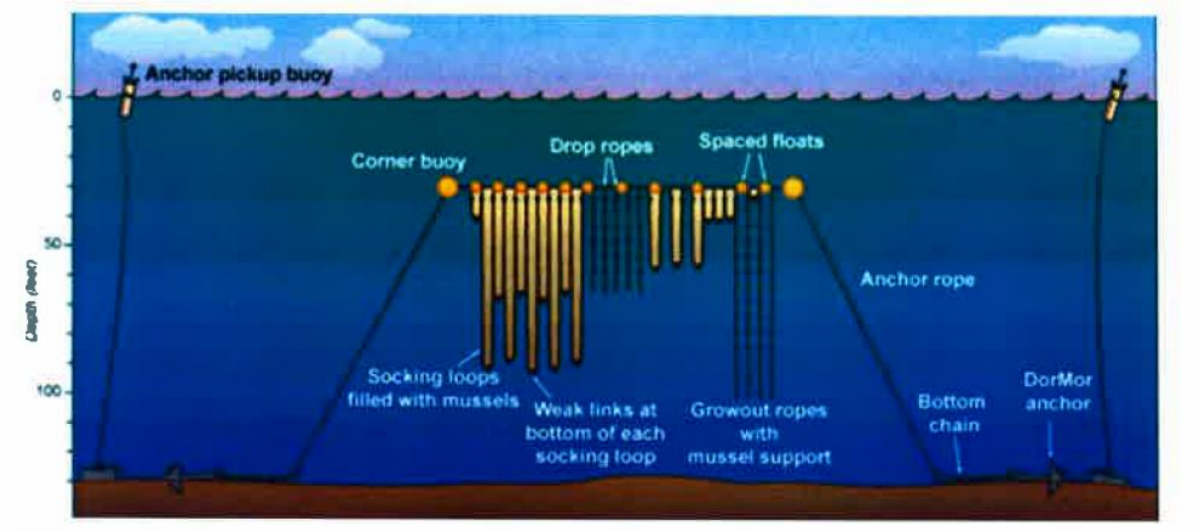
- Distance from port to mariculture
- Distance from the main trade corridors and possibility of access to large articulated lorries
- Sheltered mooring area with adequate bathymetry
- Mooring area convenient to both processing and supply areas for mariculture

The development of mariculture in the Adriatic Sea starts both from an in-depth study to define which areas of the maritime space are suitable for a specific activity (fish or shellfish), but also by guaranteeing an infrastructure on land that can provide easy management of the plant at sea as well as allow all the product processing activities (from the simple delivery ashore for sellers to the post-production processing with consequent cold chain) and the subsequent introduction into the distribution circuit.

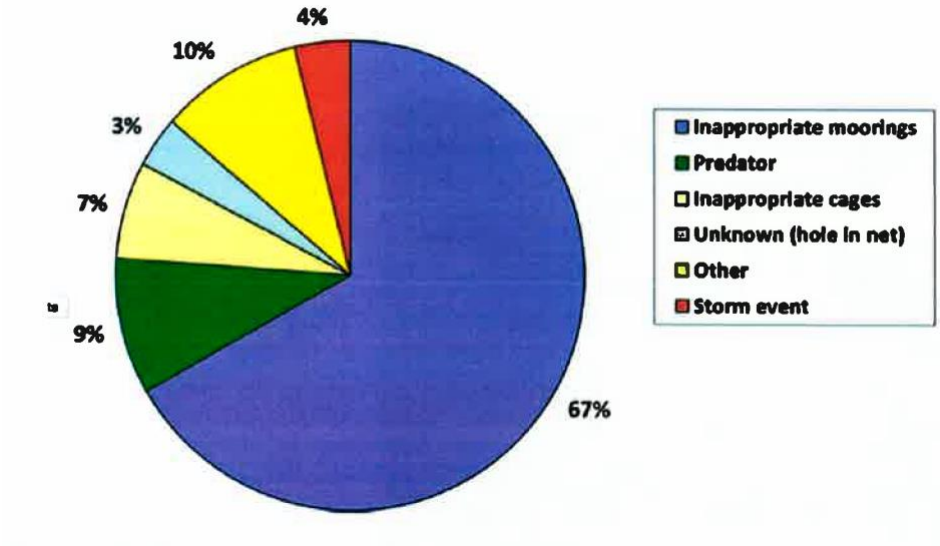
Zone Z1 - areas designated for mariculture:	Any other activity that would be developed must not be harmful to the conditions of fish and shellfish farming (Košara-Žižanj).
Zone Z2 - areas where mariculture has a high priority, but other activities are allowed:	Fish farming: Fulija-Kudica, Mrđina-Lamjana, Dugi otok – from cape Gubac to cape Žman, Zverinac, Gira, Iž - Srednji otok, Iž - Vela Sveža, Velo Žalo i Vrgada, Dinjiška – the wider area of cape Fortica, Lukar. At these locations, shellfish farming in polyculture with fish is also allowed, in accordance with the applicable regulations for shellfish farming. Shellfish farming: Novigrad Sea - excluding Karin and including Novsko ždrilo, Velebit canal – the area from Modrič to cape Pisak - Seline, Ljubač Bay, NE coast of Pag island – from Goluberje to Čiker from Srbljina, parts of Dinjiška bay and parts of Stara Povljana bay, Pakoštane-Draga area, NE from the islets of Veliki and Mali Žavinac to the mainland coast. In zones Z1 and Z2, farming capacity will be determined by special regulations governing the protection of the environment and nature.
Zone Z3 - areas where limited forms of mariculture are allowed under certain conditions and where it serves as a supplement to other dominant activities:	Kablin, Dumboka, Olib, Vičija bok - Rava, Velebit canal from Šilje Žetarica bay to cape Kozjača and from cape Dugi to County border. In addition to the existing locations, it is possible to locate white fish and shellfish family farms at depth in accordance with the regulations governing the criteria on the suitability of parts of
	the maritime domain for farming of fish and other marine organisms. (…)
Zone Z4 - areas not suitable for mariculture.	Accordingly, the capacities of individual locations were estimated. The capacities of individual locations where cultivation will take place in quantities for which the preparation of EIA is mandatory, will be determined through the environmental impact assessment procedure.

Example of different zones for mariculture in Zadar County

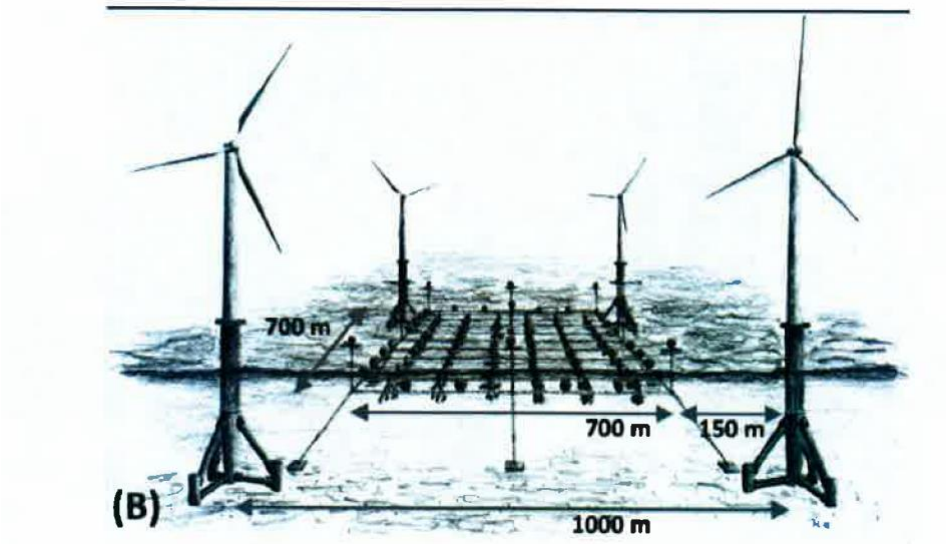
Example of fouling problems



Example of a submerged cage.



The most common causes of fish losses



Possible co-siting between mariculture and wind turbine towers.

Demonstration of work on the farm and the necessary coastal facilities for larger capacities.

Characteristics	Farm size		
	»700tons	100-700tons	<100tons
Criteria for a mariculture farm			
Good distance from the farm	<10Nm	2Nm	<1Nm
Medium distance from the farm	<15Nm	<5Nm	<2Nm
Connection with transport infrastructure	mandatary	mandatary	Mandatary
Availability (minimum limiting factor-unloading younger)	Access to trucks required	Access to trucks required	Access to trucks recommended
Criteria for mooring area			
Position within the location	Recommended – not neccessary	required	required
Mooring safety	high	high	high
Connection with transport infrastructure	Not neccessary	recommended	recommended
Criteria for operational coastal infrastructure			
Length of operational shore	Min. 20m plus 15m on each 1000t	15—25m	Min.10m
Operating share width (concrete, asphalt)	Min 10m	Min 10m	Min 10m
Sea depth	Min 4m	Min 3m	Min 2m
Mooring length at the breeding site	Min 15m	Min 10m	Min 10m

Criteria for the location of operational coastal infrastructure for mariculture farm

5 D3.2.3 by Veneto Region

Concerning maritime intra-sectorial interactions analysis as a deepening of the spill over effects of the establishment of Natura 2000 areas in the upper Adriatic sea

The Veneto region, which in 2021 established a marine SCI area south of the mouth of the Po River that also extends into the neighbouring region of Emilia Romagna, forming a single macro-area, carried out a survey on the effects on the fishing and aquaculture sector since this protection came into force. Since several official bodies have pointed out that that particular stretch of coastline is not important in terms of habitat but is very significant for the protection of the two species Caretta caretta and Tursiope truncatus, all the investigations have focused on verifying how interference between the various activities and these species has been limited.

In the areas in question there is no possibility of interference with aquaculture facilities as these areas are very far away, but in a spatial planning between AZA and marine SCI areas the possible interference of mariculture on particular habitats or on protected species will have to be taken into account.

The International Union for Conservation of Nature (IUCN) has prepared a classification of the different types of protected areas, also defining whether or not coexistence with aquaculture activities is possible. Although this classification does not concern the management of Natura 2000 sites, it does provide an indication of how aquaculture activities can be integrated with the different levels of protection of natural areas. The IUCN categorisation is:

- Category Ia Integral Natural Reserve
- Category Ib Wild Area
- Category II National Park
- Category III Natural Monument
- Category IV Area of Habitat/Species conservation
- Category V Protected terrestrial/marine landscape
- Category VI A Protected area for sustainable resource management

IUCN associates with each category the aquaculture activities that may or may not be carried out in respect of the habitats.

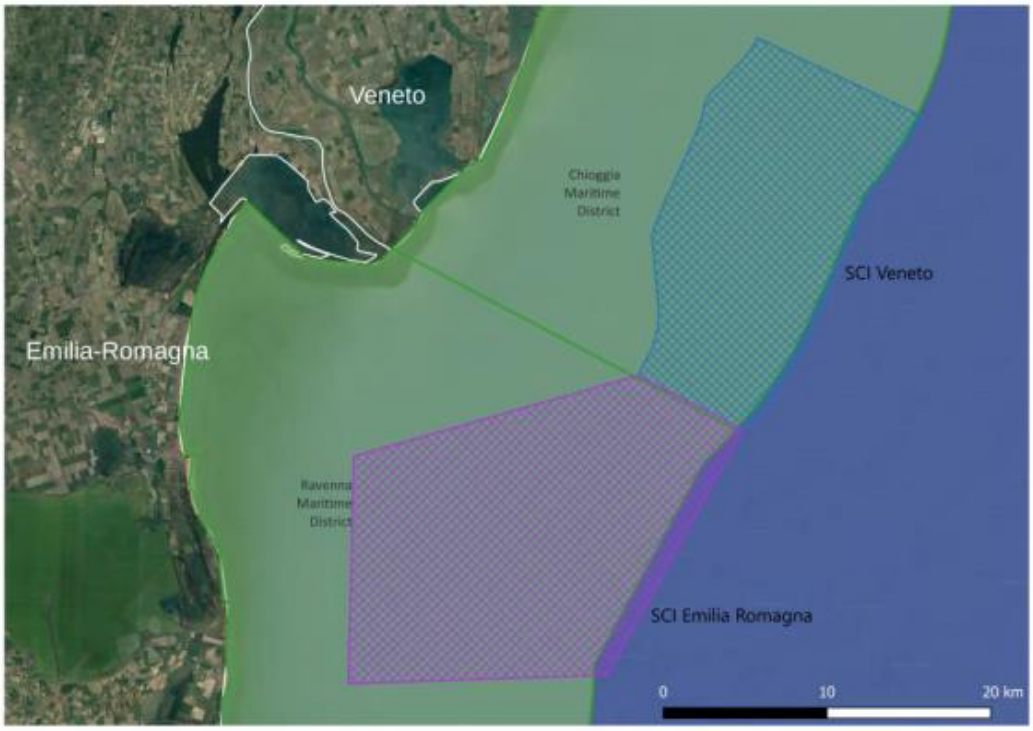
The resolutions establishing the two marine SCIs in Veneto and Emilia Romagna already include a series of indications on the activities that are prohibited within the identified perimeter; the main restrictions are on activities with gillnets that could lead to turtles and dolphins being caught in the nets, resulting in their death by suffocation, and on 'fast' boating activities that could give turtles in particular no time to avoid impact with the keel or worse, the propeller.

The Veneto Region's study also suggested other indications that could be shared not only in these protected areas but in all those in the Adriatic:

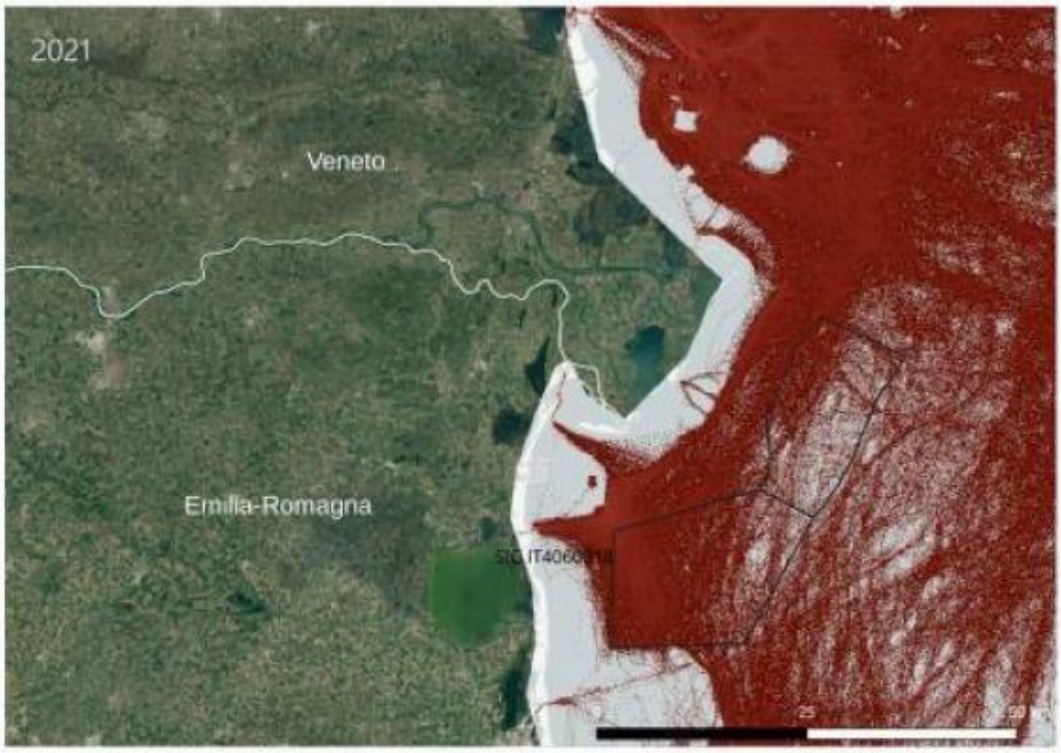
- access to the area is only allowed after a training course explaining the procedures to be adopted, which are proposed in the sheets
- access to the protected area is only allowed to boats (professional or sports) equipped with an AIS tracking device
- sports boats must notify the local Port Authority of their intention to enter the area
- use of biodegradable hooks for those entering the SCI area

In addition, the University of Padua has drawn up fact sheets on how to behave in the event of a sighting/recovery of turtle and dolphin specimens; similar activities could be studied for the various marine areas so as to allow for their use mainly for tourism-educational purposes and also with managed and controlled forms of fishing.

(A) Specimen of *Caretta caretta* found with hook and line swallowed (Source Coastal Guard). (B) Dead *Caretta caretta* specimen found on the beach with damaged carapace.



The SCI areas between Veneto and Emilia Romanga



Tracks of fishing vessels over the SCI areas

Categories	Ia	Ib	II	III	IV	V	VI
High density fish cage culture	N	N	N	N	*	*	*
High density on-land close system fish culture	N	N	N	N	*	*	Y
Medium density on-land circulating system fish pond culture	N	N	N	N	*	Y	Y
High density shell fish culture (table, long-lines)	N	N	N	N	*	*	Y
Low density pond /lagoon fish culture	N	N	N	N	*	Y	Y
High density seaweed culture	N	N	N	N	*	*	Y
Low density shellfish culture	N	N	N	N	*	Y	Y
Medium density invertebrate (e.g. sea cucumber) culture	N	N	N	N	*	Y	Y
Integrated Multi-trophic culture	N	N	N	N	*	Y	Y
Restoration purpose aquaculture *	*	*	*	*	*	Y	Y

Potential interference between aquaculture and protected areas

Example of tanker passage routes over the SCI areas

6 D3.2.4 by Emilia Romagna Region

Concerning the evaluation of the consequences on the vitality of North Adriatic fish-related chains and fisheries communities following restrictions of fishing effort derived from the establishment of new protected marine areas

As also analysed in the Veneto PP1 deliverable, the institution of the two new SCI areas in Veneto and Emilia Romagna (the first two SCI areas with a high extension in the Northern Adriatic) in addition to the two SCI areas of the Tegnue di Chioggia and Falconera, occurred in too short a timeframe to appreciate effects on the local economic network. Furthermore, the institution of the two SCI areas was requested for the protection of two species and not of particular habitats, therefore, as foreseen in the deliberations for the institution of the SCIs, the permitted and non-permitted activities have already been highlighted.

The positive effects of the presence of marine protected areas have now been incontrovertibly demonstrated on several occasions. These positive effects are exerted on biodiversity and conservation, but they are also effective for improving commercially important fish stocks. In this sense, studies are beginning to appear that demonstrate its effectiveness also in protecting the fishermen themselves, who depend on those stocks, and their economic activities in the long term. Many of these positive effects depend on "spill-over" effects, i.e. they count on the repopulation of protected areas under a "no-take" regime to repopulate consequently also the neighboring areas where fishing, aquaculture and other activities are allowed.

Fishermen have not highlighted any particular problems with the establishment of these two marine SCIs, which in fact have not resulted in changes to their activities, but they remain uncertain as to whether new protected areas could interfere with their activities in the future. Improving knowledge, including bringing evidence that in the medium to long term these precluded areas have a positive effect on the overall fish biomass, could trigger a virtuous process that would make even fishermen accept the establishment of protected areas without reservation.

	2021 (t)	Δ% on 2020	Δ% on 2012	2021 (M€)	Δ% on 2020	Δ% on 2012
Caorle	113	-15.1%	-44.0%	0.79	-2.7%	-2.3%
Chioggia	8.122	4.2%	-10.6%	22.84	15.4%	18.2%
Pila-P.Tolle	7.495	14.3%	2.5%	10.87	13.9%	15.4%
Porto Viro	715	52.7%	20.3%	1.32	33.7%	9.8%
Scardovari	347	25.3%	1.4%	0.93	24.0%	13.8%
Venice	986	-10.1%	-57.1%	5.8	-9.4%	-51.9%
Total	17. 778	8.9%	-10.4%	42.56	11.1%	-2.5%

Example of data collected Ten-year trend of landings and turnover at the fish markets of Veneto.

Sector	Employed 2021	Δ% on 2020	Δ% on 2014
Fishing	1.808	-3.7%	3.7%
Aquaculture	1.803	0.3%	5.6%
Transformation	986	10.4%	27.2%
Fresh wholesale	999	5.8%	47.8%
Processed wholesale	232	14.3%	20.8%
Retail trade	731	6.1%	8.1%
Itinerant retail	847	1.9%	11.3%
Total	7.406	2.4%	12.4%

Example of data collected Employment in fisheries, aquaculture, trade, and processing in Veneto in 2021

7 D3.2.6 by Friuli Venezia Giulia Region

Concerning the recent trends in nutrients levels in the upper Adriatic sea and how trends are linked to the sea primary production

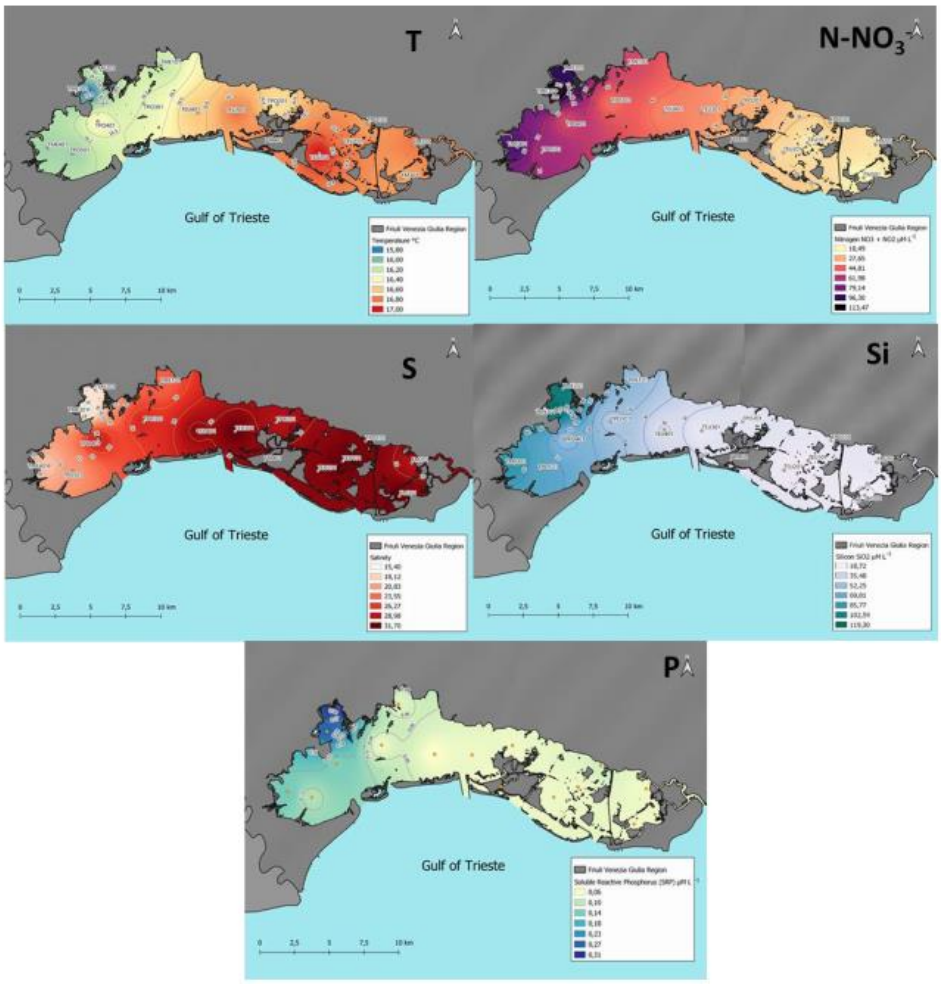
The LP Regione Friuli Venezia Giulia has produced an interesting study concerning:

- the important role of zooplankton in transferring energy from the primary producers (phytoplankton) to higher trophic levels (fish) in the lagoon and subsequently feeding them into the Adriatic Sea
- the possibility of preventing a possible invasion of alien species in Adriatic waters

Zooplankton play a fundamental ecological role transferring energy from primary producers to higher trophic levels. However, the trophic habits of zooplankton are far from uniform: although herbivores often dominate, many zooplankters are first- and second-order carnivores (i.e., their diet consists of both herbivores and other carnivores), while others are detritivores and omnivores. Few studies focused on zooplankton in Italian lagoons, although it has been recognized that the study of mesozooplankton (i.e., zooplankton with a size between 0.2 and 2 mm) can provide important information on the trophic state of these transitional areas. The survey data confirmed that the community in the lagoon was dominated mainly by omnivores-herbivores and herbivores. These two trophic groups accounted for between 55 and over 90% of the community in the lagoon, in almost every month and were mainly represented by Acartia copepods and Cladocera. Omnivore-carnivores (crab larvae) and carnivore taxa (M. leidyi) dominated the community in June and November, respectively.

The widespread problem of the invasion of ctenophores has created serious problems in the trophic network in that they are strong predators of zooplankton and therefore competitors with planktivorous species such as fish or filter-feeding molluscs, thus affecting the trophic chain in which zooplacton is an important element for the transfer of energy from primary production to higher trophic levels.

The study highlighted how an innovative technique such as environmental DNA (eDNA) can provide preventive information with respect to the explosions of certain invasive species. An extension of this analysis methodology would also make it possible to monitor the planktonic movement of the larvae of invasive species, preventing possible blooms in areas where aquaculture facilities are present.



Average distribution of physical parameters (T: temperature; S: salinity) and nutrients (N-NO_3- : nitrates; Si: silicates; P: phosphates). Data presented by A. Acquavita (ARPA FVG) at the ARGOS -Scientific Conference on Fishery - "Status and Perspectives of the Fishery Sector in the Adriatic Sea" (26th May 2022, AQUAFARM - Pordenone, Italy) (courtesy of ARPA FVG).

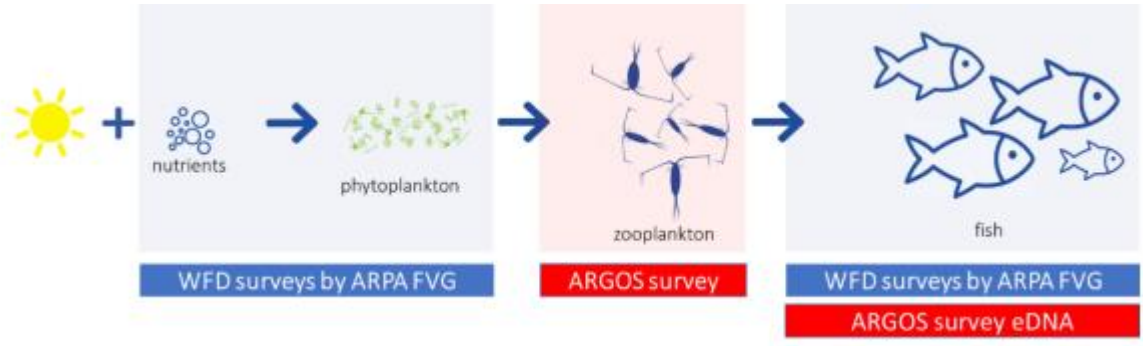
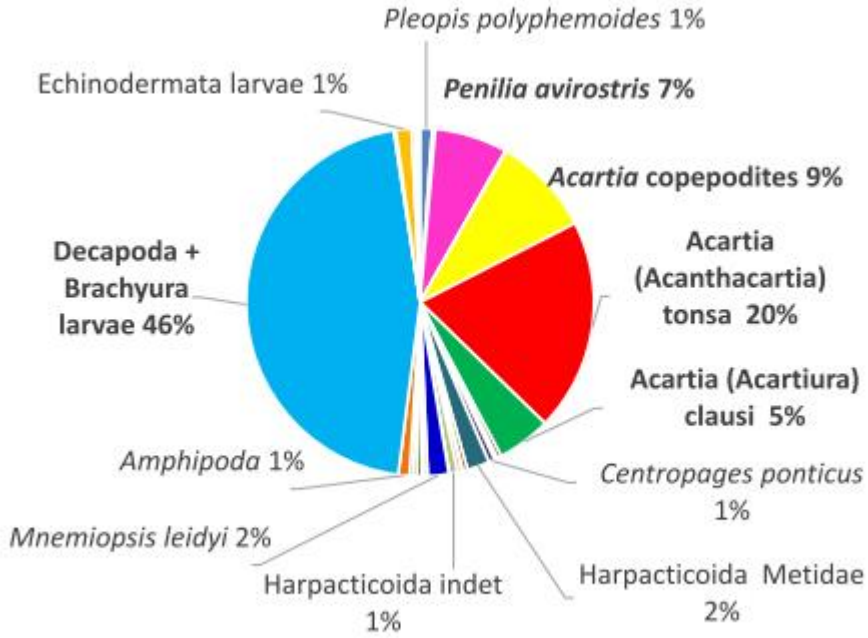
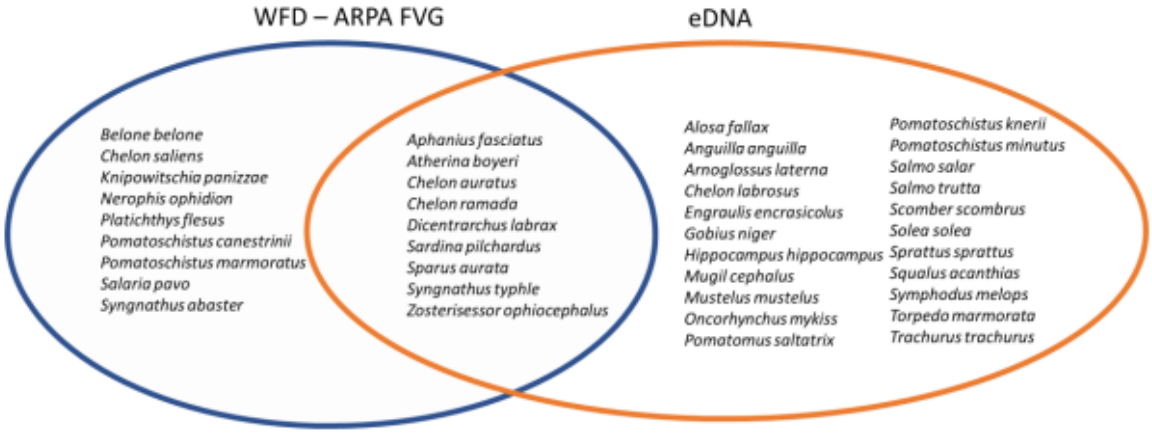


Diagram of trophic chain and related monitoring activities. WFD: Water Framework Directive



Relative abundance of identified taxa in the Marano and Grado Lagoon from May to November 2021.



Venn diagram showing the species detected by the WFD ARPA survey and with eDNA analysis.

8 D3.2.7 by CNR National Resarch Council - IRBIM Institute for the Biological Resources and Marine Biotechnologies

Concerning how different fishery methods and linked management measures interfere each other, both at biological and socio-economic level.

The CNR-IRBIM in Ancona focused its work in the ground WP3 Act. 3.2 on how different fishing methods and related management measures interfere with each other, both on a biological and socio-economic level.

Starting from the objective analysis of the status quo that currently exists in Italy and Croatia, an examination was also made of the possible interferences between the various fishing systems and related management measures, focusing on a new approach that is the socio-ecological one. While traditional approaches often focus on policies that prioritise conservation and economic aspects, sustainability science broadens the focus to include social objectives of equity and well-being. In particular, understanding the complex relationships within and between the different components of the ecological and social system, i.e. social-ecological interactions, is crucial to achieving the multiple goals of sustainability. Better fisheries management requires not only an understanding of the axioms and working hypotheses underlying current approaches and how these have evolved in response to regional or local conditions and target species, but should also promote the integration of methodologies that better reflect local situations and can be expressed in the form of one or more working paradigms.

To test these interactions and test future scenarios, the DISPLACE model was chosen. This relatively recent model allows the detailed knowledge and micro-decision-making behaviour of fishermen to be transformed into simulation and management assessment tools. It provides advanced methods for assessing and advising on the bio-economic consequences for fisheries and fish stocks of different fishermen's decisions and management. It investigates four thematic areas which are: fisheries, habitat conservation, maritime spatial planning and management issues. The drafting process

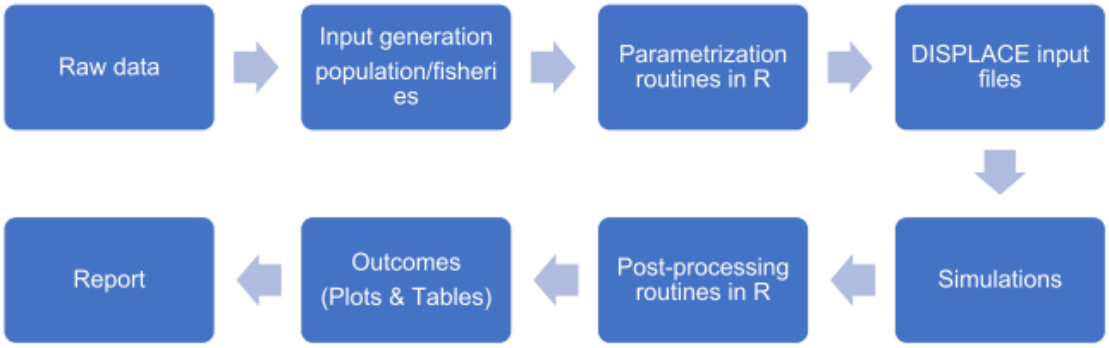
requires many hours of work so only some of the indications that emerged during the AAC discussion were tested.

The Mediterranean Sea is generally managed through the reduction of fishing effort, yet this type of management does not appear to directly improve the state of fish stocks. At the Mediterranean level, a management system based on the control of fishing effort has been considered the most appropriate for many years, although over time it has not produced the expected results; in fact, it is migrating towards a system that shifts management to production outputs. Furthermore, Regulation (EC) 1967/2006 introduced the concept of Management Plans, promoting an approach to fisheries management based on a decentralised decision-making process with specific measures in relation to the different characteristics of the areas.

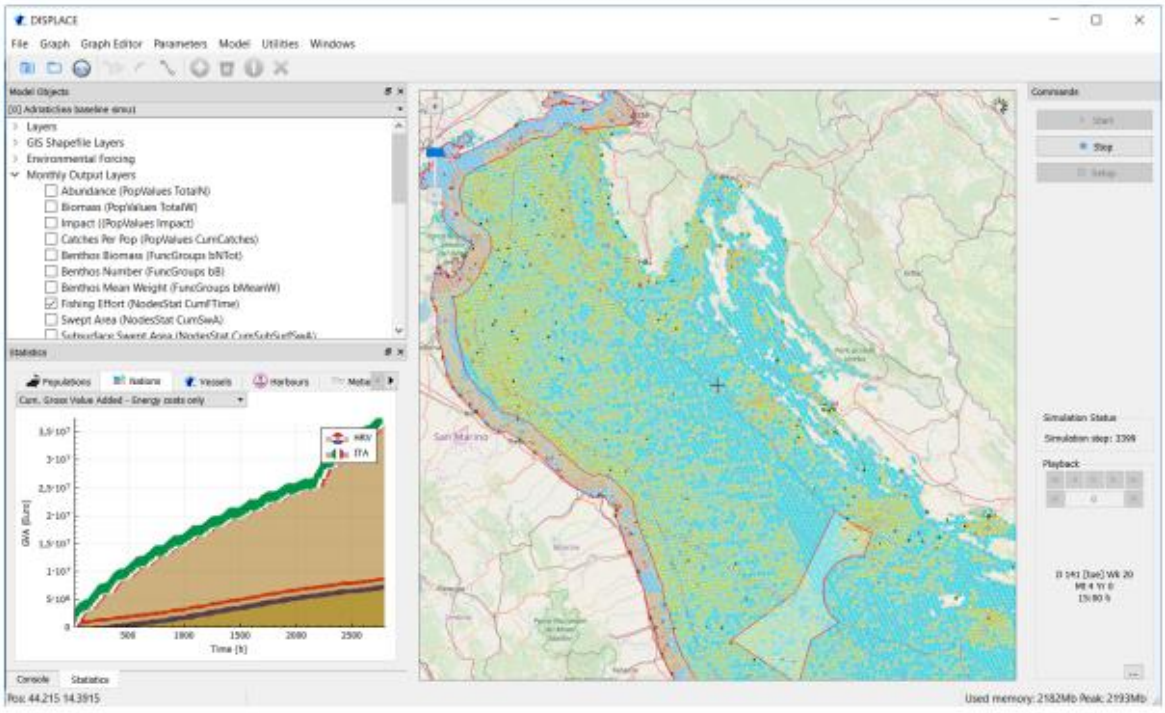
Other possible technical measures that could complement fishing time reduction are the implementation of permanent and seasonal closures, selectivity improvements and local co-management plans.

The scenarios analysed by the DISPLACE model, focused on the spatial closure of specific areas (Croatian inland canals and Italian coastal areas), seem to have positive biological and economic effects, although some minor negative effects are present.

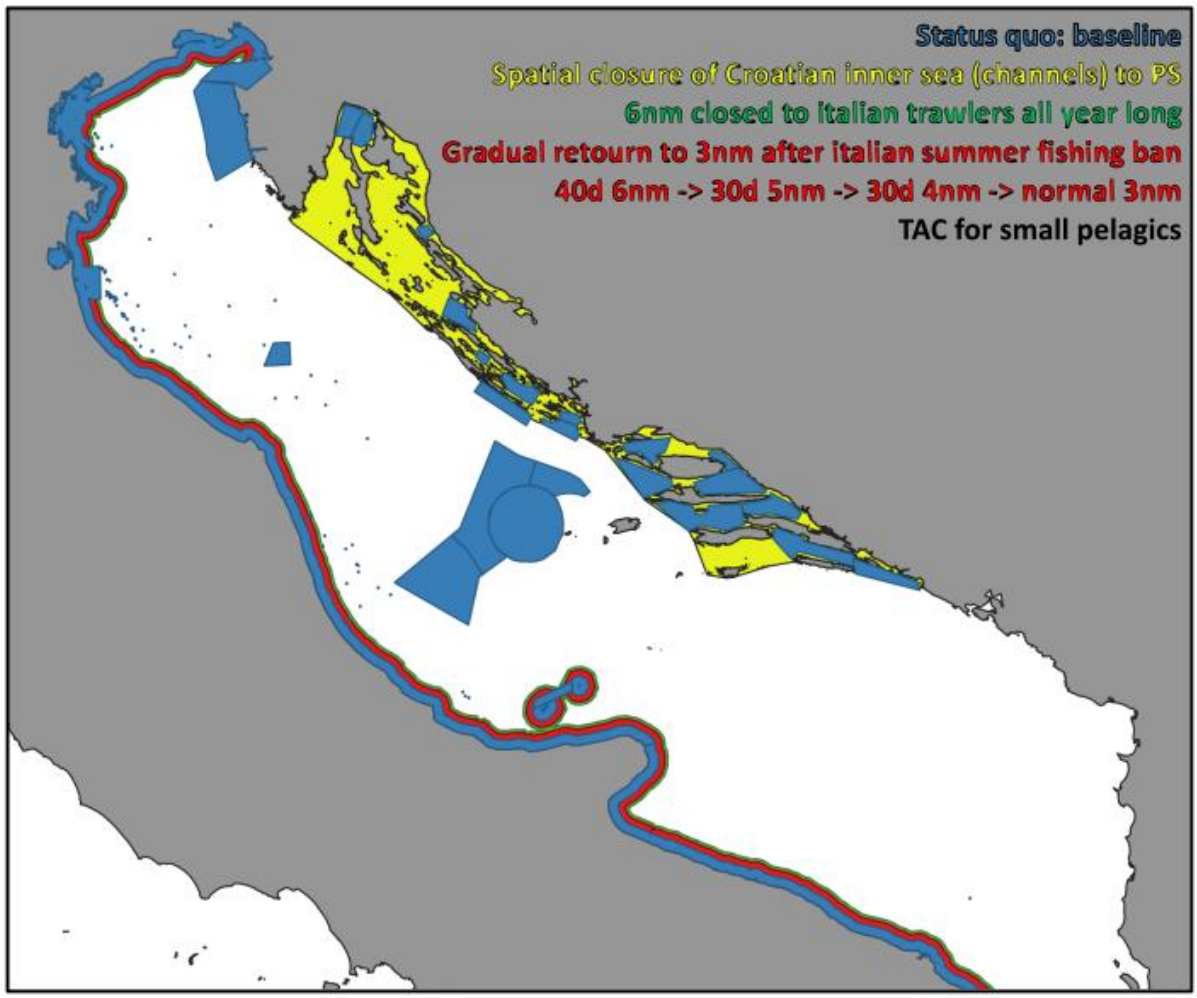
Gear modifications to increase selectivity are not always well received by operators as short-term economic losses associated with selective fishing gears are a more important concern from the fishermen's point of view coupled with the difficulty of learning how to use them correctly, although long-term projections show an increase in catches. Furthermore, it becomes important to obtain reliable estimates of post-catch survival as the information gathered indicates that escapement-induced mortality may not always be negligible.



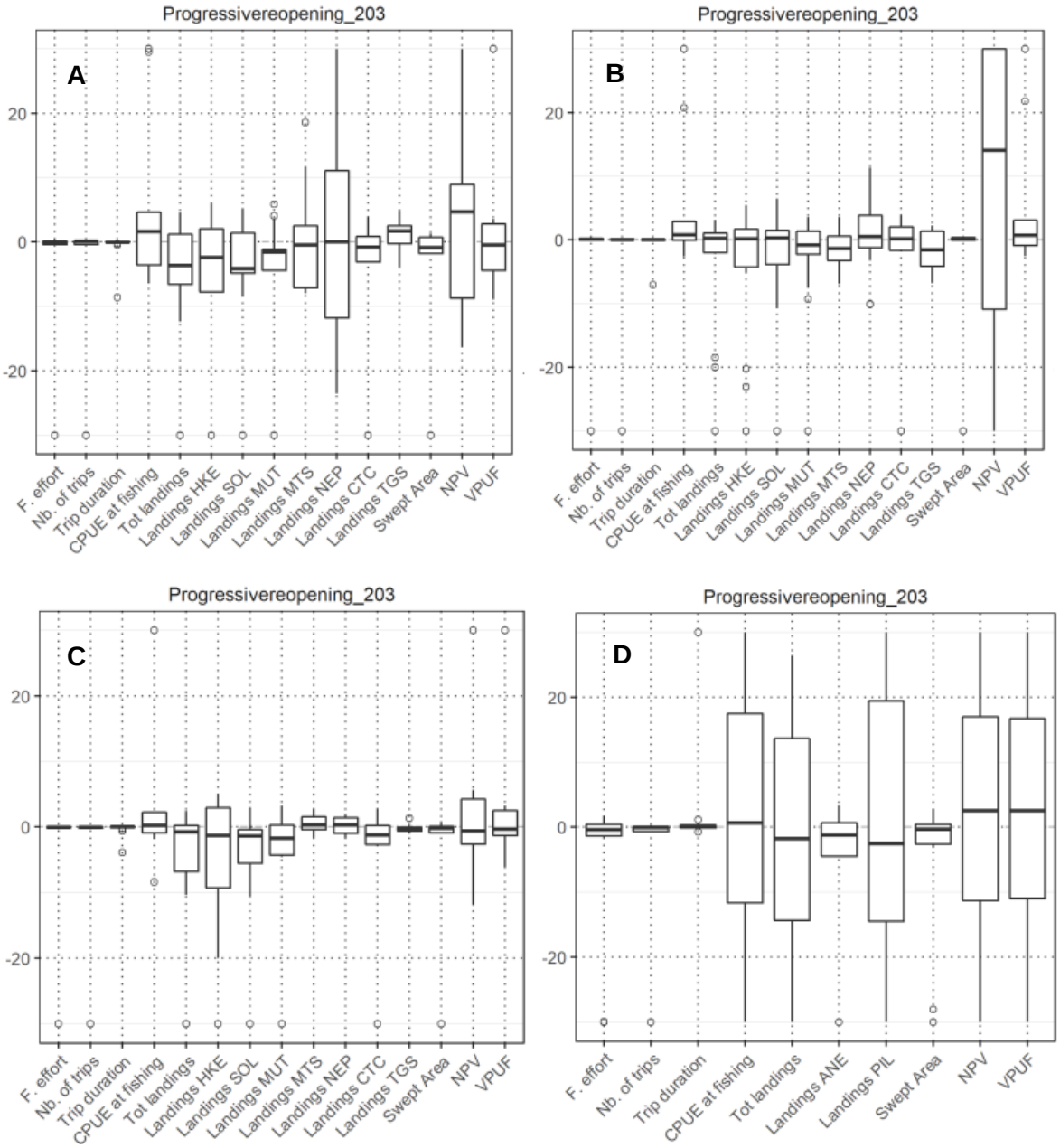
Schematization of the DISPLACE framework.



Random snapshot of the DISPLACE User Interface for the Demersal Italian & Croatian demersal fisheries in the northern Adriatic (GSA17).



Case study area with the spatial management scenarios in different colors. Since the scenario testing TAC



Simulated effect for a scenario expressed as % ratio over the baseline in respect to different indicators A OTB – B TBB – C NETS – D PS and PTM.

9 Summary Guidelines for Maritime Spatial Planning

All the results produced by the various partners contributed to the understanding of the complexity of maritime spatial management. Many aspects have been addressed, and for some of them there is already common evidence that can lead to Adriatic conclusions.

Maritime space represents an area where environmental and conservation, commercial and historical, cultural and tourism interests coexist. Fishing activities can influence the occupation of maritime space (aquaculture facilities and fishing areas) but also be affected by it, such as for the establishment of marine SCIs or priority energy facilities or commercial channels. Having a uniform view of how to manage the various overlapping interests in the MSP can ensure greater consideration of the fisheries and aquaculture sector.

The Adriatic Sea represents a virtually closed basin that has its own internal dynamics to be maintained and preserved. For this reason, it is important to be able to count on local management of resources in order to govern local dynamics in the best possible way, making art. 18 of Regulation (EC) 1967/2006, which states

Article 18 Community-level management plans

1. The Council may adopt management plans for specific Mediterranean fisheries, in particular, in areas totally or partially beyond the territorial waters of Member States.

In the case of the Adriatic, the ARGOS approach to shared management (extending the partnership to other EU or non-EU states bordering the Adriatic) will enable the AAC Permanent Technical Table to be seen as an entity that can bring its local expertise to fisheries, aquaculture, and maritime spatial management issues, providing its support to European management bodies and with ongoing scientific dialogue with STEFC and GCPM.

Data from the fisheries sector have proven difficult to obtain, despite the fact that the existing Data Collection Framework (DCF) at the European level requires member states to collect data according to national work plans and report annually on their implementation. For constructive input from AAC's permanent board, an easy access to these data is essential.

Data collection at the local level, focused on the specific needs of each partner, has had a good response from operators; succeeding in making this local data collection a constant and standardized activity that can contribute to increasing knowledge of the fishery and aquaculture resources of the Adriatic basin. It will be important to provide operators with smart tools that facilitate them in data collection and transmission, so as to limit the workload for them (such as the instrumentation implemented in WP5).

All the data collected should then be analyzed at the Adriatic basin level by AAC experts and possibly used as a starting point for model implementation; in the case of ARGOS, the DISPLACE model was tested thanks to P12 CNR-IRBIM.

The use of models could make it possible to test, based on proposed management actions, different future scenarios, testing how stocks, fishing effort or vessel revenues might evolve. These tools can help simulate bioeconomic dynamics and clarify options for sustainable and profitable fisheries in the presence of other marine sectors.

These supporting tools could provide a more certain future perspective both in terms of the management measures related to the fisheries and aquaculture sector that will be implemented in the Adriatic area, but also from the opposite point of view to see how other MSP interventions, such as those aimed at energy issues or commercial traffic, soil protection, or tourism, may affect Adriatic resources and the fisheries and aquaculture sectors.

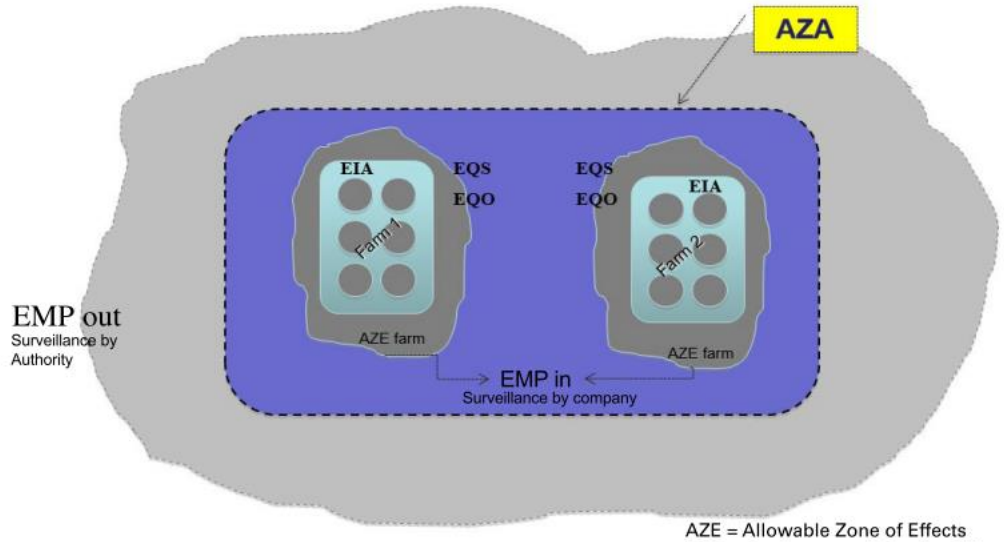
For aquaculture, on the other hand, the studies highlighted the importance of an Adriatic approach to the identification of sites that must be selected on the basis of their abiotic and biotic characteristics in order to be directed toward the activity best suited to that specific area. In addition, both the analyses and the subsequent discussions that took place within the technical table made it possible to affirm a key concept from the point of view of AZA management: these areas preferentially dedicated to aquaculture lose their natural connotation the moment they are actually used for any mariculture facility and become an anthropized area subject to continuous exchanges with the external environment.

Therefore, it becomes essential to monitor the environmental state inside and outside aquaculture facilities to see if the effects it generates are compatible with its environment.

The concept of AZA refers to a system within the broader ecosystem relationships and inherently involves the execution of several processes, such as identification, study,

selection, and spatial analysis, in order to achieve an area dedicated to planning, management, and best practices in aquaculture.

Example of environmental monitoring areas within and outside the allowable zone of effect



AZE = Allowable Zone of Effects
EQO = Environmental Quality Objective
EMP = Environmental Monitoring Programme
EQS = Environmental Quality Standard
AZA = Allocated Zone for Aquaculture

EQO: environmental quality objective.
The legislation should define the EQO in order to preserve ecosystem services

EQS: environmental quality standard.
The EQS is a value which specifies the maximum permissible concentration of a chemical in the water column and in the sediment

The MSP process is concerned not only with minimizing conflicts between existing activities, but also with anticipating and avoiding the occurrence of conflicts in the future in order to promote harmonious development of maritime activities in the areas being planned. Often in this maritime spatial planning, fisheries and aquaculture have had to undergo many of the decisions affecting the marine area, trying to reshape their activities, demonstrating a fair degree of resilience but also suffering.

The synthesis of the information gathered allowed for the development of a common strategy for MSP referring to fisheries and aquaculture activities that can be summarized in the following points:

- the concept of the Adriatic approach is fundamental to proper management of the maritime space, and this can only be achieved by expanding the partnership to include all other entities not present in ARGOS;
- aquaculture must be planned synergistically and jointly throughout the Adriatic area according to defined and shared guidelines that allow for the sizing of both the space to be devoted to AZA and the type of activities that can be carried out there;
- a space dedicated to aquaculture activities must be thought of as an environment that is no longer natural but man-made, that has bidirectional exchanges with the surrounding natural environment, and that needs constant monitoring to verify that acceptable quality levels are maintained;
- maritime spatial planning must be integrated with parallel urban planning on land that allows producers both an easy management of the facility at sea and a proper product management phase on land;
- SCIs or MPAs are opposed by the fishing and aquaculture community because they are seen as a loss of area; involving stakeholders in the decision-making process for their establishment will lead to a new awareness in the sector.
- Tools such as models are useful in the context of MSP to inform scientists, stakeholders, and administrators about the overall dynamics of the fisheries (and aquaculture) sector; however, they must have a solid data base and be interpreted in their results.
- A unified position of the Adriatic for the fisheries and aquaculture sector becomes strategic in MSP policy also to harmonize different local regulations.