


# EVALUATION OF THE CONSEQUENCES ON THE VITALITY OF NORTH ADRIATIC FISH-RELATED CHAINS AND FISHERIES COMMUNITIES DERIVED FROM THE ESTABLISHMENT OF NEW PROTECTED MARINE AREAS

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<b>Report</b>	<i>Evaluation of the consequences on the vitality of north adriatic fish-related chains and fisheries communities derived from the establishment of new protected marine areas</i>	
<b>Description</b>	This report frames from a socioeconomic point of view the northern Adriatic fisheries potentially affected by the establishment of the two new marine SCIs IT3270025 and IT4060018, located in the area off the Po delta, in the waters off the Emilia-Romagna and Veneto regions, assessing what the effects of the protection of these areas may be on the local fisheries sector.	
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## 1. Introduction

The Adriatic Sea is home to a productive and fascinating marine ecosystem. Together with its coastal lagoons, it represents one of the primary sources of livelihood for multiple human activities. The Italian coastal tourism, fisheries, and aquaculture sectors rely on its marine resources and coastal spaces, making the Adriatic coasts among the most densely populated in the Mediterranean.

Human activities, on the other hand, generate different impacts on marine and coastal ecosystems, threatening the ecosystem functionality and undermining its resources. By understanding the importance of the sea for a multifaceted socio-economic context and acknowledging the compelling necessity of preserving ecosystem structure and functions, the European Union encouraged Member States to designate Marine Protected Areas (MPAs). The ambitions of the European Union, in line with the sustainability objectives of Agenda 2030 and with the SDG14 "Life under water", aim to protect the natural environment by monitoring interactions between man and the environment and limiting the anthropogenic impacts on marine life (UN, 2015). These control and mitigation actions are implemented not only for conservation purposes, but also to avoid that the overexploitation of natural resources and excessive impacts trigger negative feedback, in which the sudden collapse of a fish stock, or the damage to an ecosystem, have risky consequences on the social and economic sectors that rely on them.

According to the Marine Strategy Framework Directive (2008/56/EC), marine protected areas are the main tool to protect marine ecosystems from the pressures and impacts of human activities. They are seen as fundamental areas where to achieve the restoration of a good status of biodiversity.

Although 625,000 km<sup>2</sup> of the European Seas are now designated as MPAs, most of these areas are currently more like legally defined areas, where effective regulations limiting the impacts of fishing and maritime activities have not yet been tested.

Fishing is considered as one of the activities that causes the greatest pressure on biodiversity and the structure of marine ecosystems. In particular, some common fishing practices in Europe, in addition to having direct impacts related to biomass harvesting, have negative effects on the productivity, the population dynamics of non-target species, and also on some key habitats which, once altered, require many years to reach again a good status. Among the fishing techniques, trawling has substantial effects on benthic habitats and impacts many non-target species through by-catch (Jennings & Kaiser, 1998) which can involve not only fish of non-commercial species, but also waterbirds, turtles, and marine mammals. Nevertheless, bottom trawling continues to be a common activity in European MPAs.

Currently, only 0.5% of MPAs in European seas are no-take zones, where all fishing is prohibited. This clashes with the objective of designating at least 30% of the European sea as MPAs by 2030. The low diffusion of these protection areas, where maximum effort is applied to conserve the

marine ecosystem and its biodiversity, is probably linked to the fear that limiting or banning human activities could generate, at least in the short term, a social and economic backlash.

This reflection is particularly felt in Italy, where fishing and aquaculture contribute to about 2.4% of the total production of the primary sector on a national scale, according to 2020 data from the *Stati Generali della Pesca e dell'Acquacoltura* (Lega Coop Agroalimentare, 2020).

In particular, the northern Adriatic serves as an extremely productive basin for aquaculture and fisheries, to the point that the national maritime fishing fleet and lagoon fleets are mostly concentrated in this area. Currently, the Italian fishing fleet consists of 12227 units (EU Fleet Register, 2023). Most of these units, according to data on fishing licenses of the Italian Ministry of Agricultural, Food and Forestry Policies, are operating in the northern Adriatic GSA 17. In this area, characterized by both sandy shallows and depths around 30-35 meters, different types of fishing gear are used: hydraulic dredges, bottom trawls, longlines, gillnets, midwater pair trawls and seines.

In these areas, so exploited by fishing, there are two important Sites of Community Importance (SCI) areas, one located off the Veneto region and one in the waters off the coast of Emilia-Romagna region. To date, fishing is allowed within these SCI areas, provided that the recommendation to safeguard species of Community importance such as turtles and dolphins is respected.

In this particular context, ecological and economic considerations seem almost at odds. While reports of dolphins and turtles tend to increase, probably also as a result of Community policies that tend to encourage reporting systems and reduce fishing effort, the maritime fleet in the Northern Adriatic has been greatly reduced in the last two decades, both in terms of number of boats and in terms of tonnage and power (Tartatur Project, Action 1 Report, 2022), determining the loss of fishing vessels especially in Veneto and Emilia-Romagna.

In the light of these considerations, it becomes appropriate to analyse the effects of the management of the SCI areas currently established off the Po Delta, especially to avoid unforeseen results from a socio-economic point of view.

Measuring the impacts of MPAs on coastal communities and fishermen typically requires a high amount of socio-economic information and the implementation of possible systemic approaches to identify relationships and interactions between natural and social ecosystems. Moreover, the difficulty of assessing the impacts of human activities on marine ecosystems is compounded by the unlikelihood of predicting the evolution of the dynamics resulting from climatic, environmental, and social threats, whether they are real or only perceived.

This report, carried out within the Interreg Italy-Croatia ARGOS project (Shared Governance of Sustainable Fisheries and Aquaculture Activities as Leverage to Protect Marine Resources in the Adriatic Sea), provides a socio-economic depiction of the local fishery sectors that insist on the SCI areas established in the northern Adriatic, describes the current SCI management system, identifies the interactions between human activities and biodiversity, and finally outlines possible suggestions to support management trajectories of these protected areas.

## 2. Marine SCI areas in the northern Adriatic

The need to establish Sites of Community Interest in the maritime waters of Veneto and Emilia-Romagna was recognized by the Italian Ministry for the Environment and for the Protection of Land and Sea (MATTM), in response to the results of the Marine Biogeographical Seminar with the European Commission (Malta, 27-29 September 2016) and the Conference on fisheries management measures in Natura 2000 sites (Zadar, 6-12 October 2017), and in response to EU Pilot 8348/16/ENV. The object of protection are the species bottlenose dolphin (*Tursiops truncatus*) and sea turtle (*Caretta caretta*). These species are included in Annexes II and IV of the Habitat Directive. Moreover, *Caretta caretta* is also a priority species, with nesting and feeding sites defined in the Mediterranean region (Casale & Margaritoulis, 2010). Bottlenose dolphin and sea turtle are transboundary species, whose protection should take into account the maritime space in its entirety (including migration barriers and disturbances, such as platforms, maritime traffic, direct or indirect pollution from estuarine areas and river deltas, and noise pollution).

In response to the input from the Ministry, the Veneto region and the Emilia-Romagna region have, on the one hand, promoted the involvement and sharing with stakeholders in the fisheries sector in defining the perimeter of the SCI areas and the conservation measures to be adopted; on the other hand, they have carried out data collection on species of interest both within the framework of the ministerial Monitoring Programs referred to in art. 11 of Legislative Decree no. 190/2010, and contributing to a study entitled "Interaction between fishing and protected species *Tursiops truncatus* and *Caretta caretta*. Assessment of the state of incidence and survey among professional fishing operators - TARTATUR" carried out under the EMFF 2014-2020 funding and published in January 2019.

This process led to the definition of marine SCIs IT3270025 and IT4060018, located in the area off the Po River delta, in the waters off the two regions (Figure 1).



**Figure 1:** Location of the SCI areas established by Veneto and Emilia-Romagna

The conservation measures implemented at the two sites, respectively by Deliberation of the Veneto Regional Council No. 1135 of Aug. 06, 2020, Annex C, and by Deliberation of the Emilia-Romagna Regional Council No. 710 of 17/05/2021, are quite similar. Below is an extract of the list of these measures found in the Deliberation of Emilia-Romagna:

### Bans

- A. Prohibition to use longlines and lines with single and multiple hooks, both for professional and recreational fishermen;
- B. Prohibition to build new offshore wind farms;
- C. Prohibition of prospecting, researching and producing hydrocarbons throughout the area of the SCI;
- D. Prohibition of windsurfing, kitesurfing, water skiing, jet skiing, motor towing of flying equipment (kites, ascending parachutes and similar devices) and organizing nautical and motor boating events;

- E. Prohibition to voluntarily approach sea turtles and bottlenose dolphins, unless the animals themselves first approach the boats or people;
- F. Prohibition to catch and feed individuals of sea turtles and bottlenose dolphins;
- G. With the exception of motorized craft engaged in professional fishing, all watercraft, motorized and non-motorized, are prohibited from transiting at a speed greater than 8 knots; this speed may be exceeded in the event of adverse weather conditions or for the occurrence of health and safety problems on board that involve the need for immediate return to port;
- H. Prohibition of any fishing activity in the SCI area currently coinciding with the military shooting range "Foce Reno" (echo 346).

### Obligations

- A. report the finding of dead specimens of sea turtles and bottlenose dolphins and report the presence of injured or unhealthy individuals, to the territorially competent Port Authorities or to authorized recovery centers;
- B. maintain a straight course when demersal trawls and trawls are in operation;
- C. mark gillnets and other fixed gear with tags;
- D. apply turtle bycatch reduction tools to fishing gear currently in use when deemed effective as mitigation measures as part of the application of the study and monitoring activities indicated in the active interventions.

### Active interventions and good practices

- A. Involvement of representatives of the professional fishing and aquaculture world by the Marine SCI Management Authority and in the possible modification and redefinition of mitigation measures, as will be established by a special Memorandum of Understanding to be entered into by the Emilia- Romagna Region;
- B. Carry out studies for the application of selection and mitigation tools for impacts on sea turtles and a on bottlenose dolphins;
- C. Confer non-releasable animals and/or carcasses to the appropriate agencies upon agreement with the Harbor Master's Office in order to ascertain the causes of injuries or deaths. In the case of live animals, ensure adequate welfare conditions for the animals by arranging for their release and/or transfer to rehabilitation centers, reporting both events to the appropriate agencies;
- D. Provide facilities for the safe storage of turtles captured alive before their transfer to recovery centers, without compromising, slowing down or hindering the activities of fishermen
- E. Financially support fishing enterprises that use sorting tools and possible deterrents or bycatch reduction tools;



- F. Support economically and promote sustainable fisheries, including through possible sustainability certifications, according to accredited standards such as MSC or "Friends of the Sea." It is possible to further implement this effort by trying to extend it to other tools and by expanding it with voluntary certification systems, thanks also to funding (e.g., EMFF) that allows for adequate economic feedback and that encourages direct contact with the consumer in such a way as to improve the economic value of the seafood product;
- G. Support fishing and aquaculture enterprises economically in case of established damage resulting from the presence of turtles and bottlenose dolphins in the marine SCI area;
- H. Promote active participation, through public meetings with stakeholders and, in particular, with the various fishing sectors, during the review phases of conservation and management measures for these species;
- I. Encourage the organization of theoretical and practical information and refresher courses for fishermen and other stakeholders on monitoring animals at sea, the management of rescued animals, and the use of mitigation tools in order to reduce possible mortality. These activities should also be extended to other stakeholders such as boaters, sport fishermen, and transport companies. Training activities should also provide information using data compiled by research and monitoring agencies;
- J. Implement training, outreach and public information activities by integrating fishing-tourism activities with dolphin-watching activities through appropriate training and compliance with international rules governing these activities;
- K. Financially support scientific research, monitoring activities on land (beaching) and at sea (free-ranging and incidental catch) also with the participation of fishing companies: these activities should be made continuous and systematic in order to identify density, abundance and distribution of animal populations. Define bycatch indices through constant monitoring on land and at sea, analyzing data by individual gear and mortality data. In addition, the Monitoring Programs referred to in Art. 11 of Legislative Decree 190/10, as defined by Italy in Ministerial Decree February 11, 2015 (Framework Agreement between the MATTM and the 15 Italian coastal regions), must be ensured. The coordination and definition of monitoring and research activities will be carried out by the Region, directly involving fishing enterprises. Fishermen will actively participate in these initiatives, providing information and using quick and effective tools (dedicated Apps, websites, etc.);
- L. Promote and involve all stakeholders in demonstration activities and research projects regarding the various impacts that threaten the conservation status of bottlenose dolphins and turtles. In particular, continue good practices regarding the collection of "marine litter" and "ghost nets" that pose imminent and real danger. These actions should involve all stakeholders and not only professional fishermen who already actively participate in "fishing for litter" campaigns and have been involved in projects to reduce the presence of plastics in the sea. In this sense, it is important that the waste collected at sea is classified

as generic and not special and that its management does not impose additional burdens on fishermen who, instead, bear the burden of an irreplaceable service that benefits the entire marine ecosystem and the community;

- M. Define and apply a protocol for the recovery of turtles in distress;
- N. Support the Interregional Stranding Network, between Veneto and Emilia-Romagna, so that it is able to intervene with unique and harmonized protocols and procedures to provide the information necessary for management and to ensure adequate monitoring with respect to all the causes (anthropic and not) that determine the strandings.

### 3. Socio-economic framework

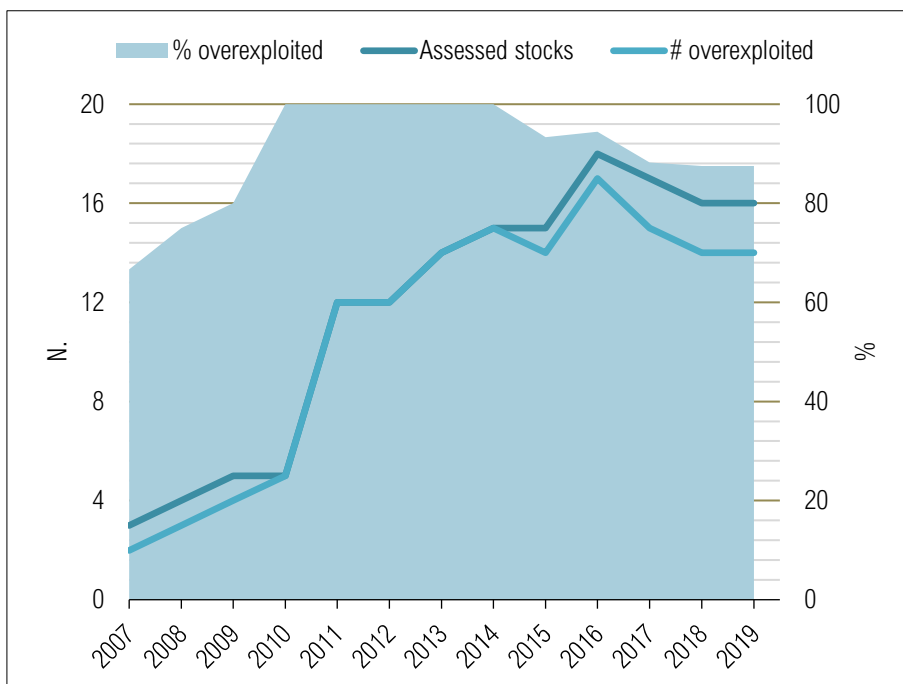
According to data from the ISPRA yearbook of environmental data 2021 (ISPRA, 2021), most commercial stocks at national level show a state of overfishing, growing from 77.8% to 93.6% in the period 2007 - 2013, indicating a general state of unsustainability of fishing. Recently, the percentage of overfished stocks has declined relatively, reaching 83.7% in 2015 and standing at 91.4% in 2019. The time series also shows a progressive increase from 2007 to 2013 in the number of stocks assessed through stock assessments, from 9 to 47. From 2014 to 2019, the stocks assessed decreased to between 35 and 43. In general, for the period 2007-2019 a state of overexploitation of the main stocks is evident regardless of the approach used, and this observation at national level is equally valid in the case of the Adriatic Sea (Table 1 and Figure 2).

Year	No. Assessed stocks*	% of nation-level landings	No. overexploited stocks	% overexploited stocks
2007	9	21.4	7	77.8
2008	16	19.9	13	81.3
2009	22	27.8	19	86.4
2010	28	30.0	26	92.9
2011	45	34.8	43	95.6
2012	45	33.4	42	93.3
2013	47	42.8	44	93.6
2014	40	45.5	37	92.5
2015**	43	46.8	36	83.7
2016**	41	46.8	36	87.8
2017**	43	47.9	39	90.7
2018**	41	48.6	38	92.7
2019**	35	42.4	32	91.4

**Table 1:** National trend of stocks in a state of overexploitation (ISPRA elaboration on stock assessment data validated internationally by STECF and GFCM - updated to December 2020)

\* In the case of stocks valued for multiple GSAs, stocks are considered at the level of individual GSAs.

\*\* Estimated based on 2014 data



**Figure 2:** Performance of stocks in a state of overexploitation in the Adriatic Sea (ISPRA elaboration on stock assessment data validated internationally by STECF and GFCM – updated to December 2020)

Among the many threats to the sustainability of fisheries in the Mediterranean, pollution, habitat degradation, the effects of climate change and overfishing are particularly important. The bottom trawl, in particular, appears very problematic in aggravating the pressures on marine environments, because it makes multi-specific catches of which up to 80% is discard.

In this context, we rely on the fact that some stocks have made some improvements, when unfortunately less than half of the landings come from stocks for which the Commission receives scientific data. ISPRA in fact reports that, even if the share of national landings corresponding to the stocks assessed has increased in the years taken into consideration by its study, most of the stocks considered are in a state of overexploitation.

In any case, Italian fishing in recent years has undergone a downward trend in landings. According to the latest reports of the *Stati Generali della Pesca e dell'Acquacoltura*, "the catch by the Italian fleet in 2019 amounted to about 174,000 tons, for a value of 887 million euros. From 2010 to today, the total value of landings has decreased by 15.7%, the volume of landed production by 16.2% and the average price (€/kg) by 9%" (Lega Coop Agroalimentare, 2020).

The threat of discontinuity of landings is also having a negative effect in the fish processing sector, which already relies heavily on imports. Only recently has the processing and valorisation of raw material from domestic aquaculture been seen as an opportunity to reduce this dependence on imports from abroad.

A market trend that is at least somewhat reassuring is provided from the perspective of fish consumption, as in the Italian diet the average consumption figure is around 25 kilograms of fishery products per capita each year, which is slightly higher than the average European figure of around 23 kilograms per capita.

## SITUATION IN THE VENETO REGION

### Fishing and maritime fleet in Veneto

As of 31 December 2021, Veneto's maritime fleet consisted of 655 registered units, as in the previous year. Compared to 2010, there was a decrease of 753 units. These 655 registered units amount to 5.4% of the national fleet, and over a third are registered at the maritime compartment of Chioggia (Table 2). To these units are added 850 fishing vessels variously used for fishing in fresh waters and lagoons (Veneto Agricoltura, 2022).

Harbor	Code	Total	Of which SSF	PS	GND	MAIN GEAR			
						GNS	LLS	OTB	DRB
Burano	02VE	9	8	0	0	7	1	1	0
Caorle	03VE	106	55	7	1	36	11	25	26
Jesolo	04VE	55	42	3	0	25	14	2	11
Pellestrina	01VE	19	9	1	0	8	0	3	7
Venice	00VE	78	30	1	0	24	5	6	42
Chioggia	00CI	218	50	5	0	37	8	96	72
Porto Levante	02CI	32	29	0	0	8	21	0	3
Porto Tolle	01CI	82	37	0	2	27	8	42	3
Scardovari	03CI	56	47	1	1	42	3	8	1
<b>Total</b>		<b>655</b>	<b>307</b>	<b>18</b>	<b>4</b>	<b>214</b>	<b>71</b>	<b>183</b>	<b>165</b>

**Table 2:** Primary gear of the Veneto fishing fleet, divided by port of registration (retrieved 31 December 2021, EU Fleet Register) - PS = Purse Seines; GND = Drifting Gillnets; GNS = Set Gillnets; LLS = Set Longlines; OTB = Bottom Otter Trawls; DRB = Dredges.

### Fish markets of Veneto

In Veneto there are currently six fish markets: in the province of Venice we find, in addition to the fish market of Venice itself, those of Caorle and Chioggia, while in the province of Rovigo we find those of Porto Viro, Pila and Scardovari (Figure 3).

With the exception of Chioggia and Venice, all Veneto fish markets are “production-level”, i.e., structures of concentration of the landing of the local fleet. Chioggia and Venice, on the other hand, are mixed, because, in addition to local fish products, they also deal with those of national and foreign origin. In particular, the national and foreign product constitutes the predominant part of what is traded at the Venice market, while in Chioggia the local product is more important.



**Figure 3:** Location of fish markets in Veneto with respect to SCI area IT3270025

Each of these fish markets has inherent characteristics due largely to the type of fleet that delivers its catch there and the type of fish production predominantly marketed. The analysis of “Veneto Agricoltura” agency shows that the local production of Veneto fish markets in 2021 was 17,778 tonnes, an increase of 8.9% compared to 2020, but a decrease of 10.4% compared to 2012 (Table 3). In 2021, the main Veneto fish market for transits in volume of local fish sold is that of Chioggia which, with 8,122 tons sold, alone representing almost 46% of the entire regional fish production, exceeding by over 600 tonnes that of Pila (about 42% of the Veneto total). Globally, landings at the Veneto fish markets increased by about 9% compared to 2020, with a more marked positive trend in the smaller markets (Pila, Porto Viro and Scardovari), and less evident in Chioggia. Caorle and Venice, on the other hand, are decreasing. The trend compared to 2012 is generally downward (-10.4%). In terms of turnover, in the period 2012-2021 there were significant decreases in Venice (51.9%), and moderate decreases in Caorle (-2.3%). The other markets are growing, between 10% (Porto Viro) and 18% (Chioggia). In terms of earnings related to the sale of local fish products, the Chioggia market has by far the highest turnover with about 22.8 million euros, equal to 54% of the total.

	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%
<b>Total</b>	<b>17. 778</b>	<b>8.9%</b>	<b>-10.4%</b>	<b>42.56</b>	<b>11.1%</b>	<b>-2.5%</b>

**Table 3:** Ten-year trend of landings and turnover at the fish markets of Veneto. Source: Veneto Agricoltura, 2022

### Employment in fishing and related industries in Veneto

In Veneto in 2021, a total of 7,406 people were employed in the fish supply chain, with an increase of 13.4% compared to 2014 (Table 4). The activities that have the highest number of employees are fishing and aquaculture with respectively 1,808 and 1,803 units, equal to 50.8% overall, while those operating downstream of the supply chain are all below one thousand units. All the sectors show positive changes in the period 2014-2021, especially for those employed in the wholesale trade of fresh products, which shows an increase of 47.8%.

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%
<b>Total</b>	<b>7.406</b>	<b>2.4%</b>	<b>12.4%</b>

**Table 4:** Employment in fisheries, aquaculture, trade, and processing in Veneto in 2021. Source: Veneto Agricoltura, 2022

### Fishing enterprise in Veneto

According to the most recent report by Veneto Agricoltura, the companies active in the Veneto fish supply chain in the last year are 3,849 and grow in the last decade by 3.3% (Table 5). The changes in the last decade are not homogeneous, with a maximum increase for wholesale companies (+40.3%), while the strongest decrease is recorded for companies engaged in processing (-5.7%). Most of the Veneto fishing companies are engaged in primary production (82%), followed by those operating in the retail trade (12%). About 90% of these enterprises are individual business or partnerships, while corporations represent a marginal portion.

Sector	2021	Δ% on 2012
Fishing	1.460	-2.6%
Aquaculture	1.680	8.8%
Wholesale Trade	181	40.3%
Retail	478	-4.8%
Processing-Preserving	50	-5.7%
<b>Total</b>	<b>3.849</b>	<b>3.3%</b>

**Table 5:** Breakdown of companies in the fishing sector in Veneto, according to segment. Source: Veneto Agricoltura, 2022

## SITUATION IN THE EMILIA-ROMAGNA REGION

### Fishing and maritime fleet of Emilia-Romagna

The coast of Emilia-Romagna extends for about 130 km, and includes four provinces (Ferrara, Ravenna, Forlì-Cesena and Rimini) and two maritime compartments (Ravenna and Rimini). According to the *Community Fishing Fleet Register*, as of 31 December 2021 the Emilia-Romagna maritime fleet consisted of 588 registered units (4.8% of the units registered throughout Italy), broken down by port and type of main fishing gear as shown in Table 6. The data shows that small-scale fishing accounts for 54.8% of the entire fishing fleet in terms of the number of vessels. The trend in the number of fishing vessels in Emilia-Romagna over the last decade has decreased by about 23%, most of which occurred before 2014, in line with the general trend throughout the Northern Adriatic.

Harbor	Code	Total	Of which SSF	PS	GND	GNS	MAIN GEAR				
							LLS	OTB	DRB	PTM	TBB
Ravenna	00RA	23	21	0	1	12	8	1	1	0	0
Porto Garibaldi	01RA	58	22	2	0	16	4	35	0	1	0
Cervia	02RA	38	24	0	0	14	10	3	11	0	0
Goro	05RA	246	133	1	0	132	41	62	7	0	3
Rimini	00RM	80	38	1	0	6	31	30	12	0	0
Cattolica	03RM	42	22	0	0	10	12	6	14	0	0
Cesenatico	04RM	45	20	6	0	6	8	23	2	0	0
Riccione	07RM	22	18	1	0	11	6	1	3	0	0
Bellaria	08RM	34	24	1	0	10	13	4	6	0	0
<b>Total</b>		<b>588</b>	<b>322</b>	<b>12</b>	<b>1</b>	<b>217</b>	<b>133</b>	<b>165</b>	<b>56</b>	<b>1</b>	<b>3</b>

**Table 6:** Primary gear of the Emilia-Romagna fishing fleet, broken down by port of registration (retrieved 31 December 2021, EU Fleet Register) - PS = Purse Seines; GND = Drifting Gillnets; GNS = Set Gillnets; LLS = Set Longlines; OTB = Bottom Otter Trawls; DRB = Dredges; PTM = Midwater Pair Trawls; TBB = Beam Trawls

### Fish markets of Emilia-Romagna

In Emilia-Romagna there are currently six fish markets: in the province of Ferrara, we find those of Goro and Porto Garibaldi (part of the municipality of Comacchio); that of Ravenna; in the province



of Forli-Cesena we find the one of Cesenatico; lastly those of Rimini and Cattolica fall within the province of Rimini (Figure 4).



**Figure 4:** Location of fish markets in Emilia-Romagna with respect to SCI area IT4060018

The most recent and homogeneous data relating to the fish markets of Emilia-Romagna are those reported by the Socio-Economic Observatory of Fisheries and Aquaculture of the northern Adriatic, which is updated to 2021 and takes into consideration the markets of Goro, Porto Garibaldi, Rimini, Cattolica and Cesenatico.

**GORO:** the Fish Market is at production, it operates with an electronic auction in the afternoon; There are about 25 companies accredited at the market, consisting of wholesalers, fishmongers and restaurants; 83% of the local product comes from sea fishing, 16% from inland fishing, and 1% from aquaculture. Volumes and turnover in the last decade have seen a phase of increase until 2016, and then stabilized around values of 1,000 tons and 2.8 million euros per year respectively. Globally, the ten-year trend is 34.4% growth in terms of landings, and 44.8% in terms of turnover.

**PORTO GARIBALDI:** the Fish Market is at production, it operates with an electronic auction in the afternoon; There are about 80 companies accredited at the market, consisting of wholesalers,

fishmongers and street retailers. The local product comes entirely from sea fishing. The ten-year trend is in sharp decline: in 2021 2,542 tons of fish passed through the market, with a decrease of 49.1% compared to 2012; the turnover was almost 4 million euros, with a decrease of 26.3% compared to 2012.

CESENATICO: the Fish Market is at production, it operates with morning and afternoon auctions, made by voice, by ear and electronics. There are about 110 companies accredited at the market, mostly wholesalers, fishmongers and street retailers. The whole local product comes from sea fishing. The ten-year trend is clearly increasing, more so until 2015. Comparing the data of 2021 with those of 2012, there is an increase of 98.4% of landings (4,210 tons in the last year), and 30.3% of turnover (8.2 million euros in 2021).

CATTOLICA: the Fish Market is at production, it operates with night auction, carried out with direct and electronic negotiation. There are about 40 companies accredited at the market, mostly wholesalers, fishmongers and street retailers. The local product is 87% from sea fishing and 13% from mariculture. In the last 10 years there is no definite trend in trading. The 906 tons sold in 2021 corresponds to a variation of +17% compared to 2012, and earnings are stable, with about 2.5 million euros invoiced in 2021 and a variation of +0.3% compared to what was recorded in 2012. For a correct interpretation of these data, it must be borne in mind that the Cattolica fish market is also attended by the vessels of the Gabicce Mare fishing fleet of Marche Region, which can count on 44 fishing boats. Moreover, it should be noted that part of the local catch does not pass through the market but is sold directly wholesale at the wharf.

RIMINI: the Fish Market is mixed, it operates with night auction, carried out with direct and electronic negotiation. There are about 160 companies accredited at the market, mostly wholesalers, fishmongers and street retailers. The local product comes entirely from sea fishing. In Rimini's fish market, local landings are also associated with the transit of fish products of national and foreign origin: the share of local products amounts to 75% of the total transits (1,232 tonnes), while national and foreign amount to 19% and 6% respectively. The ten-year trend of volumes is substantially constant at around 2,000 tonnes per year, while that of turnover is more fluctuating but without a specific trend (in 2021, approximately 10 million Euro were invoiced, equal to +10.9% compared to 2012). However, it should be noted that, considering the different shares by origin of the seafood product transiting through the Rimini site, at a ten-year level the share of local product is increasing the most (+18.0%).

### Employment in fishing and related industries in Emilia-Romagna

As reported by M.A.R.E. Soc. Coop., using data from the EU Fleet Register 2021 and a census carried out in 2018, the number of people employed in the fishing sector in Emilia-Romagna was estimated based on the main type of fishing carried out. Approximately 933 people are employed on the 434 of the estimated 588 boats that are engaged in fishing activities (excluding the vessels for mussel-farming or other functions) (Table 7).

According to the most recent report of the Socio-Economic Observatory of Fisheries and Aquaculture of the northern Adriatic, in 2021 the companies active in the entire fishing chain of Emilia-Romagna were 2,808 units, +9.6% in the last decade (Table 8). In detail, however, there was a decrease in the number of fishing companies (-24.8%), and a substantial increase in aquaculture companies (+36.4%). An even greater increase affected the fish processing sector (+43.8%), but this also depends on the low total number. About 83% of the companies active in Emilia-Romagna are linked to primary production, with a consistent pre-eminence of those of aquaculture (61.6% of the total). According to the legal nature of the companies, 78% of the total of these are individual business, while partnerships, corporations and other forms of enterprise amount to 13%, 5% and 4% respectively.

First license	Workers /boat	No. Boats	No. Workers
Dredge	2	56	112
SSF < 7m	1	110	110
SSF > 7m	2	93	186
Trawl < 15m	2	106	212
Trawl > 15m	3	16	48
Trawl > 20m	5	18	90
Midwater Trawl	5	35	175
<b>Total</b>		<b>434</b>	<b>933</b>

**Table 7:** Estimated fishing workers in Emilia-Romagna in 2021 (source: Coop MARE, 2021)

Sector	2021	Δ% on 2012
Fishing	602	-24,8%
Aquaculture	1.729	36,4%
Wholesale Trade	109	26,7%
Retail	345	-11,8%
Processing-Preserving	23	43,8%
<b>Total</b>	<b>2.808</b>	<b>9,6%</b>

**Table 8:** Breakdown of companies in the Emilia-Romagna fisheries sector by segment. Source: Veneto Agricoltura, 2022

## 4. Biodiversity of the northern Adriatic

The northern Adriatic is a basin with an average depth of 30-35 metres, which deepens very gradually as it descends towards the Ionian Sea. While on the eastern side there are rocky shores and seabed, on the western side along the coast of northern Italy the Adriatic Sea has sandy bottoms, strongly influenced by sediment and freshwater inputs from the Po River. This configuration is reflected in a particular distribution of seabed habitats, where among the prevailing muddy and sandy substrates, *Posidonia* and some rocky outcrops only appear in limited areas. In terms of biodiversity, the influence of the Po's fluvial inputs and the particular bathymetry determine a high primary and secondary productivity, capable not only of sustaining fish stocks, but also of attracting reptiles and marine mammals. Among the latter, the loggerhead turtle *Caretta caretta* and the bottlenose dolphin *Tursiops truncatus* represent the most charismatic species, towards which awareness has been raised for decades.

The SCI areas currently established in the Northern Adriatic, while not outright prohibiting fishing or boating, have made it possible to implement protective measures for these two species. As recent studies have shown, the Adriatic population of bottlenose dolphins is not to be considered as a single uniform unit from a genetic point of view but is rather composed of local populations that are slightly differentiated according to the sub-basin to which they show loyalty (Gaspari et al., 2015). The most recent data available allow us to estimate that these populations consist of around 100-150 individuals in the Gulf of Trieste area, over 200 individuals in the Kvarner area, and at least 300 in northern Dalmatia.

As far as turtles are concerned, the Northern Adriatic is considered one of the most important feeding areas for adult individuals. It is also noteworthy that, over the past five years, observations of ovipositing turtles on the Northern Adriatic coast have increased compared to the past, although the area is not ideal for breeding. Sightings of adult individuals offshore have also increased, although they often involve sightings of distressed animals floating on the surface or showing fatigue. At the same time, the finding of dead individuals, floating or stranded, also seems to be slightly on the increase (Vegal, 2022) but it must be considered that it is not easy to understand if cases have actually increased or if, instead, cases have remained stable and voluntary reports have only increased thanks to the effectiveness of awareness campaigns and the activation of projects dedicated to data collection.

Very recently, the possible occurrence of the monk seal (*Monachus monachus*) in the northern Adriatic has also been reported in the scientific literature, revealed by environmental DNA signals collected in a Mediterranean-wide study (Valsecchi et al., 2023). Although this species is not protected and the signals were mainly detected towards the Istrian side, it is interesting to report this occurrence in order to underline the significance of the Northern Adriatic habitats..

The presence of these species confirms the high environmental value of the Adriatic basin and reinforces the idea that complying with biodiversity protection systems is a desirable strategy.

Nevertheless, the risk associated with interactions between these animals and humans engaged in fishing activities has not yet been analysed in detail in the Northern Adriatic area.

In the past, it was thought in the fishing industry that the presence of dolphins in the vicinity of nets was due to their numbers. Only later has it been shown that, on the contrary, the problem of predation in aquaculture facilities and nets is caused by over-exploitation of fish stocks, which forces cetaceans deprived of the possibility of successfully hunting wild fish to seek different food sources (Bearzi et al., 2011; Pleslić et al., 2021).

Currently, various data and testimonies allow us to affirm that the interaction with fleets and fishing gear by bottlenose dolphins, as well as turtles, are rather limited. An interesting result comes from research carried out by the Dolphin Biology and Conservation association to assess in how many cases fishing vessels were followed by bottlenose dolphins in the waters of Veneto. It was found that, out of 189 vessels observed, bottlenose dolphins followed 72.7% of the pairs of vessels engaged in pelagic trawling and 24.6% of the units engaged in bottom trawling. In contrast, none of the observed “*rapido*” trawlers were followed by bottlenose dolphins (Bearzi & Bonizzoni, 2018). In addition, during a series of meetings organized within the ARGOS project, local fishermen reported that, generally, bottlenose dolphins are not observed regularly, and tend not to follow but on the contrary tend to anticipate fishing boats. As a result, they hardly get stuck in trawls, at least in the northern Adriatic. Therefore, it follows that dolphin-fishing interactions are mostly limited and do not normally bring negative impacts on each other.

Except that the use of multiple hooks is prohibited in SCI zones, one of the remaining dangers for dolphins with fishing activity may be gillnets and trammel nets. Again, the occurrence of stranded dolphins is very rare. In this regard, many fishermen are now equipped with electronic devices, in technical jargon called “acoustic harassment devices”, able to dissuade the approach of bottlenose dolphins, thus limiting both the entrapment of the same, and any damage to the nets. Acoustic bollards of this type have proven effective in protecting nets and fish even in some scientific studies, although greater effectiveness is achieved with other good practices in which the operator’s experience and the choice of suitably modified nets play a key role (Buscaino et al., 2021).

Although the possible damage to the nets caused by bottlenose dolphins cannot be absolutely excluded, it is also true that their presence is beneficial for the ability to keep the trophic network in good balance, and in this sense, thanks to a regulation service it can compensate the punctiform and occasional economic losses that may eventually occur (Pace et al., 2022).

As far as turtles are concerned, data are currently scarce on their interactions with professional fishing. Some catches by midwater and bottom trawls are reported periodically, as evidenced both by the testimony of fishermen and by monitoring activities such as that carried out within the TartaTur project, but at the moment there is no complete and exhaustive database in this regard. In case of an accidental capture, in most cases the impact is worse for the turtle than for the fishing gear or the catch. For this reason, some turtle catch avoidance systems are being studied to be placed at the mouth of trawl nets (Tudela, 2004, Padlocks et al., 2019).

A starting point to improve the protection and management of bottlenose dolphins and turtles in the northern Adriatic could certainly derive from guidelines appropriately designed for each fishing system, including both existing devices, such as acoustic deterrents and barriers to prevent turtles from entering the nets (as suggested eg. from Vegal, 2022 and reported in Lucchetti et al., 2019), and from new experiments.

In the overall picture, the protection of bottlenose dolphins and turtles in the Northern Adriatic Sea does not clash at all with a fishery management that respects social and socio-economic aspects, but rather becomes an opportunity for experimentation, training and collaboration between operators and stakeholders.

## 5. Discussion and conclusions

The success of marine protected areas depends above all on their conservation effectiveness and their ability to deliver on the one hand, the expected results for society, including the protection of ecosystems and natural resources, and on the fairness and social and economic sustainability of the application of fisheries management systems on the other. The relationship between conservation and human development therefore remains a controversial issue, which requires the scientific collection of rigorous and solid evidence on the possible benefits of marine protected areas on neighbouring populations, both in the short and long term.

The positive effects of the presence of marine protected areas have now been incontrovertibly demonstrated on several occasions (FAO, 2017). 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 (Medoff et al., 2022). Nevertheless, the effect in the zones surrounding protected areas in the northern Adriatic is yet to be demonstrated. The assessment depends on multiple aspects, belonging to the ecological, social and economic spheres, and should consider the threats and effects of external pressures, such as climate change and the unpredictability of social dynamics.

On the other hand, the collection of precise and accurate data, as well as the identification and monitoring of anthropic pressures on coastal ecosystems, are essential prerequisites for obtaining valid and shared suggestions for management purposes. The success of marine protected areas in achieving their conservation objectives also depends to a large extent on the management of social, demographic, cultural and market factors. It is crucial that the management of marine protected areas is able to provide clear benefits to the communities concerned, especially in terms of livelihoods, food security and social resilience. The challenges for the implementation of this approach are multiplied if we consider that the interactions between marine protected areas and human activities often involve multiple stakeholders, partly overlapping with fisheries and partly competing with it. In addition, compliance with regulations often depends on the proper performance of controls, or the availability of any financial compensation where necessary. In this sense, only participatory methods and the ecosystem approach to fisheries management could support measures to protect, monitor and manage fisheries and marine protected areas, ensuring the resilience of both.

In the light of the considerations set out in this report, analysed together with current data and trends in socio-economic indicators concerning the fisheries sector in Veneto and Emilia-Romagna, it can be said that the establishment of SCI areas IT3270025 and IT4060018 off the Po Delta has not led to significant changes in the northern Adriatic Sea fishing sector. Furthermore, no negative economic and employment impact can be expected to be caused by the current SCI management system.

However, this also implies that no significant result on the maintenance of marine biodiversity, nor on the effective conservation of habitats, can be expected either, except limited to the increased protection of dolphins and turtles.

The management of protected areas in the Northern Adriatic could be improved through a research and data collection effort, so as to ensure all the interdisciplinary knowledge needed to implement management plans that are truly sustainable from all points of view. Considering how important the Adriatic Sea is, on the one hand for the persistent presence of species of great interest, and on the other hand for the presence of economically relevant human activities, the involvement of all stakeholders at the decision-making tables should be a pivotal objective for management hypotheses that are able to keep potentially harmful human activities within acceptable levels, and that succeed in applying virtuous measures both in the SCIs and in the surrounding areas.

In order to envisage effective long-term management that responds to the principles of ecosystem-based fishery management, it would therefore be desirable to deepen studies with interdisciplinary approaches, preferably using modelling tools and participatory approaches. The latter in particular should involve local, national and cross-border administrations in a dialogue together with scientific research actors, with the common goal of achieving a shared management strategy.



## 6. References

- Bearzi, G., & Bonizzoni, S. (2018). *Interazioni fra delfini e pesca in Adriatico settentrionale*. Resoconto tecnico. Consulenza e supporto tecnico-logistico per Università degli Studi di Padova.
- Bearzi, G., Bonizzoni, S., & Gonzalvo, J. (2011). Dolphins and coastal fisheries within a marine protected area: mismatch between dolphin occurrence and reported depredation. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 21(3), 261–267. <https://doi.org/10.1002/aqc.1179>
- Buscaino, G., Ceraulo, M., Alonge, G., Pace, D. S., Grammatta, R., Maccarrone, V., Bonanno, A., Mazzola, S., & Papale, E. (2021). Artisanal fishing, dolphins, and interactive pinger: A study from a passive acoustic perspective. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 31(8), 2241–2256. <https://doi.org/10.1002/aqc.3588>
- Casale, P., Margaritoulis, D. (2010) Sea turtles in the Mediterranean : Distribution, threats and conservation priorities. <https://iucn.org/resources/publication/sea-turtles-mediterranean-distribution-threats-and-conservation-priorities>
- Coop MARE (2021) - Rapporto a cura di M.A.R.E. Soc. Coop. a r.l.: Studio commerciale sulle necessità delle imprese cooperative di pesca a livello regionale per incrementare la loro promozione e valorizzazione
- Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). Official Journal of the European Union L164/19., (2008).
- FAO (2017) Marine protected areas: Interactions with fishery livelihoods and food security. FISHERIES AND AQUACULTURE TECHNICAL PAPER, 603. <https://www.fao.org/3/i6742e/i6742e.pdf>
- Gaspari, S., Scheinin, A., Holcer, D., Fortuna, C., Natali, C., Genov, T., Frantzis, A., Chelazzi, G., & Moura, A. E. (2015). Drivers of Population Structure of the Bottlenose Dolphin (*Tursiops truncatus*) in the Eastern Mediterranean Sea. *Evolutionary Biology*, 42(2), 177–190. <https://doi.org/10.1007/s11692-015-9309-8>
- ISPRA, Annuario dei dati ambientali, anno 2021. <https://annuario.isprambiente.it/#:~:text=Annuario%20dei%20dati%20ambientali%202021&text=Descrive%20le%20condizioni%20delle%20diverse,e%20da%20Annuario%20in%20cifre.>
- Jennings, S., & Kaiser, M. J. (1998). *The Effects of Fishing on Marine Ecosystems* (pp. 201–352). [https://doi.org/10.1016/S0065-2881\(08\)60212-6](https://doi.org/10.1016/S0065-2881(08)60212-6)
- Lega Coop Agroalimentare, *Documento degli Stati Generali della Pesca e dell'Acquacoltura* (2020). [http://www.legacoopagroalimentare.coop/public/my\\_files/All\\_Pesca\\_Documento\\_Stati\\_generali\\_pesca\\_e\\_acquacoltura\\_F2E.pdf](http://www.legacoopagroalimentare.coop/public/my_files/All_Pesca_Documento_Stati_generali_pesca_e_acquacoltura_F2E.pdf)
- Lucchetti, A., Bargione, G., Petetta, A., Vasapollo, C., & Virgili, M. (2019). Reducing Sea Turtle Bycatch in the Mediterranean Mixed Demersal Fisheries. *Frontiers in Marine Science*, 6. <https://doi.org/10.3389/fmars.2019.00387>
- Medoff, S., Lynham, J., & Raynor, J. (2022). Spillover benefits from the world's largest fully protected MPA. *Science*, 378(6617), 313–316. <https://doi.org/10.1126/science.abn0098>

- Pace, D. S., Ferri, S., Giacomini, G., di Marco, C., Papale, E., Silvestri, M., Pedrazzi, G., Ventura, D., Casoli, E., & Ardizzone, G. (2022). Resources and population traits modulate the association patterns in the common bottlenose dolphin living nearby the Tiber River estuary (Mediterranean Sea). *Frontiers in Marine Science*, 9. <https://doi.org/10.3389/fmars.2022.935235>
- Pleslić, G., Rako-Gospić, N., & Holcer, D. (2021). Bottlenose dolphins (*Tursiops truncatus*) in North Dalmatia, Croatia: Occurrence and demographic parameters. *Marine Mammal Science*, 37(1), 142–161. <https://doi.org/10.1111/mms.12735>
- Tudela, S. (2004). *Ecosystem effects of fishing in the Mediterranean: an analysis of the major threats of fishing gear and practices to biodiversity and marine habitats. Studies and Reviews. General Fisheries Commission for the Mediterranean. No. 74.*
- UN. (2015). *Transforming our world: the 2030 agenda for sustainable development.*
- Valsecchi, E., Tavecchia, G., Boldrocchi, G., Coppola, E., Ramella, D., Conte, L., Blasi, M., Bruno, A., & Galli, P. (2023). Playing “hide and seek” with the Mediterranean monk seal: a citizen science dataset reveals its distribution from molecular traces (eDNA). *Scientific Reports*, 13(1), 2610. <https://doi.org/10.1038/s41598-023-27835-6>
- Vegal (2019). *Interazione tra pesca e specie protette Tursiops truncatus e Caretta caretta. Valutazione dello stato d'incidenza e indagine tra gli operatori della pesca professionale.* [https://www.vegal.net/public/studi\\_e\\_publicazioni/FLAG\\_Tartatur1/Azione1\\_Valutazione%20dello%20stato%20di%20incidenza%20e%20indagine%20tra%20gli%20operatori%20della%20pesca.pdf](https://www.vegal.net/public/studi_e_publicazioni/FLAG_Tartatur1/Azione1_Valutazione%20dello%20stato%20di%20incidenza%20e%20indagine%20tra%20gli%20operatori%20della%20pesca.pdf)
- Vegal (2020). *Relazione Tecnica Finale - Progetto Tartatur: Valutazione dell'interazione della pesca marittima e della maricoltura con le specie Caretta caretta e Tursiops truncatus nella fascia costiera veneta. Azione 7: linee guida per consentire la pescamarittima nel rispetto della tutela delle specie protette.* [https://www.vegal.net/public/studi\\_e\\_publicazioni/FLAG\\_Tartatur1/Azione7\\_Linee%20guida%20per%20consentire%20la%20pesca%20marittima%20nel%20rispetto%20della%20tutela%20delle%20specie%20protette.pdf](https://www.vegal.net/public/studi_e_publicazioni/FLAG_Tartatur1/Azione7_Linee%20guida%20per%20consentire%20la%20pesca%20marittima%20nel%20rispetto%20della%20tutela%20delle%20specie%20protette.pdf)
- Veneto Agricoltura (2022). *Il settore ittico dell'alto adriatico. Report 2022.* <https://www.venetoagricoltura.org/wp-content/uploads/2022/08/Report-Alto-Adriatico-2022.pdf>