

Technical Report on Drafting Management Plans for Italian Demersal Trawl Fleets in 2025-2030

CONTENTS

EXECUTIVE SUMMARY	3
1 BACKGROUND	4
1.1 The EU MAP and the GFCM recommendations	5
1.2 Stock status in the Italian GSAs	7
1.3 Trend in effort in the most recent years	7
1.4 Trend in economic indicators and reference points	8
1.5 Trend in social indicators and reference points	11
2 METHODOLOGY	14
2.1 Biological data	14
2.1.1 Forecasting settings and scenarios	14
2.1.2 Stock Selection	16
2.1.3 Spatial effort displacement	16
2.2 Socio-economic data	17
2.2.1 Relationships between fishing mortality and nominal effort	17
2.2.2 Price dynamics	18
2.2.3 Total revenues and total catches	18
2.2.4 Cost dynamics	19
2.2.5 Socio-economic indicators	21
3 RESULTS	23
4 GOVERNANCE AND SAFEGUARDS	24
5 MONITORING: IMPLEMENTATION AND EVALUATION OF THE RESULTS OBTAINED	26
6 REFERENCES	32

EXECUTIVE SUMMARY

The following simulations evaluate multiple scenarios for fishing effort reduction to achieve sustainable fishery management. Through biological and socio-economic simulations, the analyses aim to support decision-making on fishing management policies, balancing ecological sustainability with economic and social objectives.

Key Findings:

1. **Biological Simulations:**

- Various effort reduction scenarios were modeled, including gradual reductions of 3% and 5% annually from 2025 to 2027, status quo maintenance, and a transition towards FMSY (Maximum Sustainable Yield).
- The 3% annual reduction scenario for bottom otter trawlers (OTB) demonstrates **balanced biological benefits** across stocks, effectively maintaining spawning stock biomass (SSB) levels and contributing to long-term sustainability, without drastic disruptions to fishing activities. It is important to stress that in the cases where the 3% reduction is not enough for specific stocks with high level of overfishing, further management measures, as capacity reduction envisaged not only on trawl fleets and spatio-temporal closures of trawling activity, would support the achievement of sustainable exploitation in 2030. In addition, having in mind that most of the stocks are shared both with EU and non-EU countries and are subject to international Multiannual Management Plans (e.g.: EU Westmed MAP, GFCM MAPs), a further fishing pressure reduction will be implemented also in the framework of such plans.

2. **Socio-Economic Simulations:**

- The socio-economic model assesses the impact of different scenarios on profit margin, current revenue on break-even revenue (CR/BER), employment (FTE), and labor productivity (GVA/FTE). It emphasizes that economic sustainability is contingent on maintaining a balance between reduced fishing efforts and acceptable profitability levels.
- The 3% effort reduction scenario (S1) shows **manageable socio-economic impacts**, preserving employment levels and economic viability better than the more aggressive 5% reduction or the FMSY transition.

Recommendation for 3% Reduction:

- **From both a biological and socio-economic perspective**, the 3% scenario emerges as the most advisable strategy for effort reduction for bottom trawlers only (OTB):
 - **Biological Outcomes:** The scenario offers a gradual transition to sustainable fishing without jeopardizing stock recovery, also considering that such reduction is not needed for beam trawlers (TBB) targeting common sole in GSA 17, for which a status quo scenario is advisable.
 - **Economic and Social Impacts:** It mitigates the risks of profit loss and unemployment compared to more aggressive measures.
 - **Long-Term Alignment:** This scenario aligns with national and EU sustainability goals, balancing ecological health with economic livelihoods.

Conclusion:

The report supports the **3% annual reduction in fishing effort** for bottom otter trawlers only as the optimal path for the 2025–2030 Italian Demersal Trawl Fishery Management Plans. This strategy provides a sustainable trajectory for fish stocks while minimizing economic and social disruptions, making it the most balanced and viable option.

1 BACKGROUND

Council Regulation (EC) No. 1967/2006 “Concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea” introduced a national and EU-level multiannual management plan system that combines effort management and specific technical measures based on a decentralized decision-making process. Article 19 regulated the adoption of National Management Plans, which Mediterranean Member States must adopt for a number of fishing activities in their waters.

The earliest plans for Italian fisheries were implemented in 2010 (Director’s Decree No. 44 of 17 June 2010) and were subsequently updated in 2011 (Director’s Decree of 6 September 2011). Although the first generation of management plans for demersal trawl fisheries should have covered the period 2011–2013, they were extended several times and remained in force until 31 December 2017. The main measure envisaged by those plans was the capacity reduction through vessel decommissioning associated with a range of technical measures, such as the temporary cessation and technical stops, to reduce stock exploitation and promote sustainability. The Director’s Decree of 30 January 2018 introduced a new generation of management plans (2018–2023) to better address the overexploitation of the stocks. The management plans 2018–2023, as updated in January 2019, mainly aimed at reducing fishing mortality (F) by reducing fishing capacity (2018) and effort (2019–2020). Different to the first-generation plans, the new plans provided for ex-ante evaluation of the effectiveness of the measures through a simulation of their biological, economic and social effects both in 2020 (the last year of the first period of plan implementation and the year when measure effectiveness is to be evaluated) and in 2023 (final year of plan validity)¹.

In 2023, the analysis of trends in fishing effort and stock status showed both a gradual and constant improvement in the exploitation status of many stocks and a general trend towards a reduction of fishing effort. This suggests that the current management system was quite effective in gradually bringing all (or almost all) stocks towards more biologically sustainable levels. Furthermore, additional and complementary measures, such as catch limits, were recently introduced for giant red shrimp and blue and red shrimp in the western and central Mediterranean and for deep water rose shrimp in the Strait of Sicily (namely, the previously cited GFCM recommendations). Therefore, it was deemed not necessary to amend this system, but rather to propose, for 2024, a one-year extension of the measures already adopted in the previous 5-years period at the level of the national plans, while maintaining the technical measures and harvest control rules defined in these plans and refining the monitoring mechanisms to consolidate and possibly improve the results obtained. In the specific case of the management plans for trawl fisheries in the Strait of Sicily and for deep-water red shrimps, the technical measures, including the spatial and temporal restrictions of fishing activities, recommended by the GFCM and implemented by the EU, will be adopted in accordance with the established procedures. It was then foreseen that a complete update of Italian Demersal Trawl Fishery Management Plans had to be prepared for the period 2025-2030 and the scientific rationale is here presented.

In preparation for the revision of the Multi-Annual Plans (MAPs) promoted by the European Commission and/or the General Fisheries Commission for the Mediterranean (GFCM), a full assessment of what has been done so far, from a biological, economic, and social point of view, is hereby proposed to lay the basis for new MAPs considering both national and international management objectives. These new plans aim at incorporating any measure (e.g. vessel decommissioning) decided in 2024. The

¹ Sabatella, R.F., Accadia, P., Cozzolino, M., Gambino, M., Malvarosa, L., Sabatella, E.C. (2020). Socio-Economic Impacts of the Common Fisheries Policy on South and Central Tyrrhenian Sea (GSA 10) Demersal Trawl Fisheries. In: Bevilacqua, C., Calabrò, F., Della Spina, L. (eds) *New Metropolitan Perspectives*. NMP 2020. Smart Innovation, Systems and Technologies, vol 177. Springer, Cham. https://doi.org/10.1007/978-3-030-52869-0_12

above-mentioned revision will consider the need to integrate the national plans within the broader framework of the EU and GFCM plans currently in force.

1.1 The EU MAP and the GFCM recommendations

The Regulation (EU) 2019/1022 establishing a multiannual plan for the fisheries exploiting demersal stocks in the Western Mediterranean Sea introduced for the first time a multiannual management plan for the conservation and sustainable exploitation of demersal stocks in the western Mediterranean Sea, in line with the Common Fisheries Policy (CFP). The main objectives of the plan are:

- to contribute to achieving the objectives of the CFP objectives, in particular by applying precautionary and ecosystem-based approaches to fisheries management;
- to ensure that exploitation of marine biological resources restores and maintains populations of harvested species above levels which can produce the maximum sustainable yield (MSY);
- to contribute to eliminating discards by avoiding and reducing unwanted catches and implementing the landing obligation in the long-term.

The regulation applies to the stocks driving demersal fisheries (i.e., European hake, Red mullet, Deep-water rose shrimp, Blue and red shrimp, Giant red shrimp, and Norway lobster), by-catch stocks and other demersal stocks for which sufficient data are not available. It also applies to commercial and, to a certain extent, recreational fisheries exploiting those stocks in the Western Mediterranean (i.e. General Fisheries Commission for the Mediterranean sub-areas 1, 2, 5, 6, 7, 8, 9, 10, 11.1 and 11.2).

The fishing mortality targets are F_{MSY} ranges which should be achieved by 2020 where possible, and by 1st January 2025 at the latest, and then maintained within these ranges.

The regulation introduces a fishing effort regime at EU level for all trawls exploiting demersal stocks in the Western Mediterranean Sea. Each year, the Council sets a maximum allowable fishing effort (number of fishing days) for each fishing effort group managed by each EU country. The plan foresees a 10% reduction for 2020 and up to 30% reduction of fishing effort between the second and fifth year. The Council may also set limits for recreational fishing. Data on fishing effort will be shared with the European Commission.

Concerning the technical measures, the use of trawls is banned within 6 nautical miles from the coast, except in areas deeper than 100 m, for 3 months each year based on scientific advice, timing to be determined by each EU country and applying during the most relevant period. In alternative, on expert advice, EU countries may establish other closure areas, provided that a reduction of at least 20% of catches of juvenile hake in each geographical subarea is achieved.

The regulation has been applied since 16 July 2019. The fishing effort regime applies from 1st January 2020. The targets and the safeguard measure for the precautionary reference point (BPA) apply from 1st January 2025.

In addition, the EU regulation 2023/195 established, for 2023 and for a list of authorized vessels, the fishing opportunities in terms of catch limits for the Blue and red shrimp (*Aristeus antennatus*) and the Giant red shrimp (*Aristaeomorpha foliacea*) in the GSA 8, 9, 10 e 11. Set on the basis of the catches in the previous years, such catch limits in 2023 were 243 tons for *A. antennatus* and 354 tons for *A. foliacea*.

The other areas of the Mediterranean are instead regulated by Recommendations emanated by the General Fisheries Commission for the Mediterranean (GFCM), because several stocks that are the main targets of the fisheries are shared with non-European countries. Effort regimes and technical measures are the basis of such Recommendations. The list of the Recommendations on Management Plans is reported below.

For the deep-water red shrimps *A. antennatus* and *A. foliacea*, catch limits are applied in all the areas covered by the GFCM recommendations (MASAF_2023_0331725_Catch limits red shrimps GSAs 24_27; MASAF_2023_0331721_Catch limits red shrimps GSAs 19_21; MASAF_2023_0331716_Catch limits red shrimps GSAs 12_16), considering specific lists of authorized vessels. In addition, catch limits also apply to Deep-water rose shrimp *Parapenaeus longirostris* in the Strait of Sicily.

It is also worth mentioning that Fishery Restricted Areas (FRAs) have been established in different sub-regions, as for instance: the Jabuka-Pomo Pit in the Adriatic Sea (GSA17; Recommendation GFCM/44/2021/2 on the establishment of a fisheries restricted area in the Jabuka/Pomo Pit in the Adriatic Sea (geographical subarea 17), amending Recommendation GFCM/41/2017/3); and the three FRAs in the Strait of Sicily (East of Adventure Bank and West of Gela Basin in GSA 16, and East of Malta Bank in GSA 15-19; Recommendation GFCM/45/2022/4 on a multiannual management plan for the sustainable exploitation of demersal stocks in the Strait of Sicily (geographical subareas 12 to 16), repealing Recommendations GFCM/44/2021/12 and GFCM/42/2018/5).

List of the Recommendations in place emanated by GFCM

Levant Sea	GFCM/45/2022/7	on a multiannual management plan for sustainable demersal trawl fisheries targeting giant red shrimp and blue and red shrimp in the Levant Sea (geographical subareas 24 to 27), repealing Recommendation GFCM/42/2018/3
Adriatic Sea	GFCM/45/2022/8	on the implementation of a fishing effort regime for key demersal stocks in the Adriatic Sea (geographical subareas 17 and 18) in 2023, stemming from Recommendation GFCM/43/2019/5
Central Mediterranean	GFCM/45/2022/6	on a multiannual management plan for the sustainable exploitation of giant red shrimp and blue and red shrimp stocks in the Ionian Sea (geographical subareas 19 to 21), repealing Recommendations GFCM/44/2021/8 and GFCM/42/2018/4
Central Mediterranean	GFCM/45/2022/5	on a multiannual management plan for the sustainable exploitation of giant red shrimp and blue and red shrimp stocks in the Strait of Sicily (geographical subareas 12 to 16), repealing Recommendations GFCM/44/2021/7 and GFCM/43/2019/6
Central Mediterranean	GFCM/45/2022/4	on a multiannual management plan for the sustainable exploitation of demersal stocks in the Strait of Sicily (geographical subareas 12 to 16), repealing Recommendations GFCM/44/2021/12 and GFCM/42/2018/5

EU REGULATION (EU) 2023/2124 of 4th October 2023 on certain provisions for fishing in the GFCM Agreement area (recast), lays down the rules for the application by the Union of the conservation, management, exploitation, monitoring, marketing and enforcement measures for fishery and aquaculture products established by the GFCM.

1.2 Stock status in the Italian GSAs

In the Mediterranean, there are two bodies that provide annual advice on the status of fished stocks: the GFCM and the Scientific, Technical and Economic Committee for Fisheries (STECF). The main stock assessments outcomes are publicly available at the following websites: STECF ([Stecf Stock Assessment DB for Med-BS - European Commission \(europa.eu\)](#)) and GFCM ([Stock Assessment Results \(STAR\) | General Fisheries Commission for the Mediterranean - GFCM | Food and Agriculture Organization of the United Nations \(fao.org\)](#)). The trends of fishing mortality F relative to the reference point F_{MSY} (F/F_{MSY}) for the main demersal stocks, derived from the 2023 assessments (reference year 2022) endorsed by the two bodies are presented as plots by stock and reference area covered by a multiannual management plan (MAP) (see Annex I Biological analysis).

1.3 Trend in effort in the most recent years

The evolution of the fishing effort, expressed in kW per fishing day, exerted by bottom trawlers (OTB) from 2018 to 2022 in all Italian GSAs and beam trawlers (TBB) (only in GSA17) on demersal stocks is reported in Figures 1.3.1 and 1.3.2, respectively.

In assessing the 2022 value, it is important to consider the allocation of effort on the basis of where a certain vessel operates, rather than where it is registered. For example, the large reduction in effort in GSA16 is mainly since vessels from GSA16 operate on fishing grounds located in other GSAs (both Italian GSAs, e.g., GSA10, as well as EU and non-EU GSAs).

The 2017 values for some GSAs had to be cross-checked as they did not appear to be reliable. On the basis of these considerations, the percentage of variation has been calculated for the period 2018-2021 (Table 1.3.1).

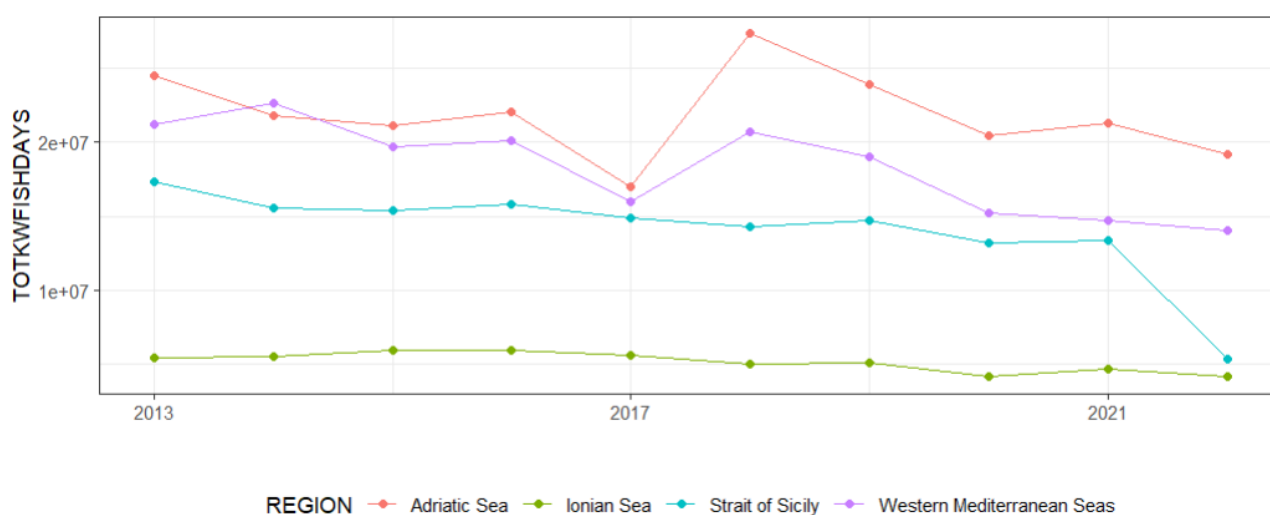


Figure 1.3.1. Trend of effort as kW per fishing days of the trawlers working in the four main MAPs areas

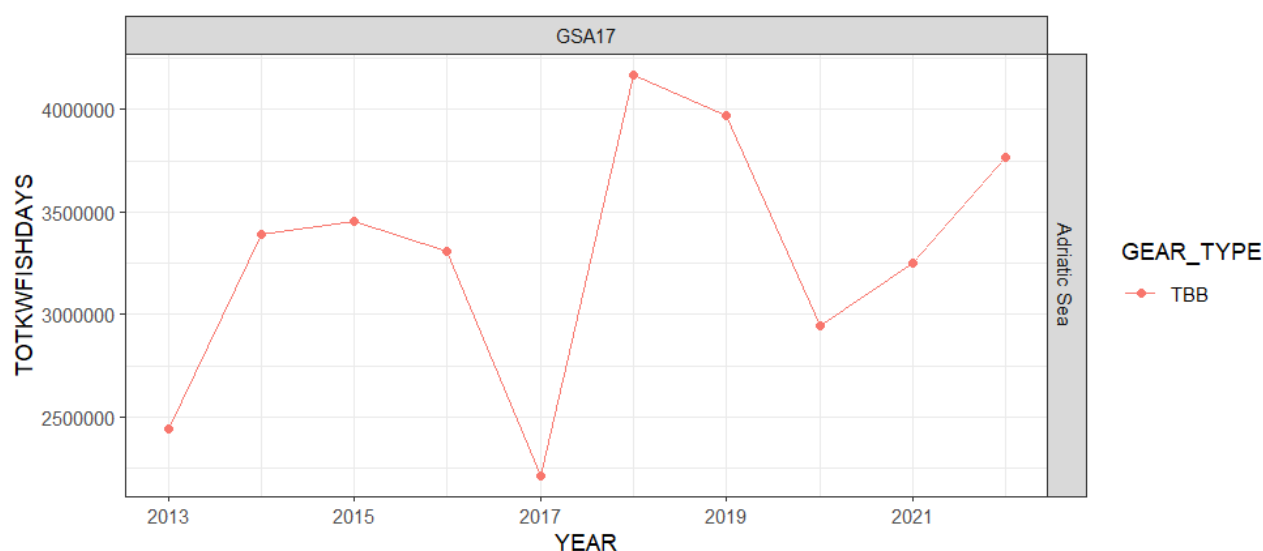


Figure 1.3.2. Trend of effort as kW per fishing days of the beam trawlers (TBB) working in GSA17 (Adriatic Sea)

The effort in the last years is decreasing (Table 1.3.1). The percentage of variation in OTB effort ranged between a minimum of ~6% in GSA19 to a maximum of ~40% in GSA10. TBB effort decreased of about 22%.

Table 1.3.1. Percentage of variation of effort in terms of kW per fishing days between 2018 and 2021 by gear, region and sub-region.

REGION	SUB_REGION	GEAR_TYPE	2018	2021	Percentage of variation
Western Mediterranean Seas	GSA9	OTB	9433330	7851962	-16.76
Western Mediterranean Seas	GSA10	OTB	6086938	3649130	-40.05
Western Mediterranean Seas	GSA11	OTB	5150298	3219417	-37.49
Strait of Sicily	GSA16	OTB	14332184	13340251	-6.92
Adriatic Sea	GSA17	OTB	17273487	14376762	-16.77
Adriatic Sea	GSA18	OTB	10054147	6886452	-31.51
Ionian Sea	GSA19	OTB	5003916	4702531	-6.02
Adriatic Sea	GSA17	TBB	4170379	3251462	-22.03

1.4 Trend in economic indicators and reference points

The specific objective of the Management Plan with regard to economic sustainability is to promote a profitable fishing industry; this objective consists of:

1. Improving the long-term viability of the fishing fleet
2. Maintaining current revenues above break-even revenues

The following economic indicators are used for the evaluation of the management measures of the Management Plan:

Net Profit Margin (NPM):

The Net Profit Margin is an indicator of long-term profitability, given by the ratio between net profit and revenues. The indicator represents how much of the revenue generated by the fleet is converted into profit.

An indicator above 10% is commonly considered an index of high profitability. A value between 0 and 10% reflects insufficient profitability; a net profit margin of less than 0 denotes a loss (STECF, 2023).

CR/BER:

The break-even revenue (BER) is the revenue required to cover both fixed and variable costs so that no losses are incurred and no profits are generated. The current revenue (CR) is the total operating income of the fleet segment, which consists of income from landings and non fishing income. The ratio between a fleet's current revenue and break-even revenue shows how close the current revenue of a fleet is to the revenue required for the fleet to break even in the short term. If the ratio is greater than 1, then enough income is generated to cover variable, fixed and capital costs, indicating that the segment is profitable, with potential undercapitalisation. Conversely, if the ratio is less than 1, insufficient income is generated to cover variable, fixed and capital costs, indicating that the segment is unprofitable, with potential over-capitalisation. If the CR/BER result is negative, this means that variable costs alone exceed current revenue, indicating that the more revenue is generated, the greater the losses will be (STECF, 2023).

Table 1.4.1 - Economic objectives, indicators and reference points.

Economic objective	Specific objectives	Indicators	Reference Points (RP)
Promoting a Profitable Fishing Industry	Improving the profitability of the fishing fleet	NPM	$\text{NPM} \geq 10\%$
	Maintaining current revenues above break-even revenues	CR/BER	$\text{CR/BER} \geq 1$

The trend of economic indicators in the period 2013-2022 is shown in the following figure 1.4.1.

Western Mediterranean Seas

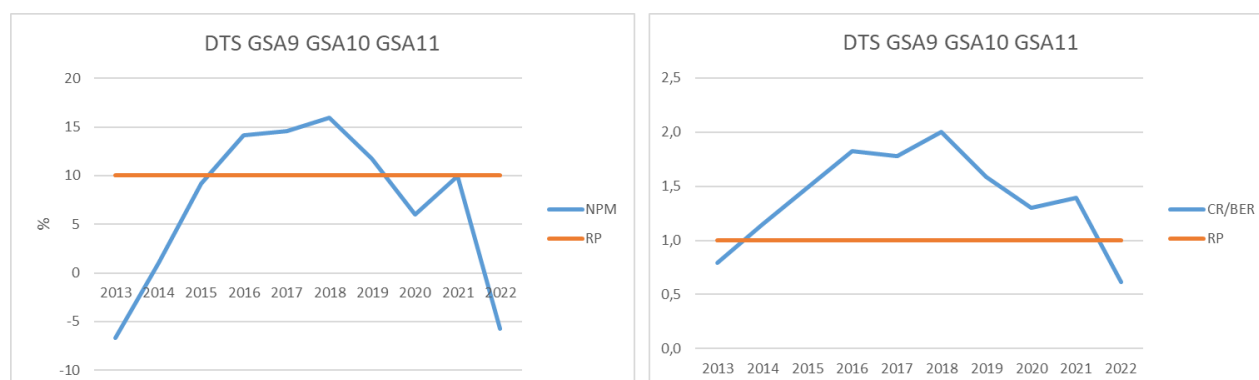
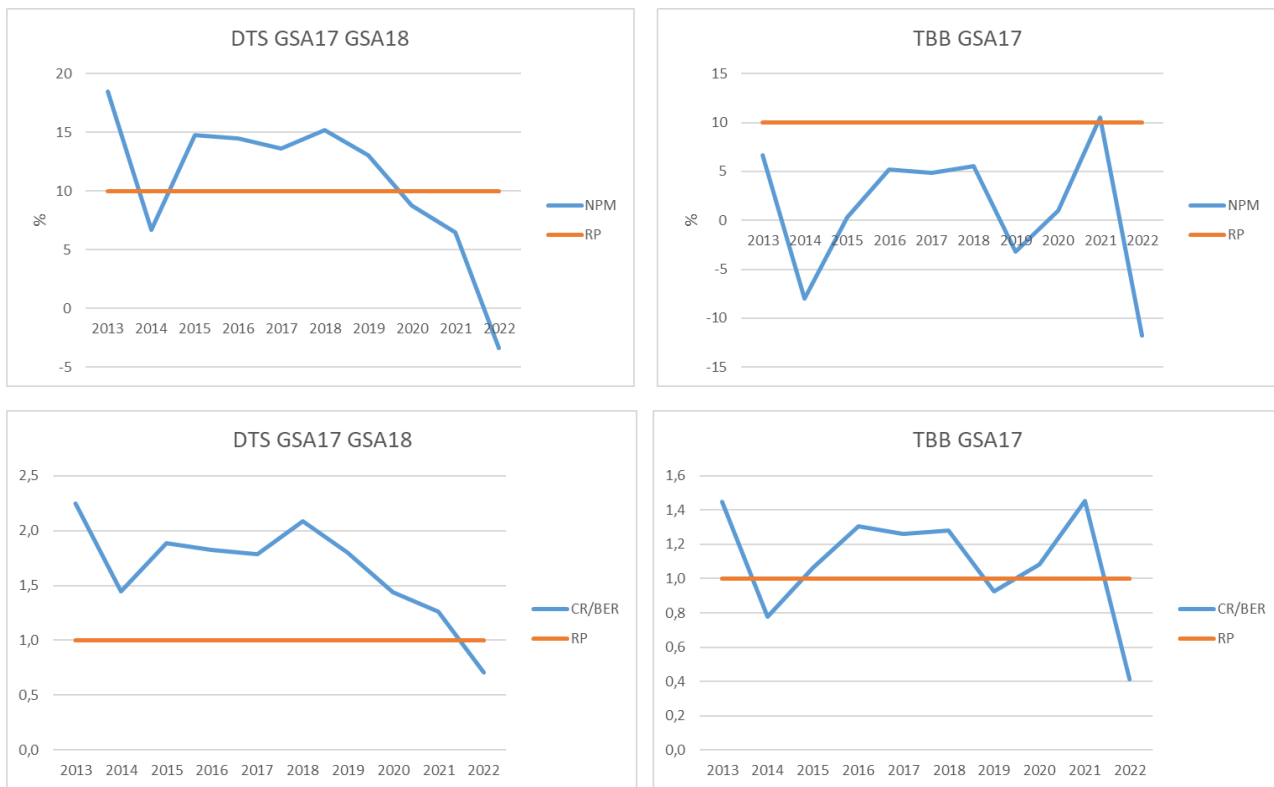
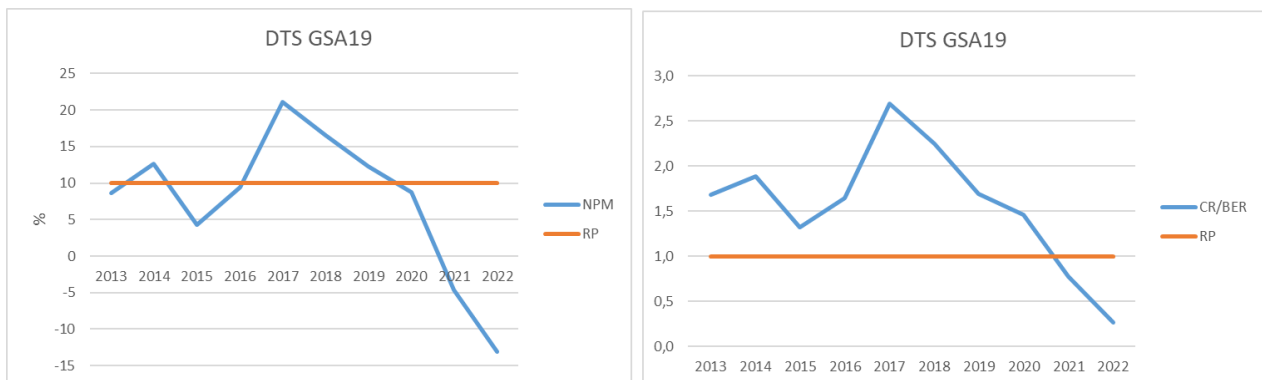


Figure 1.4.1 - Continues

Adriatic Sea



Ionian Sea



Strait of Sicily

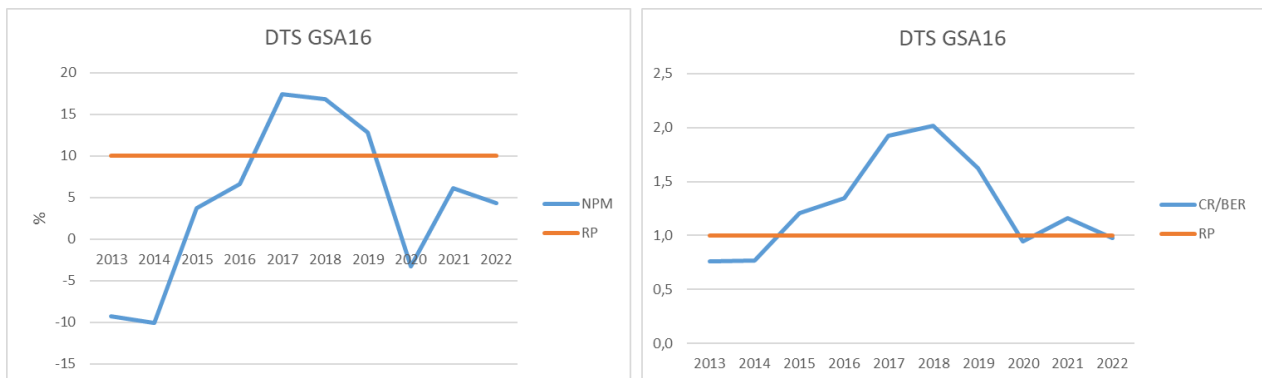


Figure 1.4.1 - Performance of the Net Profit Margin and current revenues on break-even revenues (CR/BER) for the fleet segments covered by the Management Plans, years 2013-2022.

1.5 Trend in social indicators and reference points

In relation to the social dimension, the specific objective of the Management Plan is the reduction of the social impact deriving from the contraction of the fishing effort; this objective consists of:

1. maintaining the current Gross Value Added by employment
2. maintaining of the current level of employment expressed as a function of FTE (*Full Time Equivalent*)

The indicators proposed for the quantification of the following objectives are the following (Table 1.5.1):

Gross Value added (GVA) per FTE (GVA/FTE):

Labour productivity is defined as output per unit of labour and it is calculated as Gross Value Added (GVA) per unit of labour input. Labour productivity can be used as a measure of economic growth, competitiveness, and living standards within a sector. An increase in labour productivity indicates that a unit of input labour is producing more output or that the same amount of output is being produced with fewer units of labour. Labour productivity may also be used as a proxy of worker's wellbeing or living standards, assuming that increases in productivity are matched by wage increases (STECF, 2018). In addition to this, this is much more valid for the Italian fishing sector where most of the wages are based on the share system and the share is a fraction of the GVA. The threshold value is the average value from the last three years (2020-2022) for each fishing segment.

Number of fishermen in Full Time Equivalent (FTE) units:

The FTE is the unit of measure equivalent to one person working full-time, based on the national reference level for crew members' working hours on board the vessel (excluding rest time) and for shore working hours. If the annual working hours per crew member exceed the reference level, the FTE equals 1 for each crew member. Otherwise, the FTE corresponds to the ratio of hours worked to the reference level. The threshold value is the average value from the last three years (2020-2022) for each fishing segment: an FTE equal to or greater than the threshold value indicates a situation of maintaining current employment levels. An FTE not exceeding 20% below the average FTE indicates an acceptable situation. Conversely, an FTE more than 20% below the average FTE from 2013-2015 implies a negative situation with significant social impacts. When a management measure that consists of a reduction in fishing effort is implemented, a proportional reduction in employment is expected; in the medium term, the improvement in the sector's profitability should allow for a recovery in employment levels.

Table 1.5.1 - Social objectives, indicators and reference points.

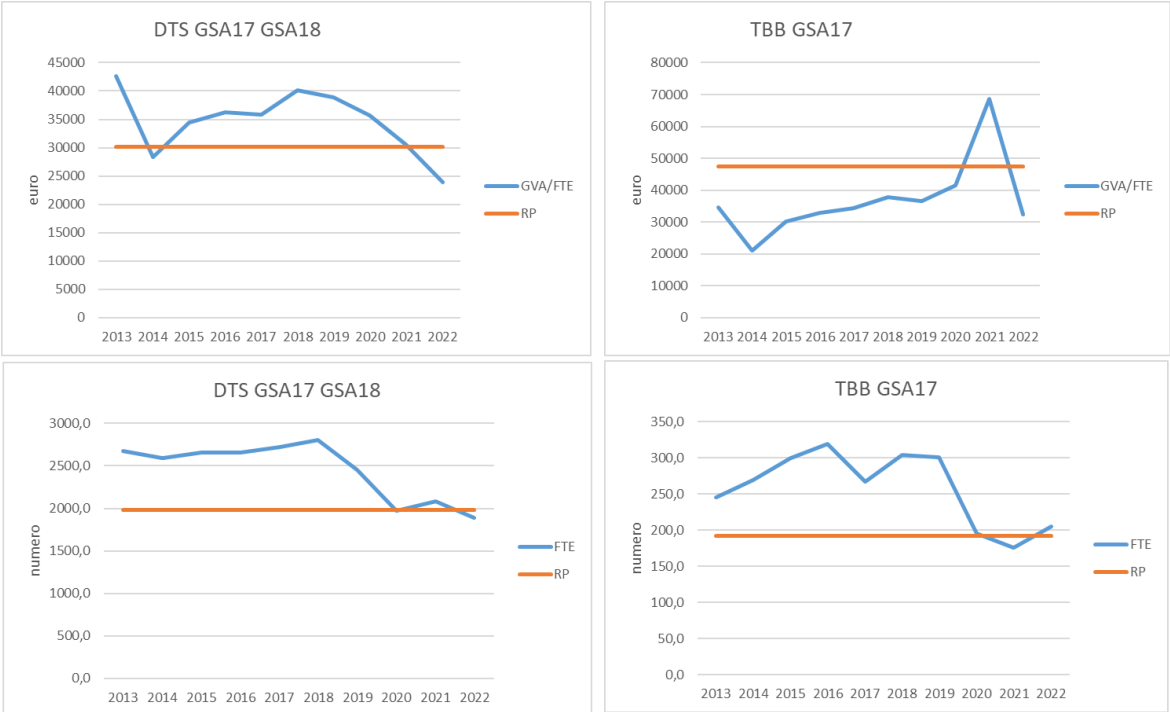
Social objective	Specific objectives	Indicators	Reference points
Reduction of social impact deriving from the reduction of the fishing effort	Maintaining current GVA by employment levels	GVA/FTE	Gross value added by FTE at least equal to the average value of the last 3 years 2020-2022
	Maintaining current FTE employment levels	FTE	Number of fishermen in FTE at least equal to the average value of the last 3 years 2020-2022

The trend of social indicators in the period 2013-2022 is shown in the following figures. (Fig. 1.5.1).

Western Mediterranean Seas



Adriatic Sea



Ionian Sea

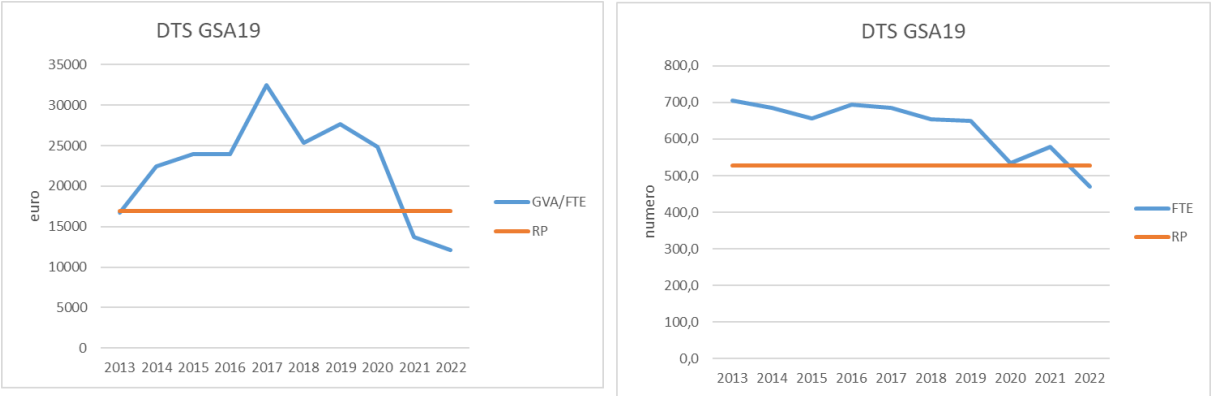


Fig. 1.5.1 – Continues.

Strait of Sicily

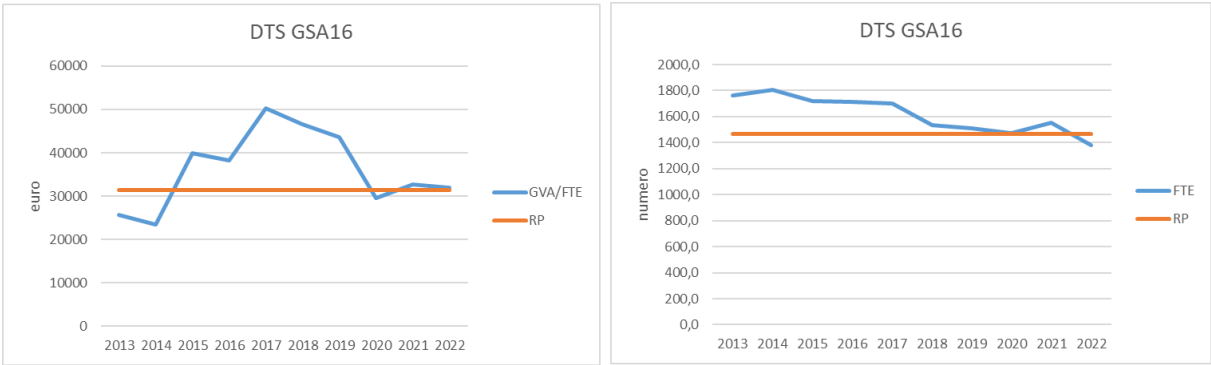


Fig. 1.5.1 Gross Value added by FTE and Number of fishermen in FTE for the fleet segments covered by the Management Plans, years 2013-2022.

2 METHODOLOGY

The MAP is based on several biological and socio-economic simulations based on fishing effort reduction, which aim to support decision-making on fishing management policies, balancing ecological sustainability with economic and social objectives.

2.1 Biological data

Data (stock objects and reference points) are gathered from STECF EWG 23-09 (STECF 2023a), STECF EWG 23-12 (STECF 2023b), GFCM Working Group on Stock Assessment of Demersal species (WGSAD) (GFCM, 2023), benchmark sessions for Red mullet (GFCM, 2024a) and European hake (GFCM, 2024b) done by WGSAD in 2024. Most of these stock assessments (with the exception of common sole in GSA 17, red mullet and European hake in GSAs 17-18, giant red shrimps, red mullet and Deep water rose shrimps in GSAs 12-16) are based on models fitted on survey time series ending in 2021 and updated to 2022 based on deterministic catch projections. The methodology used to implement the biological analysis is available at: https://github.com/CNRFisheries/MP_forecasts

2.1.1 Forecasting settings and scenarios

The main forecast settings are:

- Forecasts start in 2025
- F status quo (F_{sq}) is defined as the F_{bar} observed in the last year of assessment (2022)
- F weak (F_{weak}) is defined as $F_{bar} * Reduction_{weak}$, where $Reduction_{weak}$ is the lower F_{01}/F_{sq} observed in the area. This scenario is particularly useful in mixed fisheries, where multiple stocks are targeted by Italian trawlers.
- 2023 and 2024 are intermediate year, where $F_{year} = F_{sq}$ for each scenario.
- F reductions are only applied to Italian trawlers (also Italian beam trawlers in the case of common sole in GSA 17).
- Scenarios are applied as gradual reduction over the period 2025-2027, with the exception of those stock assessments based on the SPiCT model whose scenarios were implemented as unique reductions in 2025.
- 2028-2030 are maintained equal to F values for 2027. Monitoring activities are planned for this period in the case the F values are still above F_{MSY} proxies and further reduction in F are needed.

Stock objects setting used in forecast period are:

- Biological quantities (recruitment, weight, maturity) used for forecast are the mean of 2019-2021.
- Stock-Recruitment relation used is geometric mean for the period 2019-2021.
- Stochastic forecasts in the a4a model are implemented by adding residuals to the expected recruitment (age 1).
- Recruitment residuals in the a4a model were $\sim \text{Lognormal}(\mu, \sigma^2)$, where $\mu = 0$ and σ^2 is the CV of the observed recruitment (entire time series)

Scenarios are:

- F status quo (F_{sq} fixed up to 2030)
- Fmsy transition: $F_y = a_y * F_{sq} + (1 - a_y) * F_{01}$, where $\mathbf{a}$ is a vector of linear change.

- F weak: $F_y = a_y * F_{sq} + (1 - a_y) * F_{weak}$, where $\mathbf{a}$ is a vector of linear decrease. This scenario simulates the effect of implementing to all stocks the same % reduction needed to reach F_{01} for the stock having the largest F_{sq}/F_{01} in 2022
- Gradual reduction, 3% per year: $F_{y+1} = F_y * 0.97$
- Gradual reduction, 5% per year: $F_{y+1} = F_y * 0.95$

In the forecast scenarios, any changes to F have been applied exclusively to Italian trawlers. It is important to emphasize that if a stock is shared with other countries, as in the case of Adriatic and Strait of Sicily stocks, or is fished using gear types other than trawlers, as in the case of European hake in Tyrrhenian Sea, the fishing mortality rate (F_y) has been divided by fleet.

In the case of stock assessment model implementing aggregated fishing mortality (a4a, SPiCT, JABBA), F_y has been apportioned based on the mean proportion observed in 2020-2022 catches (see table below). The source of information for catch data was the FDI 2023 data call, available at https://stecf.ec.europa.eu/data-dissemination/fdi_en

In the case of SS3 model, F_y is explicitly modeled by fleet, and therefore no further elaboration was necessary to obtain partial F values.

Mean catches proportion by country and gear in 2020-2022. Source: FDI data call 2023.

			Countries					
Species	area	Gear type	Croatia	France	Greece	Tunisia	Malta	Italy
Aristeomorpha foliacea (ARS)	18_19_20	OTB			0.078			0.909
	9_10_11	OTB						0.998
	12_13_14_15_16_21	OTB				0.115	0.04	0.845
Parapenaeus longirostris (DPS)	17_18_19_20	OTB	0.184					0.804
	8_9_10_11	OTB						0.992
	12_13_14_15_16					0.734	0.01	0.256
Merluccius merluccius (HKE)	19	GNS						0.043
		GTR						0.043
		LLS						0.187
		OTB						0.726
	8_9_10_11	GNS						0.273
		GTR						0.076
		LLS						0.135
		OTB		0.013				0.496
	12_13_14_15_16	OTB				0.687	0.01	0.22
		GNS;GTR;LLS				0.013		0.07
Mullus barbatus (MUT)	9	GNS						0.017
		GTR						0.03
		OTB						0.948
	10	GNS						0.04

		GTR						0.117
		OTB						0.837
	19	GNS						0.15
		GTR						0.209
		OTB						0.641
	16	OTB						1
Norway lobster (NEP)	9	OTB						0.999

2.1.2 Stock Selection

The stocks analyzed in the following section are the primary focus of MAPs. In the case of the Adriatic Sea, the stock of Norway lobster (NEP17-18) was not analyzed because the assessment was deemed qualitative only, by the WGSAD in 2023 (GFCM, 2023).

2.1.3 Spatial effort displacement

Maps of the fishing trawl effort for the period 2018–2020 are also presented for each basin to provide a better understanding of the spatial distribution of fishing effort, which has contributed to the current status of the stocks.

The analysis was based on terrestrial AIS (t-AIS) data, provided by a private provider (<http://www.astrapaging.com/>) and owned by CNR-IRBIM, covering the entire Mediterranean basin over three years (2018–2020). The t-AIS data were characterized by a polling frequency of five minutes and included both EU and non-EU fleets (AIS type = 30). The table below summarizes the main statistics of the t-AIS dataset used for each year.

CNR-IRBIM t-AIS dataset and main statistics by year (coverage: Mediterranean basin)

Year	num. AIS messages	num. fishing vessels
2018	52,803,147	4761
2019	55,142,088	4509
2020	56,809,903	4533

The R4AIS workflow (Galdelli et al., 2021), developed on historical annotated data of the Adriatic Sea, was used to process AIS data. The workflow enhanced in recent experiments (Coro et al., 2022; Pulcinella et al., 2023), classify data on a monthly basis according to five predefined gear classes: bottom trawl, pelagic trawl, beam trawl, purse seine, and “other” fishing (including dredges and passive gears). Detailed steps of the workflow are synthesized below:

1. Fishing trip identification: consecutive AIS records for each unique Maritime Mobile Service Identity (MMSI) are splitted into individual trips, from the time a vessel leaves a port to the time it returns to a port.

2. Classification wrapper: a cascade of classification algorithms (k-means and dbscan) is applied to each fishing trip. Thus, each AIS signal is labelled with an activity type.
3. Decision gear: on a monthly basis a Random Forest is applied to assign the gear deployed in the month. Possible cases are bottom trawl, beam trawl, pelagic trawl, purse seines and others.
4. Identification of fishing points: the labelling performed in the classification wrapper is refined according to the gear predicted by the Random Forest.
5. Fishing tracks retrieve: fishing points are formatted into spatial objects. For towed gears (OTB, TBB, PTM) the output is presented as segments representing fishing tracks while for PS the output is composed of points representing the centroid of the fishing activity. The OTHER category do not produce an output.

Fishing tracks of bottom trawlers (OTB) were extracted and intersected with a 0.05° grid (~5km) in order to compute durations of each feature. Finally, data were aggregated to obtain yearly fishing effort layers for bottom trawl at 0.05° resolution.

2.2 Socio-economic data

The socio-economic component of the model is primarily aimed at simulating the dynamics of prices and costs. It also includes equations to estimate catches and total revenues from the simulated values for the target species.

The model can also estimate several economic and social indicators. The equations used by the model for estimating prices, costs and socio-economic indicators are described below.

Before proceeding with the description of the proper economic components, the link between catches and fishing mortality estimated through biological models on the one hand and landed and fishing effort exerted by the fleet segments and used in the economic model on the other is reported.

2.2.1 Relationships between fishing mortality and nominal effort

The nominal effort is expressed in terms of fishing days. The fishing days of the different fleet segments cannot simply be added up and related to fishing mortality as these represent, compared to the catches of the specific stock, non-comparable measures.

The main differences between the effort measures of different fleet segments with respect to the impact on a particular stock are represented by:

1. different productivity;
2. different selectivity.

To overcome the problem of different productivity, it is possible to calculate an equivalent measure of effort, i.e. a homogeneous measure in terms of productivity. Taking the particular fleet segment k as a productivity reference (in the model the most relevant segment in terms of catch has been used for each stock), the equivalent effort of the other fleet segments will be given by the following equation:

$$Eq_i = \frac{CPUE_i}{CPUE_k} E_i,$$

where CPUE represents catches per unit effort, E the fishing effort expressed in days, i the generic fleet segment and k the reference segment.

Clearly, the equivalent effort for fleet segment k will be equal to its nominal effort.

Once the equivalent effort for each fleet segment has been calculated, it can be added up and compared with fishing mortality. A proportional relationship between the two entities can therefore be assumed, so that percentage changes in fishing mortality can be obtained by means of variations of the same magnitude in the total equivalent effort. In addition to defining the link between fishing mortality and fishing effort, the division of the equivalent effort between the different fleet segments also allows the total catches per species to be proportionally distributed among the different fleet segments. The catch by species is then allocated among the fleet segments on the basis of their equivalent effort share:

$L_f = \frac{Eq_f}{\sum_{i=1:m} Eq_i} L$, where L represents the total catch of a particular species, L_f the catch share of fleet segment f , Eq_f the equivalent effort of fleet segment f .

Finally, catches by species and fleet segment are subject to a constraint that prevents an excessive increase. This constraint is inserted to take into account technical aspects not considered in the biological model. The biological model estimates production based on biomass and fishing mortality. Considerable increases in biomass at sea can be translated by the biological model into increases in catches that are incompatible with the size of the vessels and/or with the technical time required to take on board these quantities of catch. The constraint is calibrated taking into account the maximum values of daily catches per vessel recorded in the period 2015-2022.

2.2.2 Price dynamics

Prices are estimated for each species and fleet segment on the basis of commercial catch. The functional relationship between prices and catches by fleet segment and species is defined by a flexibility coefficient according to the following equation:

$$p_{s,f,t} = p_{s,f,t-1} \left(\frac{L_{s,,t}}{L_{s,,t-1}} \right)^{\varepsilon_s},$$

where

$p_{s,f,t}$ is the price of the species s captured by fleet segment f at time t ;

$L_{s,,t}$ is the total catch of species s at time t ;

ε_s is the coefficient of flexibility between price and catches for species s .

The flexibility coefficients applied in the management plans have been assumed to be -0.2; a value based on previous market analysis.

2.2.3 Total revenues and total catches

For each combination of target species and fleet segment, revenues are calculated by multiplying the related production, estimated using the biological sub-model, by the prices. The remaining share of landing, both in weight and value, is estimated on the basis of linear relationships with the values obtained for the target species:

$$R_{f,t} = rr_f \sum_{s=1:n} R_{f,s,t},$$

$$L_{f,t} = ll_f \sum_{i=1:n} L_{f,i,t},$$

where

$R_{f,t}$ is the total revenue of all species (target species and other species) of fleet segment f at time t;

$R_{f,s,t}$ is the revenue related to the target species s from fleet segment f at time t;

$L_{f,t}$ is the total catch of all species (target species and other species) of fleet segment f at time t;

$L_{f,s,t}$ is the catch related to the target species s from fleet segment f at time t;

rr_f is a correction factor for fleet segment f used to estimate total revenues from the revenues of the target species;

ll_f is a correction factor for the f fleet segment to estimate total production by weight from the landing of the target species.

2.2.4 Cost dynamics

The costs relating to each fleet segment are divided into the following four items:

1. variable costs,
2. fixed costs,
3. capital costs,
4. labour costs.

Variable costs are divided into fuel costs, commercial costs and other variable costs.

While the costs of FuC fuel and the "other variable costs" OVC are estimated as a function of fishing effort E expressed in number of days at sea, commercial CoC costs are a function of revenues. For variable costs, the model uses the following equations:

$$FuC_{f,t} = \alpha'_f E_{f,t},$$

$$OVC_{f,t} = \beta'_f E_{f,t},$$

$$CoC_{f,t} = \alpha''_f R_{f,t},$$

where

$FuC_{f,t}$ are the fuel costs for fleet segment f at time t;

$OVC_{f,t}$ are the other variable costs for fleet segment f at time t;

$E_{f,t}$ is the effort (expressed in terms of annual fishing days) of fleet segment f at time t;

$CoC_{f,t}$ are the commercial costs for fleet segment f at time t;

$R_{f,t}$ is the total revenue of all species (target species and other species) of fleet segment f at time t;

α'_f is the fuel cost per unit effort of fleet segment f;

β_f' are the other variable costs per unit of effort of fleet segment f;

α_f'' are the commercial costs per euro of revenue produced by the fleet segment f.

Fixed costs, divided into MC maintenance costs and OFC "other fixed costs", are simulated assuming a proportional relationship with the total GT of the fleet segment. The model uses the following equations:

$$MC_{f,t} = \alpha_f'' GT_{f,t},$$

$$OFC_{f,t} = \alpha_f' GT_{f,t},$$

where

$MC_{f,t}$ are the maintenance costs for fleet segment f at time t;

$OFC_{f,t}$ are the "other fixed costs" for fleet segment f at time t;

$GT_{f,t}$ is the gross tonnage of fleet segment f at time t;

α_f' are the other fixed costs per unit of GT in the fleet segment f;

α_f'' are the maintenance costs per GT unit of the fleet segment f.

Capital costs, divided into DC depreciation expenses and OC opportunity cost, are estimated using the following equations:

$$DC_{f,t} = \beta_f' GT_{f,t},$$

$$OC_{f,t} = \left(\frac{(1+r_t)}{(1+i_t)} - 1 \right) CV_t \text{ con } CV_{f,t} = \beta_f'' GT_{f,t},$$

where

$DC_{f,t}$ are the depreciation costs for fleet segment f at time t;

$OC_{f,t}$ are the opportunity costs for fleet segment f at time t;

$CV_{f,t}$ is the value of the capital of the vessels belonging to fleet segment f at time t;

$GT_{f,t}$ is the gross tonnage of fleet segment f at time t;

β_f' are the depreciation costs per GT unit of fleet segment f;

β_f'' is the capital value per unit of GT of fleet segment f;

r_t is the interest rate on 10-year multi-year treasury bonds calculated for year t;

i_t is the rate of inflation at time t.

The cost of labour depends on the employment contract used in the specific fishery sector. Generally, the "share contract" is the prevalent system in Italian fisheries. This contract calculates the crew remuneration by a division of revenues, after deduction of variable costs, between the owner and the crew. Given the predominance of this contract, the cost of labour is estimated by the model by applying the crew's share to the difference between total revenues and variable costs.

The equation used in the model for labour cost estimation can be expressed as follows:

$$LC_{f,t} = cs_f(R_{f,t} - VC_{f,t}),$$

with

$$VC_{f,t} = FuC_{f,t} + CoC_{f,t} + OVC_{f,t},$$

where

$LC_{f,t}$ is the labour cost for fleet segment f at time t;

$R_{f,t}$ are the total revenues (target species + other species) of fleet segment f at time t;

$VC_{f,t}$ are the total variable costs for fleet segment f at time t;

$FuC_{f,t}$ are the fuel costs for fleet segment f at time t;

$CoC_{f,t}$ are the commercial costs for fleet segment f at time t;

$OVC_{f,t}$ are the other variable costs for fleet segment f at time t;

cs_f is the share of revenues (after deduction of variable costs) for the crew for fleet segment f.

2.2.5 Socio-economic indicators

Among the economic indicators estimated by the model, particularly important for the analysis are added value, profit, the ratio between current revenues and break-even revenues, and RoFTA. From a social point of view, the indicators used in the analysis are the number of employed people and the average wage.

The following are the equations used by the model to estimate the above indicators.

GVA added value is obtained by subtracting CV variable costs and FC fixed costs from total revenues:

$$GVA_{f,t} = R_{f,t} - VC_{f,t} - FC_{f,t},$$

where $FC_{f,t} = MC_{f,t} + OFC_{f,t}$.

Subtracting the cost of labour from the GVA also gives the GCF gross cash flow; while the profit is obtained by subtracting from the GVA both the LC labour cost and the CC capital costs:

$$GCF_{f,t} = GVA_{f,t} - LC_{f,t}$$

$$\Pi_{f,t} = GCF_{f,t} - CC_{f,t},$$

where $CC_{f,t} = DC_{f,t} + OC_{f,t}$.

The ratio between current revenues and break-even revenues is an indicator of economic efficiency that measures the ability of a company to cover operating costs with the revenues. For an economic activity to be economically efficient, the indicator must be greater than 1. This ratio requires the calculation of the break-even value BER:

$$BER_{f,t} = \frac{OFC_{f,t} + DC_{f,t} + OC_{f,t}}{1 - \frac{LC_{f,t} + VC_{f,t} + MC_{f,t}}{R_{f,t}}}$$

Another widely used indicator of economic efficiency is the RoFTA (Return on Fixed Tangible Assets), calculated as the ratio between the net profit $N\Pi$ and the value of the CV capital:

$$ROFTA_{f,t} = \frac{N\Pi_{f,t}}{CV_{f,t}},$$

where the value of capital is obtained by multiplying the average value of a unit of GT by the total GT of the fleet segment:

$$CV_{f,t} = \beta_f'' GT_{f,t}$$

Regarding the social indicators, the number of EM employees is obtained by multiplying the average number of employees per boat by the number of boats and the average wage is calculated by dividing the cost of labour by the number of employees:

$$EM_{f,t} = em_f N_{f,t},$$

$$W_{f,t} = \frac{LC_{f,t}}{EM_{f,t}},$$

where

em_f is the average number of employees per boat for the fleet segment f;

$N_{f,t}$ is the number of vessels belonging to fleet segment f at time t.

The level of employment is also calculated in terms of Full Time Equivalent (FTE). This indicator is estimated by the model as the minimum value between the number of employees and the total number of hours worked divided by 1600 (conventional hours for a full-time work):

$$FTE_{f,t} = \min\left(EM_{f,t}, \frac{fte_f}{1600} EM_{f,t} \frac{DD_{f,t}}{N_{f,t}}\right),$$

where the product of the EM employees and the average days of fishing per vessel (given by the ratio between DD and N) is used to calculate the total days worked in the year t. The fte coefficient, on the other hand, measures the hours worked per day. The product of these two quantities produces the total number of hours worked, which, divided by the number of hours resulting in an FTE at national level, allows the number of FTEs per fleet segment to be estimated.

The relationship between labour costs and the FTE makes it possible to calculate an additional social indicator, namely the average wage per full-time worker; while the ratio between gross value added and FTE expresses a measure of labour productivity.

3 RESULTS

According to the results of the simulations it is possible to conclude that from both a biological and socio-economic perspective, the 3% of effort reduction scenario for bottom otter trawlers (OTB) emerges as the most advisable strategy for effort reduction.

Indeed:

- i) **Biological Outcomes:** The scenario offers a gradual transition to sustainable fishing without jeopardizing stock recovery.
- ii) **Economic and Social Impacts:** It mitigates the risks of profit loss and unemployment compared to more aggressive measures.
- iii) **Long-Term Alignment:** This scenario aligns with national and EU sustainability goals, balancing ecological health with economic livelihoods.

Below are just summarized the main results observed running the different simulations based on the 5 scenarios hypothesized. For more details, plots and tables please refer to **Annex I – Biological results** and **Annex II – Socio Economic results**

Biological Simulations:

- Various effort reduction scenarios were modeled, including gradual reductions of 3% and 5% annually, status quo maintenance, and a transition towards FMSY (Maximum Sustainable Yield).
- In relation to the bottom otter trawl fleets (OTB), the 3% annual reduction scenario demonstrates **balanced biological benefits** across stocks, effectively maintaining spawning stock biomass (SSB) levels and contributing to long-term sustainability, without drastic disruptions to fishing activities. It is important to stress that in cases where the 3% reduction is not enough for specific stocks with high level of overfishing, further management measures, as capacity reduction envisaged not only on trawl fleets and spatio-temporal closures of trawling activity, would support the achievement of sustainable exploitation in 2030.
- For the beam trawl fleet (TBB) operating in GSA 17 and primarily targeting common sole, maintaining the current status is recommended. This advice is based on the fact that common sole in this area is not in overfishing, and the spawning stock biomass (SSB) is showing an upward trend. Furthermore, the GFCM recommendations GFCM/46/2023/6 and GFCM/45/2022/8 do not propose any reduction in fishing days for the current fleet.

Socio-Economic Simulations:

- The socio-economic model assesses the impact of different scenarios on profit margins, current revenue on break-even revenue (CR/BER), employment (FTE), and labor productivity (GVA/FTE). It emphasizes that economic sustainability is contingent on maintaining a balance between reduced fishing efforts and acceptable profitability levels.
- The 3% effort reduction scenario (S1) shows **manageable socio-economic impacts**, preserving employment levels and economic viability better than the more aggressive 5% reduction or the FMSY transition.

4 GOVERNANCE and SAFEGUARDS

The implementation of the Management Plan will be ensured by the definition of a governance structure, where the roles and responsibilities relating to the management, supervision and monitoring activities in the execution of the Plan are defined and agreed. The governance structure is inspired by the most recent approaches in terms of co-management and responsive management (Sampedro et al., 2017; Silva et al, 2015; Ecofishman project) demonstrating that it widely involves stakeholders in the management, control and monitoring phases.

In parallel with the adoption of the decree approving the Plan or just after, the implementing body of the Plan (IBP) will be appointed (which may take the form of a Consortium and may be made up of representatives of the main recipients of the Plan, e.g. trade associations and/or POs); it is responsible for the coordination, management and administration functions. The IBP will play the role of filtering between the central administration (MASAF), the Scientific Body responsible for the monitoring, and the recipients of the Plan, i.e. the producers (shipowners and/or fishers), who will have to implement the measures. The monitoring activities will play a fundamental role in the governance of the Plan and will be aimed at verifying the results obtained from the implementation of the proposed measures. In this regard, it is essential that the Administration (MASAF) identifies, at the same time as the adoption of the decree approving the Management Plan, the body responsible for monitoring (Scientific Body; SB).

The designated scientific body will be responsible for monitoring the indicators - identified in the Plan as being able to provide a measure of the Plan's objectives - and for producing reports on the progress/implementation of the Plan. For details on the contents of the monitoring activities, please refer to the following paragraph. The Scientific Body will monitor and update the results of the plan through the results of the scientific analysis carried out at GFCM and STECF level.

Figure 4.1 illustrates the bodies and parties involved, the roles and the flow of information that will characterize the governance structure of this Management Plan.

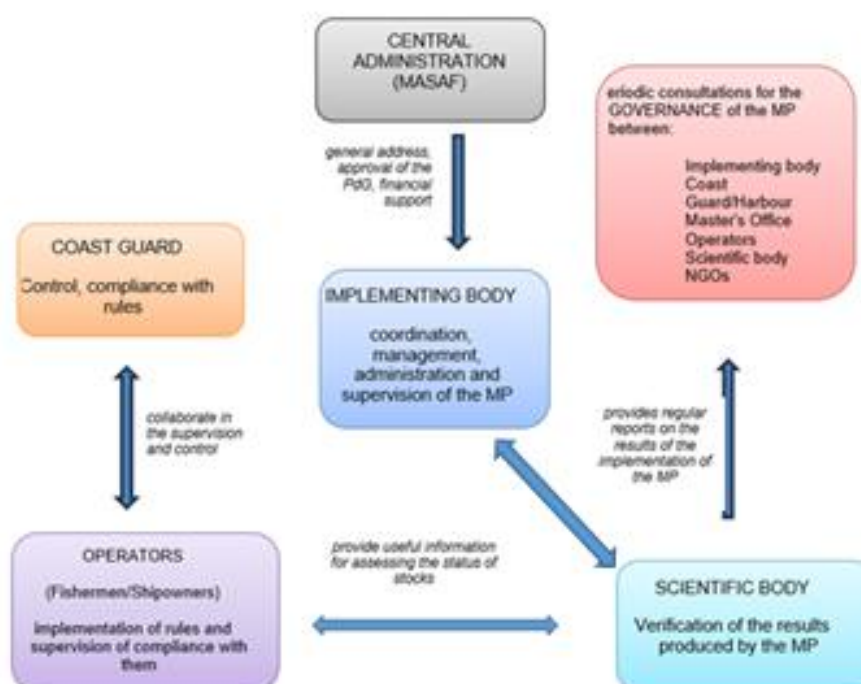


Figure 4.1 - Management Plan (MP) governance structure.

The general governance of the Management Plan will be ensured by periodic consultations with representatives of all stakeholders, with the sole objective of achieving the general and specific objectives defined by the Plan itself. To this end, once the main actors (implementing body, scientific body, etc.) have been identified and appointed, governance will be ensured by periodic consultations, coordinated by the implementing body.

The following will be of fundamental importance: an initial consultation, necessary to start the implementation of the Plan and aimed at illustrating, to all interested parties and, in particular, to operators, the main measures adopted by the Plan. Their feedback will be essential to promptly take note of any detachment of the Plan from the reality of the sector and the emergence of situations of non-acceptance and compliance of the measures envisaged (fundamental for the effectiveness of the Plan and the achievement of the objectives); an intermediate consultation (e.g. 18 months after the actual adoption of the Plan), necessary to detect any deviations from the set direction and to give the necessary input for the possible adoption of adjustments to the Plan;

A consultation in the initial monitoring phase: to be carried out during 2028, on the first 3 years of implementation, with data updated to 2027, the last year of the planned effort reductions. This consultation will aim to illustrate the results achieved, any deviations and, if so, any corrective measures to be adopted (for details, please refer to the following paragraphs); a consultation in the final monitoring phase: to be carried out at the end of the period covered by the Plan (2031 on data updated to 2030), to illustrate whether the sustainability situation (positive or negative) achieved in 2027 has been maintained and/or whether changes in direction (worsening and/or improvement) are detected.

As anticipated, the control of the management measures defined by the Plan will be carried out, mainly, by the Coast Guard. The main measures adopted by the Plan to achieve the sustainability objectives concern the management of fishing effort, through the reduction of fishing days in the segments concerned, gradually over the period covered by the Plan. The Coast Guard will also control compliance with the technical measures adopted in the plan, such as spatial and temporal closures.

Where, on the other hand, the application of the reduction of fishing days will concern the suspension of fishing activity in defined periods and areas, the implementation will be carried out after delivery of the navigation logbook to the respective Port Authorities.

5 MONITORING: IMPLEMENTATION AND EVALUATION OF THE RESULTS OBTAINED

The effectiveness and validity of the measures envisaged in the Management Plan must be verified through annual monitoring aimed at:

1. verify the effective application and compliance with the management measures proposed in the Plan;
2. verify the results obtained from the implementation of the Plan;
3. verify the achievement of the management objectives defined by the Plan.

As already mentioned in the previous paragraph (Governance), in this regard, it is essential for the Administration (MASAF) to identify, at the same time as the decree approving the Management Plan, the body responsible (Scientific Body) for monitoring. In the event that it is necessary (for the contents of the activities), monitoring may be delegated to several scientific bodies which must, in any case, be coordinated by a single body (main scientific body).

The Scientific Body will be responsible for conducting the monitoring and production of progress reports (of the implementation of the Plan, in line with the timing of the consultations described below).

As regards point 1), the most appropriate indicators will be identified and monitored to assess compliance with the fishing rules of the Management Plan. In particular, reference will be made to the main types of checks, the number and the outcome of the same.

As regards point 2), the activities will concern the collection of data (through DCF) relating to biological, economic and social indicators, identified, in paragraph 5, as being able to provide a measure of the state of implementation and effectiveness of the measures defined in the Management Plan.

In the phase described in point 3), the data collected in point 2) will be compared with the *identified reference points*.

The monitoring activity referred to in point 2) will take into account the data collected as part of the National Fisheries Data Collection Programme, carried out by the Central Administration in compliance with the Data Collection Framework (DCF) of the European Commission on the subject of fisheries data collection, in place since 2000 and currently regulated by EU Reg. 2017/1004 and the EU MAP multi-year programme (defined by Commission Delegated Decision (EU) 2021/1167 and the Implementing Decision (EU) 2021/1168). The DCF provides for the systematic collection of biological, economic and social data on national fishing resources and fleets.

The National Programme is a useful tool for annually verifying the impact of the Management Plan on the resources and fleets active in the GSAs covered by the Plan, both in biological terms, using the indicators and parameters produced by the stock assessment and in economic and social terms, by the indicators and parameters collected through the economic data module.

On the basis of the provisions of the National Data Collection Programme, starting from 2002, data are available for the Italian fishing fleet shown in Table 5.1.

The National Programme of Data Collection shall therefore ensure the availability of basic data for the calculation of the biological, economic and social indicators necessary to monitor the progress of the Management Plan and the achievement of the objectives.

The results of the monitoring activities will be presented and discussed during the consultations listed in the previous paragraph (Governance), in which all parties involved in the management of the Plan (*stakeholders*) will participate. If there are any discrepancies with respect to what was expected, the Plan will be reformulated and/or corrective measures will be implemented

Table 5.1 - Biological and economic data collected in the National Data Collection Programme for each year and of particular interest for the execution of the Management Plan.

<i>Transversal data</i>	1. Capacity: number of vessels, tonnage, engine power and average age by GSA and fleet segment; 2. Landings: quantity, value and average prices by species, GSA month and fleet segment; 3. Effort: days at sea, fishing days, days*kW, days*GT, by month, GSA and fleet segment.
<i>Socio-economic data</i>	Value of landings, other revenues, subsidies, labour costs, variable costs, fixed costs, depreciation, investments, capital value, employees and FTEs, by GSA and fleet segment
<i>Scientific surveys</i>	MEDITS/SoleMon surveys
<i>Biological sampling</i>	Length and age of catch by species, quarter, fleet segment and geographical area

The information necessary for monitoring the results of the Management Plan (objectives, indicators, source, periodicity and reliability) is detailed in Table 5.2.

Table 5.2 - Indicators for monitoring biological, economic and social objectives.

Objectives	Indicators	Source	Direct availability or estimate	Periodicity
<i>Biological</i>	<i>Fishing mortality or Harvest rate</i>	Scientific surveys	both	Annual
	<i>Spawning stock biomass or total biomass (in absolute or relative values)</i>	Biological sampling		
<i>Economic</i>	Net Profit Margin (NPM)	Socio-Economic data collection	estimation	Annual
	CR/BER		estimation	
<i>Social</i>	GVA/FTE		estimation	Annual
	FTE		direct availability	

With reference to the state of biological resources, the effects of the measures adopted will be evaluated by estimating the abundance indices of the total population, of the spawning stock and of the recruits in relation to internationally defined reference points in the framework of STECF and GFCM.

With reference to the economic and social dimension, the effects of the measures adopted will be assessed by observing and/or estimating certain parameters and/or indicators, which will be compared with.

Economic sustainability will be assessed through the estimation of two indicators, NPM and CR/BER (for the definition of which please refer to paragraph 5), starting from the economic data relating to revenues, operating costs, value and capital costs, collected and immediately made available as part of the National Programme, by GSA and fleet segment. The NPM, calculated on the basis of data from the National Programme, will be compared with a reference value of 10% and on the basis of the range already identified and described in paragraph on description of economic and social indicators and reference points. The assessment of economic sustainability in terms of break-even between current revenues and break-even revenues will be ensured if the value of the CR/BER is equal to or greater than 1.

The sustainability of the measures from a social point of view will instead be assessed by observing the level of the number of jobs expressed in FTE (*Full Time Equivalent*) and by labour productivity, expressed as GVA/FTE. Both indicators will be estimated from the data collected and immediately made available within the National Program, by GSA and fleet segment. Both indicators will be compared with the baseline, estimated, for each fleet segment, as an average over the period 2020-2022.

Any delays in the execution of the Plan and/or failure to pursue the objectives will constitute grounds for review by the Managing Authority. In particular, the results of the scientific monitoring action will be communicated, annually, by the designated scientific body to the central administration, which will analyze the reasons underlying the failure to achieve the objectives envisaged and the possible rescheduling of the interventions (adjustment of the measures, in terms of extent and/or timing).

The tables 5.3 to 5.6 report the monitoring calendar with the indicators to be monitored for the fleet segments covered by the Management Plan for the Tyrrhenian, Adriatic, Ionian and Strait of Sicily.

Table 5.3 - Calendar of objectives for the monitoring of the Tyrrhenian Sea Plan.

Dimension	Specific objectives	Indicators	Stock	Fleet segments (FT_GSA)	Target to 2027 (monitoring carried out in 2028 on data updated to 2026)	Target to 2030 (monitoring carried out in 2031 on data updated to 2029)
Biological	Promoting the sustainable use of target species	<i>F/FMSY ratio</i> <i>Spawning stock biomass (relative or absolute)</i>	<i>HKE GSA 8-9-10-11</i>	<i>DTS_</i>	<i>F ≤ FMSY</i> <i>and</i> <i>SSB ≥ ref point or 66 percentile time series</i>	<i>F ≤ FMSY</i> <i>and</i> <i>SSB ≥ ref point or 66 percentile time series</i>
			<i>DPS GSA 8-9-10-11</i>	<i>DTS</i>		
			<i>ARS GSA9-10-11</i>	<i>DTS</i>		
			<i>MUT GSA9</i>	<i>DTS</i>		
			<i>MUT GSA10</i>	<i>DTS</i>		
			<i>NEP GSA9</i>	<i>DTS</i>		
Economic	Improving the long-term viability of the fishing fleet	NPM			0%<=NPM <=10%	NPM > 10%
	Maintaining current revenues above break-even revenues	CR/BER			CR/BER > 1	
Social	Maintaining the current level of labour productivity (observed value not lower than baseline, average value 2020-2022)	GVA/FTE (€)			26447<=GVA/FTE<=29092	GVA/FTE>29092
	Maintaining the current level of employment in FTE (observed value not lower than baseline, average value 2020-2022)	FTE		DTS_all GSAs	1442<=FTE<= 1586	FTE>1586

Table 5.4 - Calendar of objectives for the monitoring of the Adriatic Sea Plan

Dimension	Specific objectives	Indicators	Stock	Fleet segments (FT_GSA)	Target to 2027 (monitoring carried out in 2028 on data updated to 2026)	Target to 2030 (monitoring carried out in 2031 on data updated to 2029)
Biological	Promoting the sustainable use of target species	<i>F/FMSY ratio</i> <i>Spawning stock biomass (relative or absolute)</i>	<i>HKE GSA 17-18</i>	DTS	<i>F ≤ FMSY</i> <i>and</i> <i>SSB ≥ ref. point or 66 percentile time series</i>	<i>F ≤ FMSY</i> <i>and</i> <i>SSB ≥ ref. point or 66 percentile time series</i>
			<i>DPS GSA 17-18-19-20</i>	DTS		
			<i>MUT GSA 17-18</i>	DTS		
			<i>SOL GSA 17</i>	TBB		
Economic	Improving the long-term viability of the fishing fleet	NPM	DTS TBB_all GSAs	e	0%<NPM <=10%	NPM > 10%
	Maintaining current revenues above break-even revenues	CR/BER			CR/BER > 1	
Social	Maintening the current level of labour productivity (observed value not lower than baseline, average value 2020-2022)	GVA/FTE (€)	DTS_ all GSAs	17	29456<=GVA/FTE<= 32401	GVA/FTE>32401
					47463<=GVA/FTE<= 52210	GVA/FTE>52210
	Maintening the current level of employment in FTE (observed value not lower than baseline, average value 2020-2022)	FTE	DTS_ all GSAs	17	1980<=FTE<= 2178	FTE>2178
					192<=FTE<= 211	FTE>211

Table 5.5 Calendar of objectives for the monitoring of the Ionian Sea Plan

Dimension	Specific objectives	Indicators	Stock	Fleet segments (FT_GSA)	Target to 2027 (monitoring carried out in 2028 on data updated to 2026)	Target to 2030 (monitoring carried out in 2031 on data updated to 2029)
Biological	Promoting the sustainable use of target species	<i>F/FMSY ratio</i>	<i>HKE GSA 19</i>	DTS	<i>F ≤ FMSY</i> <i>and</i>	<i>F ≤ FMSY</i> <i>and</i>
			<i>DPS GSA</i>	DTS		

		Spawning stock biomass (relative or absolute)	17-18-19-20		SSB ≥ ref. point or 66 percentile time series	SSB ≥ ref. point or 66 percentile time series
			MUT GSA 19	DTS		
			ARS GSA 18-19-20	DTS		
Economic	Improving the long-term viability of the fishing fleet	NPM		DTS_GSA 19	0%<NPM <=10%	NPM > 10%
	Maintaining current revenues above break-even revenues	CR/BER			CR/BER > 1	
Social	Maintening the current level of labour productivity (observed value not lower than baseline, average value 2020-2022)	GVA/FTE (€)		DTS_GSA 19	16877<=GVA/FTE<=18565	GVA/FTE>18565
	Maintening the current level of employment in FTE (observed value not lower than baseline, average value 2020-2022)	FTE		DTS_GSA 19	527<=FTE<= 580	FTE>580

Table 5.6 - Calendar of objectives for the monitoring of the Strait of Sicily Plan.

Dimension	Specific objectives	Indicators	Stock	Fleet segments (FT_GSA)	Target to 2027 (monitoring carried out in 2028 on data updated to 2026)	Target to 2030 (monitoring carried out in 2031 on data updated to 2029)
Biological	Promoting the sustainable use of target species	F/FMSY ratio Spawning stock biomass (relative or absolute))	HKE GSA 12-13-14-15-16	DTS	$F \leq FMSY$ and SSB $\geq$ ref. point or 66 percentile time series	$F \leq FMSY$ and SSB $\geq$ ref. point or 66 percentile time series
			DPS GSA 12-13-14-15-16	DTS		
			MUT GSA 16	DTS		
			ARS GSA 12-13-14-15-16-21	DTS		

Economic	Improving the long-term viability of the fishing fleet	NPM	DTS_GSA 16	0%<NPM <=10%	NPM > 10%
	Maintaining current revenues above break-even revenues	CR/BER		CR/BER > 1	
Social	Maintening the current level of labour productivity (observed value not lower than baseline, average value 2020-2022)	GVA/FTE (€)	DTS_GSA 16	31363<=GVA/FTE<=34499	GVA/FTE>34499
	Maintening the current level of employment in FTE (observed value not lower than baseline, average value 2020-2022)	FTE	DTS_GSA 16	1467<=FTE<= 1614	FTE>1614

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