Institut Català de Recerca per a la Governança del Mar

Commercial fisheries advisory report for the northern GSA 6

2025

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This report conveys ICATMAR's considerations on fisheries management actions for 2025 supported by data from its monitoring program.

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Context and aim of this document

The Western Mediterranean Multiannual Plan for demersal species (WMMAP), implemented in Spain since 2020, has motivated long-needed management measures and supported a vision of more sustainable fisheries in the Mediterranean Sea. Since the start of its implementation, and even years before, scientists, fishers, and administrations at regional, national, and European levels have joined efforts to come up with and implement management measures for the bottom trawl fleet, in most cases by means of participative initiatives.

In 2020, at the start of the WMMAP implementation, a simulation was done to calculate the upcoming yearly reduction in fishing days based on the objective of reaching FMSY for European hake in 2025 (Table 1, ICATMAR 20-07). At the sight of the resulting 50-66 yearly fishing days per vessel for the different segments of the fleet, and taking into account the ongoing reduction in the number of vessels since 2000 (Figure 1), we understood that the viability of the fisheries model was compromised, and that efforts were needed towards complementary management measures besides the reduction of fishing effort in days at sea. On the basis that the Common Fisheries Policy (CFP) calls for ecosystem-based initiatives, and supports the idea that management should not only be based on the evaluation of target species stocks, during the last few years different fisheries management alternatives have been proposed, tested and implemented to work towards more sustainable fishing practices (ICATMAR 22-06, 23-09, 24-07), as recommended by the latest address of the EU Commission to the EU Parliament and the Council (COM2025 296).

Table 1. Fishing effort (in terms of annual fishing days per vessel under each fleet segment) per year under the simulation scenarios deriving from the WMMAP. (1) To attain 30% of effort reduction in 2025, and (2) To achieve FMSY for European hake in 2025 Values for terminal year 2025 are highlighted (ICATMAR 20-07).

Scenarios / Fishing segments		< 12	12 < X < 18	18 < X < 24	> 24
Status quo (2020)	Year	152	181	193	201
(1) 30% effort reduction	2021	136	163	174	181
	2022	126	150	161	168
	2023	117	139	149	155
	2024	108	129	137	143
	2025	100	119	127	133
(2) Effort reduction to achieve F_{MSY} for hake	2021	121	145	154	161
	2022	97	116	123	129
	2023	78	93	99	103
	2024	62	74	79	82
	2025	50	59	63	66

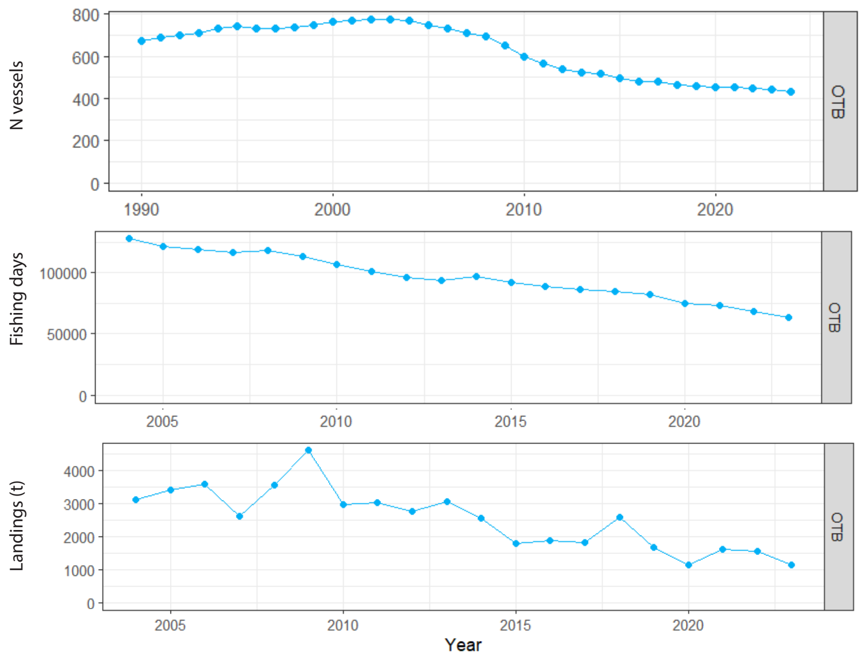


Figure 1. Number of vessels (top), annual fishing days (center), and landings (bottom, in tonnes) for the bottom trawling fleet of the GSA 6 during the last decades.

The current situation in the Spanish Mediterranean Sea is that the trawling fleet has been assigned 27 fishing days per vessel for 2025 (Official Journal of the European Union 2025), expandable to the maximum assigned days of 2024 by means of compensation mechanisms, i.e. 130 days per vessel in average, depending on fleet length segment. The result of this measure is that the fleet has no means of reaching the working days effectively done in 2024 (an average of 170 per vessel, with variations by fleet segments). With this present situation, fishing days in the northern GSA 6 (N GSA 6) are expected to run out by the end of September, with smaller vessels having to end their activity even at mid-summer. It is important to note that, in the context of Mediterranean multispecific fisheries, there is no other trawling fishery that fishers can switch to (fishers do not work on different vessels depending on season, as occurs in North Atlantic fisheries). Furthermore, the fleet dedicated to the most valuable fishing resource, the blue and red shrimp, is now virtually out of catch allowance for the species due to the reduction of the catch limit, even before the usual yearly peak in landings and prices which is in July-August (Figure 2). In this sense, we understand that the strategy of saving the quota to cover this period was out of the question, since Mediterranean fisheries are based on a small, regular supply of fresh product that cannot be concentrated in a couple of months.

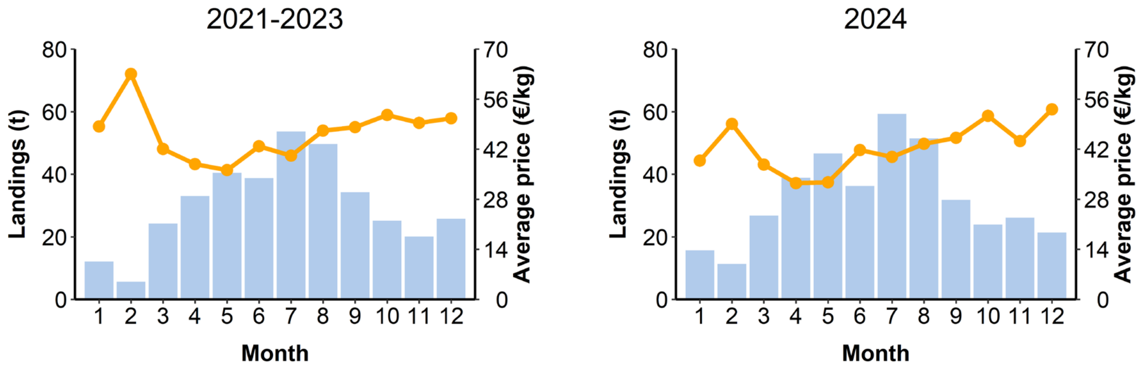


Figure 2. Monthly landings and average sales price for the blue and red shrimp in the N GSA 6 for the years 2021-2023 and 2024 (ICATMAR 25-04).

In our understanding, the CFP aims to ensure the sustainability of exploited populations, but also the resilience and competitiveness of the fleet. Based on this, we present our proposals for fisheries management in the N GSA 6, together with our concerns about a potential change in the traditional Mediterranean fisheries model.

Because of all the concerns exposed for this exceptional situation, we have decided to address this document in July instead of our usual timing in September.

1

Fisheries management proposals for the N GSA 6: ecosystem-based approaches

1. Extension of permanent no-take zones

a) Coastal permanent no-take closures

The current permanent no-take area extension in the N GSA 6 is 3.8% of the actual fishable area (from 50 to 800 m depth), with closures co-designed attending to recruitment or nursery zones for target WMMAP species (except for the blue and red shrimp) and equitably distributed along the coast forming a network of no-take MPAs with the aim of facilitating the connectivity of the biological processes (ICATMAR 23-06; López-Aguilar et al., submitted; Clavel-Henry et al. 2024a, 2024b; 2019). The claims that these closures were placed in areas where there was no fishing effort contrast with the effort data presented in the ad-hoc report published in 2023 (Figure 3, ICATMAR 23-06). A second claim was the potential effort redistribution to adjacent areas. Our data show that redistribution, if occurring, never reaches overall previous effort levels, also possibly related to the general reduction of fishing effort either in number of vessels or in working days (Figure 4, ICATMAR 23-06). Besides these two claims, results show that there is a clear spillover effect, proven for some species such as the red mullet, and that populations are more abundant and better structured inside closure areas than outside for species like the Norway lobster (Vigo et al. 2023). Also, their effectiveness should be seen in both population and ecosystem recovery.

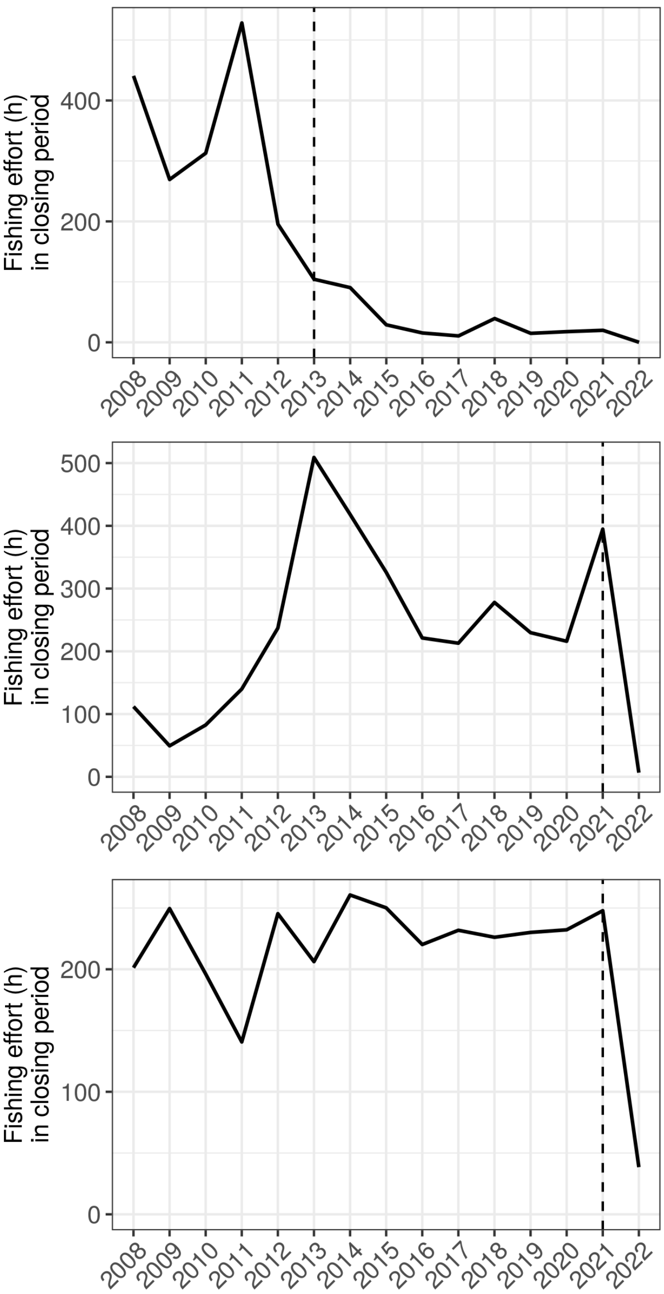


Figure 3. Examples of reduction in fishing effort (in hours) inside three permanent closure areas from 2008 to 2022. Top: Área merluza Roses; Center: Zona merluza Arenys; Bottom: Área cigala Barcelona. ICATMAR 23-06.

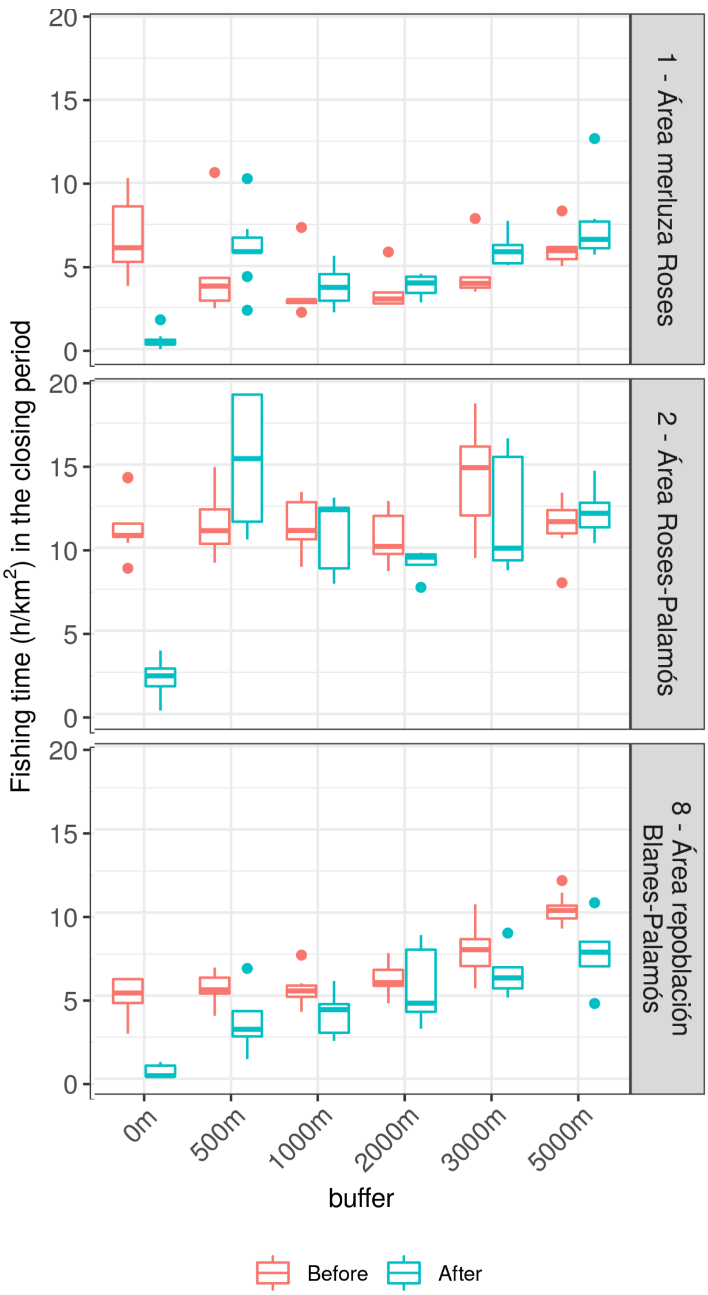


Figure 4. Effort redistribution in three closure areas of the N GSA 6: fishing effort (in hours per km2) before and after closure in each buffer area, by distance to the closure border (in m). ICATMAR 23-06.

Even so, these areas only account for a small percentage of compensation in fishing days, and no other additional mechanism has been activated to support their implementation. This may discourage the expansion of the protected surface. A possible way to boost this kind of measures would be to assign compensation if fishers' associations carry out restoration actions inside the closures, which are already proving successful in the N GSA 6 (e.g. LIFE-ECOREST, Aguzzi et al. 2024).

Additionally, the effectiveness of temporary closures is not comparable to that of permanent closures (Figure 5), and so the latest proposal we articulated was to substitute the temporary protected area in Tarragona (Subarea Catalunya, Figure 6) for an extension of 73 km2 to the existing permanent closures in the area. This would represent an expansion of the protection from 3.8% to 4.5% of the exploitable fishing grounds in the N GSA 6. The proposal is currently being evaluated by the administrations and fishing sector.

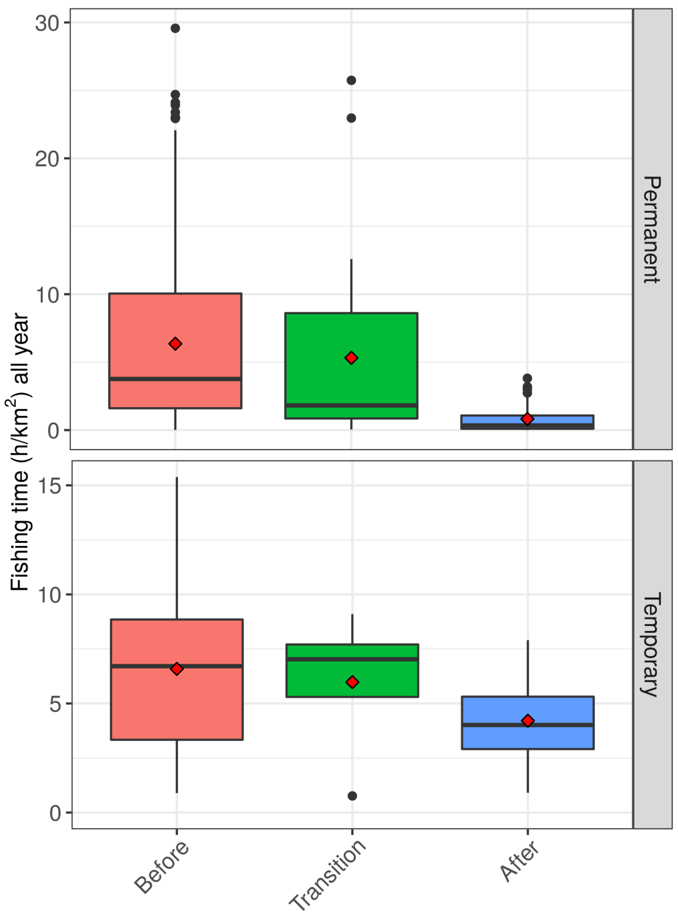


Figure 5. Reduction in fishing effort (in h/km2) before and after the protection of permanent (top) and temporary (bottom) closures. A transition period has been defined during the year of the delcaration of the protection status.

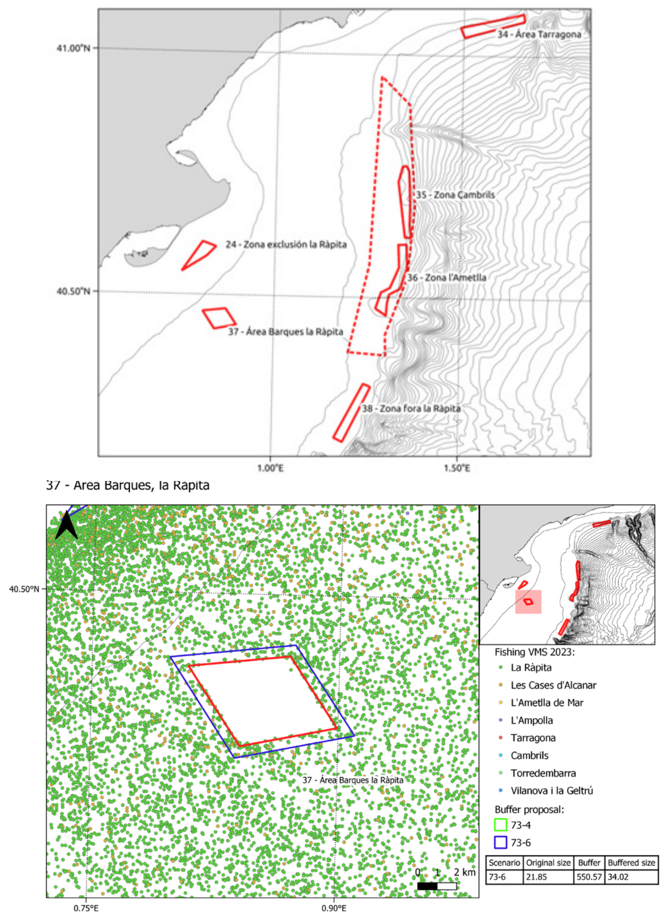


Figure 6. Fishing closures in the Tarragona area, in southern Catalonia. The dotted line indicates the current location of Subarea Catalunya, a temporary closure area that is proposed to be substituted for an extension in 73 km2 of the adjacent permanent closures.

b) Deep-sea permanent no-take areas

With the vast majority of marine protected areas being located in coastal ecosystems, there is urgent need to protect deep-sea habitats (Jacquemont et al. 2024). The core team of ICATMAR were the promoters of the first permanent ban at 1000 m (BOE 2008; WWF/IUCN 2004). An additional percentage of no-take closures could be added to the N GSA 6 if the 2024 Spanish proposal to ban trawling beyond 800 m was implemented (ICATMAR 24-09), since it is not in force in 2025. This would further protect the recruitment of various species, but it is of special relevance to the most valuable fishery resource of the area, the blue and red shrimp.

c) General considerations regarding number of vessels versus swept area and ecosystem impact

Even with the drastic reduction of number of vessels intended by some administrations or other stakeholders, their impact on ecological dynamics of the sea would virtually be the same because of the ploughing capacity of the trawling fishery (Puig et al. 2012). For instance, 50% of the current fleet (only 100 of the 197 vessels) would sweep the entire fishable area at least once a year due to the narrowness of the fishable margin of the Spanish Mediterranean. Therefore, no-take areas are essential to population and ecosystem recovery, and are in need of more incentives for their implementation and expansion. We recommend focusing on the co-design and implementation of permanent closure areas that protect species of interest during their vulnerable life stages. A significant step towards the valuing of this strategy could be the establishment of a discontinuous FRA encompassing all current permanent no-take areas along the coast of the N GSA 6.

2. Protection of hake spawners through temporary closures on small-scale fisheries

European hake spawners are the largest individuals of the stock, targeted exclusively by small-scale fisheries (long-liners, gillnets, and others), which represent a low percentage of the fleet in number of vessels, but are currently not affected by any restrictions linked to the life cycle of the species. The regulation of these gears during one of the reproductive peaks of the species (from October to January; Recasens et al. 2008) would ensure the protection of a fraction of the stock that is key for its recovery.

Landings data per vessel for the years 2019 to 2023 in the N GSA6 were analyzed to detect ves-sels who caught over 20% in weight of European hake in any fishing trip during the months of the reproductive peak. An average of 20 vessels fulfilled this condition during the studied period. The proposal specifically includes a temporary closure that affects only these vessels during 2.5 months of this period, since it is unlikely that the entire fleet can be compensated for the totality of the duration of the reproductive peak. This proposal was quantified in terms of fishing effort reduction in ICATMAR 24-09.

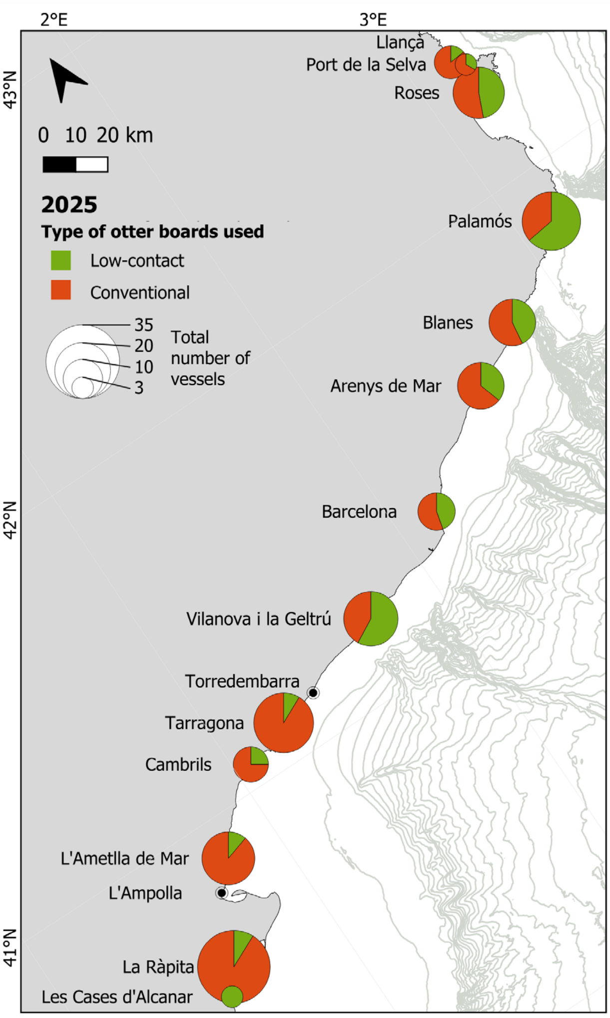


Figure 7. Proportion of vessels commited to changing to low-contact otter boards by port in the northern GSA 6.

3. Technical improvements to fishing gear

a) Use of low-contact otter boards

The recovery of deep-sea habitats is key to the improvement of the state of marine populations. The use of low-contact otter boards has been proven to significantly reduce the resuspension of sediment from the sea floor, and contribute to the recovery of the structure and ecological dynamics of its first centimeters (ICATMAR 23-01; Pusceddu et al. 2014). Some target species such as the Norway lobster have burrowing behaviors, but non-commercial sessile or structuring species play a key role in maintaining the biodiversity, structure, and health of deep-sea ecosystems. Low-contact otter boards significantly reduce the impact of bottom trawling in the ecosystems, and yet the compensation granted so far in the WMMAP has gone from none to low (in 2025), favoring a limited implementation in the fleet (Figure 7). The present year 2025 has seen an increase in the vessels committed to changing to low-contact otter boards, probably incentived by the commitment of the Catalan government to support this shift for the entire fleet. Some new ports such as Port de la Selva, Tarragona, and Cambrils have already been added to the list, but there is still room for progress, at 32% of the fleet having requested the change.

b) Improvements in gear selectivity

Gear selectivity of 45 mm square mesh for coastal fisheries and 50 mm square mesh for deep-sea fisheries was implemented as a compulsory measure for all the Spanish trawling fleet as of June 1st 2025, in exchange for additional fishing days (up to 130 days). It is a decisive change that is expected to positively affect the stocks, and will need to be carefully evaluated when data are available. Then, a precautory span of time should be allowed for the measure to impact the life cycle and status of the stocks, especially in the case of long-lived species such as the European hake and the three crustacean species of interest in the WMMAP, i.e. the blue and red shrimp, the deep-water rose shrimp and the Norway lobster. Data shows that these three crustacean species will be caught over their MCRS and over their first maturity size with this new enforcement of mesh size selectivity (ICATMAR 21-05).

4. Strengthening mechanisms for participative management

The above proposals are issued from participative initiatives set in place and agreed upon among administrations, scientists, the fishing sector and NGOs. In Catalonia, the legal structures of the co-management committees ensure the participation and engagement of all stakeholders and fosters mechanisms for consensuated, bottom-up decision-making with clearly (Druon et al. 2023). However, there is a lack of such structures at state or European level, as pointed out by projects GAP and GAP2 (“Bridging the gap between science and stakeholders”; Dramstad et al. 2011).

2

Stock assessment in the GSA 6: preliminary results and next steps

Following our roadmap in stock assessment for data-limited fisheries traced in previous years (ICATMAR 23-08), we continue the comparative work with length-based models, using production models as a stepping stone towards the broader approach of integrated models (Figure 8). In our latest stock assessment report (ICATMAR 25-06; to be published July 2025), we used length-based models LBSPR and LBB, and production model SPiCT fed with historical fisheries-dependent and -independent data for all species of interest of the WMMAP. As part of our workplan of improving our knowledge on Integrative models, this year we are including the results of the integrated model MESTOCK for European hake, red mullet, and blue and red shrimp. MESTOCK is an integrated assessment model formulated by Canales et al. (2014) that can directly incorporate inputs of length composition data and historical landings data. It was applied as a single-fleet model in a simplified way based on evidence that the trawl fleet has historically dominated the fishery (accounting for 95% of landings; ICATMAR 25-06, 25-04). In terms of extension of the models, LBSPR and LBB were used with data from N GSA 6, and SPiCT and MESTOCK with data from the entire GSA 6.

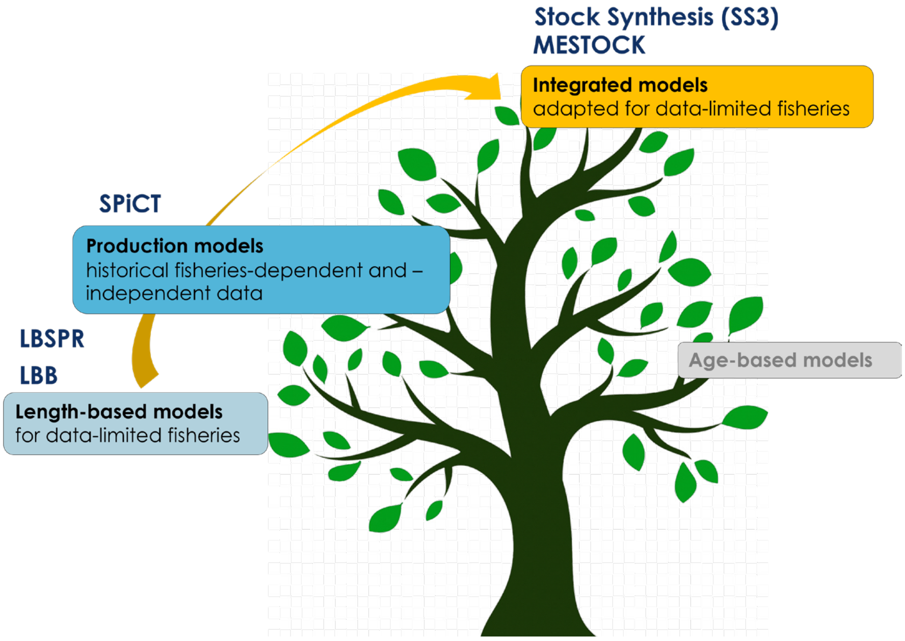


Figure 8. Roadmap for ICATMAR stock assessment procedures.

Our aim when working on different models and scenarios is to understand the sensitivities of each model to changes in parameters and input data, and to be able to choose the most reliable indicator in each case to build a balanced advice. Also, analyzing the temporal trends of different indicators is useful in looking for temporal variability, rather than focusing on a specific reference point. Stock assessment models are known to show uncertainties that are often not translated to the management decisions (Hilborn 2003).

1. Preliminary results of stock assessment in the GSA 6

a) LBSPR and LBB

The Spawning Potential Ratio (SPR) was estimated below the limit reference value for all species of interest, with stable values over the last 6 years for the red mullet and the Norway lobster (Figure 9). Recruitment peaks occurred for hake on years 2021 and 2022, and for deep-water rose shrimp in 2020 and 2024 (ICATMAR 25-05, to be published this July). For the model, these recruitment peaks are translated as drops in SPR since, in these cases, the ratio of large individuals to the total population decreases due to the increase in smaller individuals (ICATMAR 25-05, to be published in July 2025). In this sense, it is important to bear in mind that these models deal with uncertainty related to the influence of external factors beyond fishing pressure, such as environmental conditions or population dynamics of the species.

As for LBB, the output parameter is a ratio between the exploitable biomass over the biomass that would be available if the stock was unexploited. Trends over time are in line with those estimated by LBSPR (Figure 10).

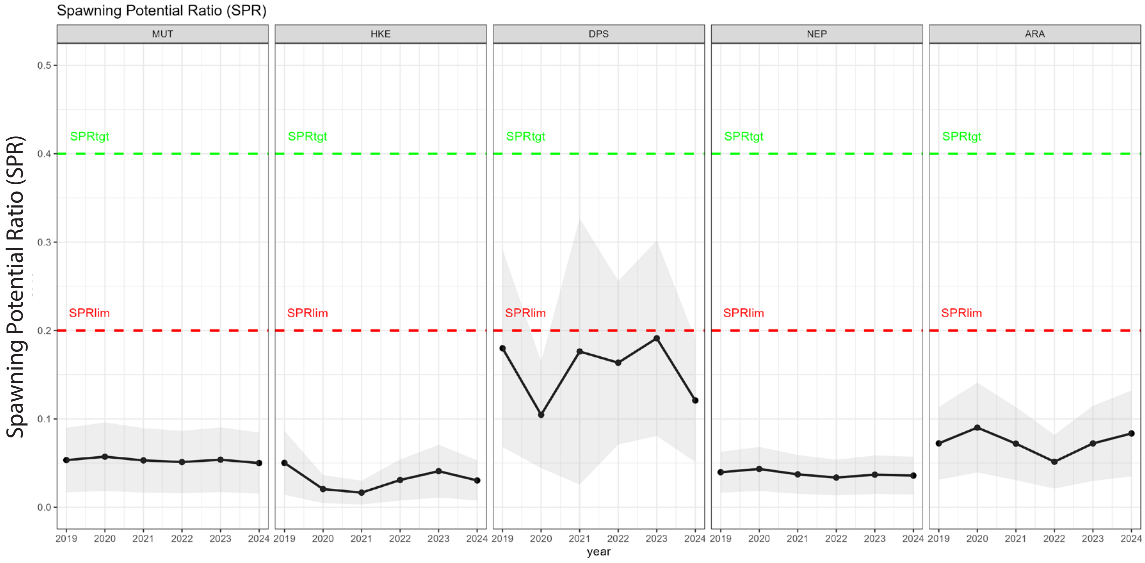


Figure 9. Spawning Potential Ratio (SPR) estimated by LBSPR for the five species of interest of the WMMAP. From left to right: red mullet, European hake, deep-water rose shrimp, Norway lobster, blue and red shrimp. Note the SPR value drops in European hake in 2021 and deep-water rose shrimp in 2020 and 2024, illustrating recruitment peaks of these species (ICATMAR 25-05). LBSPR: Length-Based Spawning Potential Ratio.

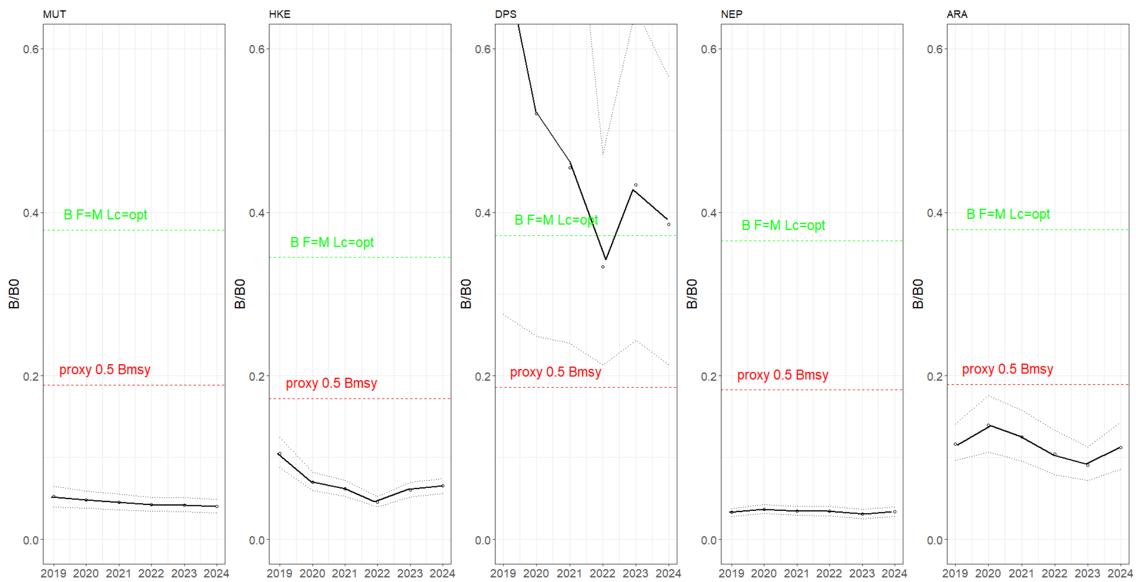


Figure 10. Ratio of the exploitable biomass versus the biomass in an unexploited state estimated by LBB for the five species of interest of the WMMAP. From left to right: red mullet, European hake, deep-water rose shrimp, Norway lobster, blue and red shrimp. LBB: Length-based Bayesian Biomass.

b) SPiCT

For SPiCT, estimates indicate that biomass (B) is low but stable and fishing mortality (F) in a steadily decreasing trend for Norway lobster and European hake (Figure 11). For blue and red shrimp and red mullet, B is increasing and F is also in a decreasing trend, while catches remain stable (Figure 11). The case of the deep-water rose shrimp is particular in that the model has difficulties interpreting the sudden spike in abundance and catches from 2015 (probably caused by favorable environmental conditions, Mingote et al. 2024), and so the estimates before 2015 cannot be taken into account. A broader view with historical data and a representation of unceratinty can be found in Figure 12. Both stocks of red mullet and blue and red shrimp are estimated to be sustainably exploited, with little uncertainty in the case of red mullet (Figure 13). Although we are aware of the claimed limitations of SPiCT outputs (GFCM 2025), for most species these estimates provided by SPiCT are in line with observations in the field and historical abundance and LPUE data series (ICATMAR 25-06; to be published July 2025; Garriga-Panisello et al., in prep.).

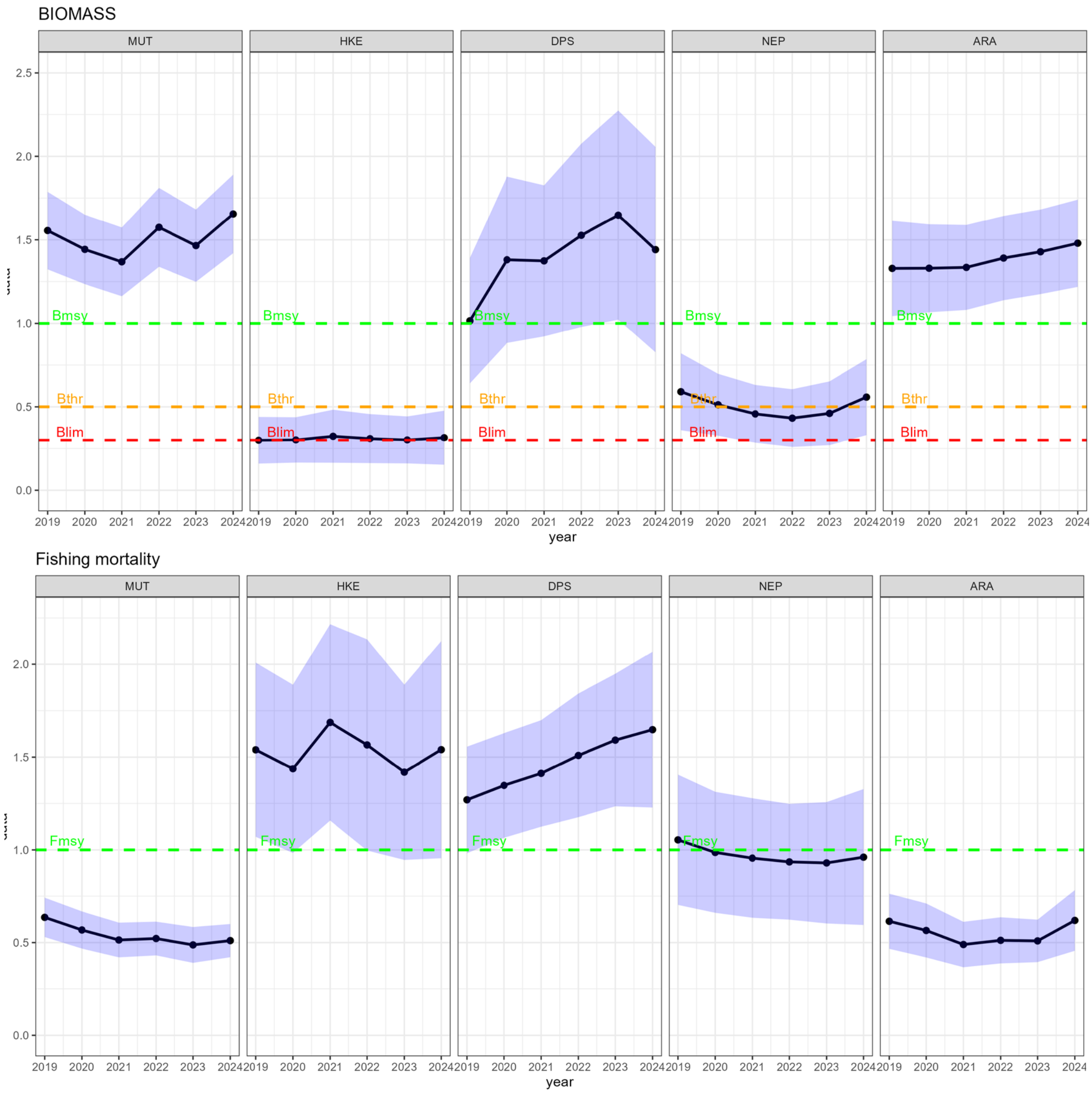


Figure 11. (top) Relative biomass (Bcurr/Bmsy) and (bottom) relative fishing mortality (Fcurr/Fmsy) per year (2019 to 2024) for the five demersal stocks evaluated with SPiCT model. MUT: red mullet, HKE: hake, DPS: deep-water rose shrimp, NEP: Norway lobster, ARA: blue and red shrimp. SPiCT: Stochastic Production model in Continuous Time. Fmsy: Fishing mortality at a maximum sustainable yield, Blim: Biomass limit, Bthr: Biomass threshold, Bmsy: Biomass target. Blue shade indicates uncertainty of the model.

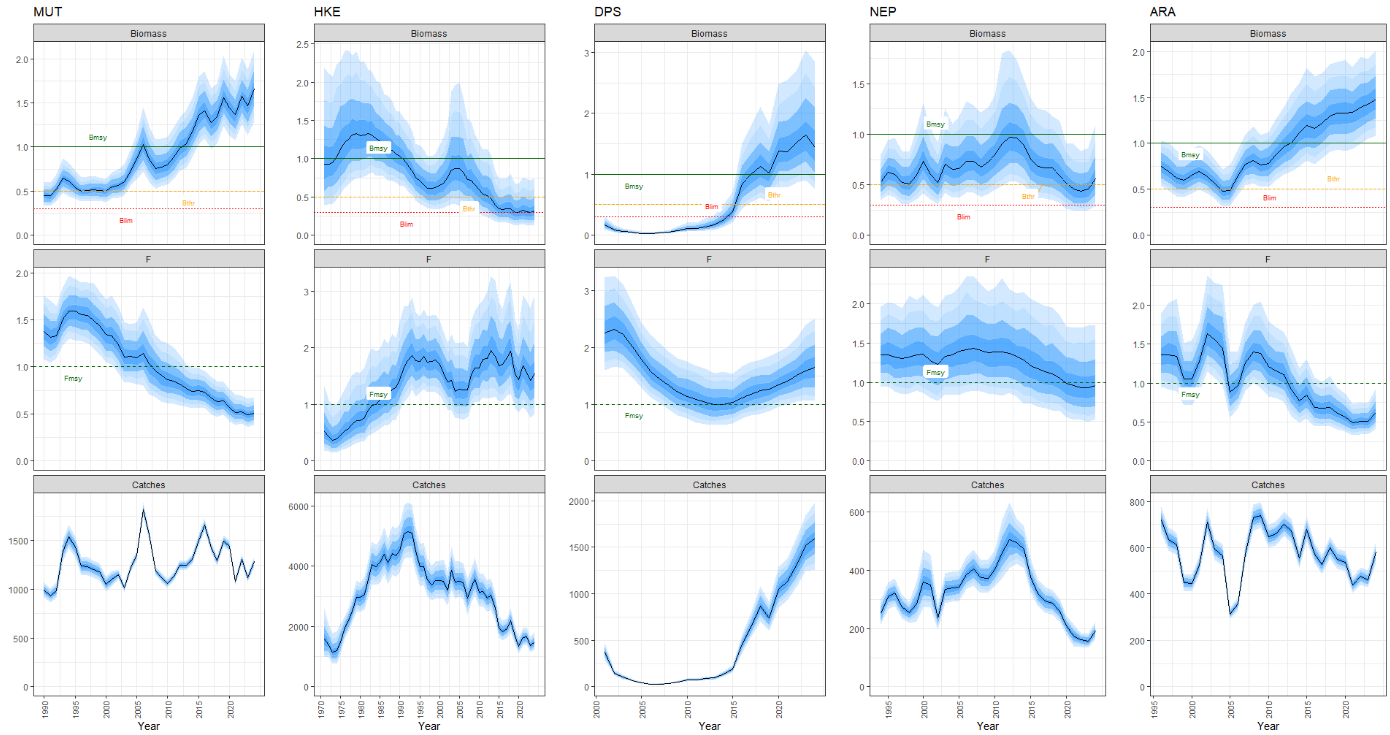


Figure 12. Summary of assessment results with SPiCT, showing the estimated stock trajectories for biomass as ratio to Bmsy, fishing mortality (F) as ratio to Fmsy and total catches. Darker and lighter blue shaded areas illustrated the 80% and 90% Confidence Intervals. estimated biomass (B, top), fishing mortality (F, center), and catches (bottom). MUT: red mullet, HKE: hake, DPS: deep-water rose shrimp, NEP: Norway lobster, ARA: blue and red shrimp. SPiCT: Stochastic Production model in Continuous Time. Fmsy: Fishing mortality at a maximum sustainable yield, Blim: Biomass limit, Bthr: Biomass threshold, Bmsy: Biomass target. Blue shades indicate uncertainty of the model.

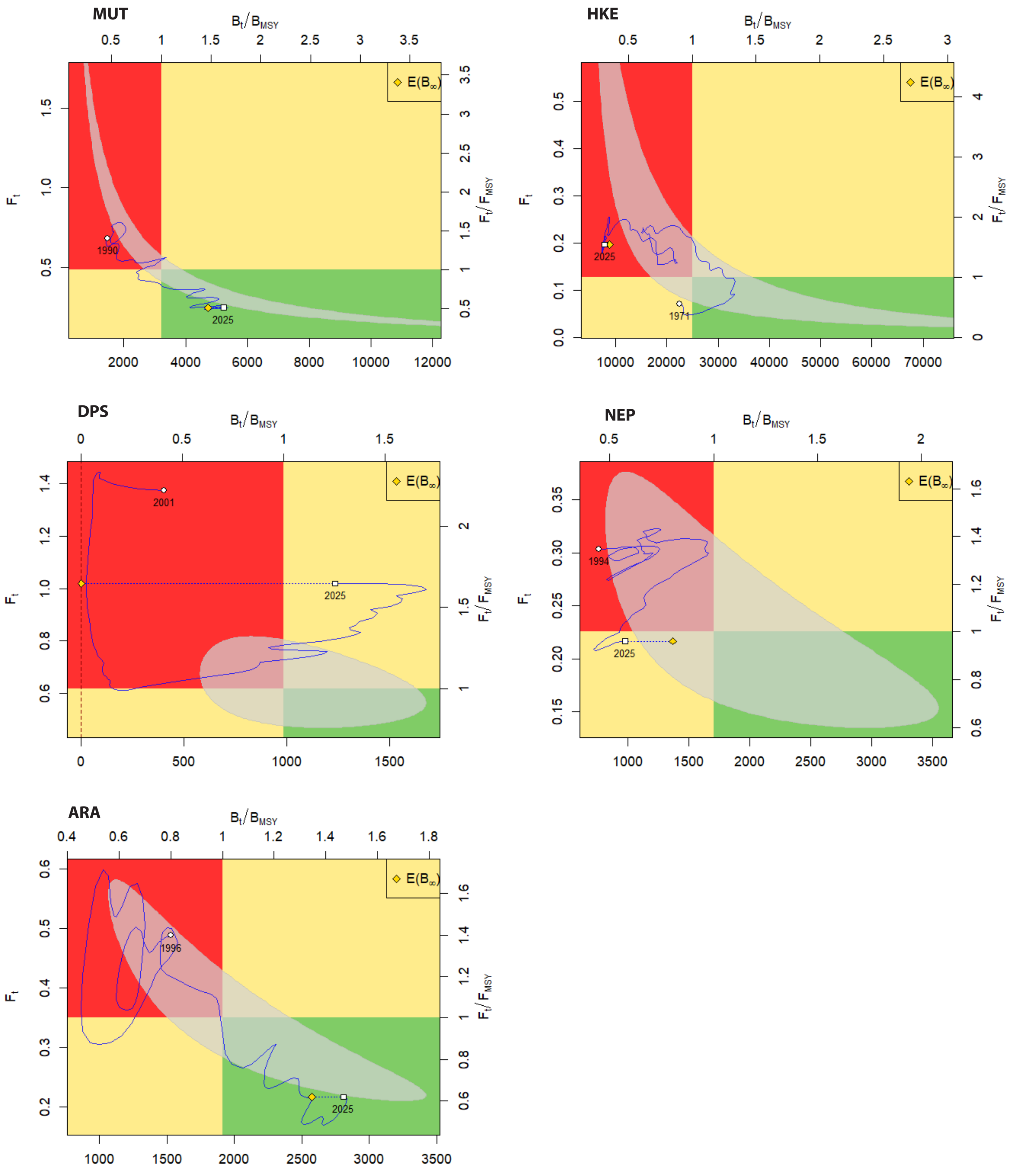


Figure 13. Kobe plots for the five demersal stocks evaluated with the SPiCT model. MUT: red mullet, HKE: hake, DPS: deep-water rose shrimp, NEP: Norway lobster, ARA: blue and red shrimp. SPiCT: Stochastic Production model in Continuous Time. Fmsy: Fishing mortality at a maximum sustainable yield, Blim: Biomass limit, Bthr: Biomass threshold, Bmsy: Biomass target. Shade shows the uncertainity of the model.

c) MESTOCK

In the case of MESTOCK, the analysis performed for European hake concurs in estimating biomass at low but stable levels, fishing mortality in a decresing trend, and thus a slow progress of the fishery towards recovery while still in need of time to recuperate biomass (Figure 14). Models may not be seeing a reaction because more time is needed for measures to affect the stocks. In addition, estimated biomass levels around Blim are difficult to pair with the sustained exploitation of the species and its place in the top three in demersal species catches for the last two decades.

The estimates of B of MESTOCK are in line with LBSPR, SPiCT and a4a, indicating that an effort on recovering spawning potential should be enforced. A direct strategy to do this is to manage the spawning stock when possible. In this sense, see Section 2.2 where we indicate the need to focus on management strategies on small-scale fisheries while observing the effects of management measures enforced during the last 5 years for the trawling fleet.

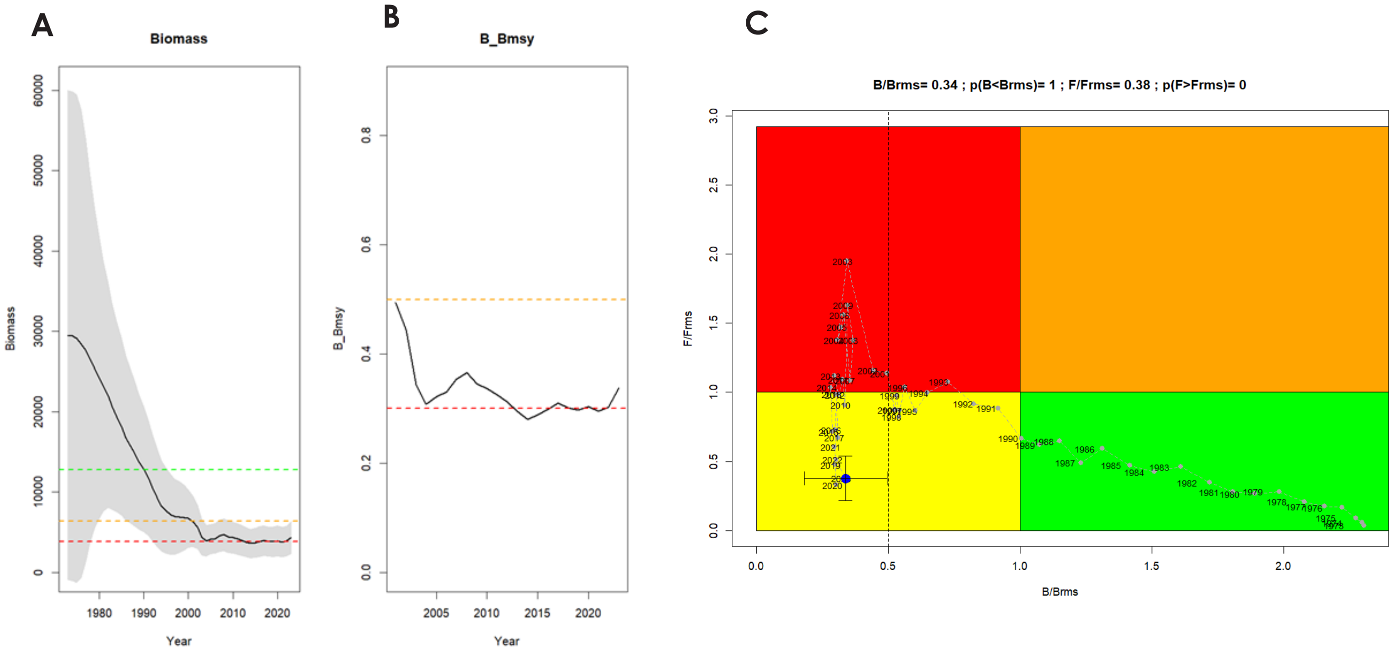


Figure 14. MESTOCK (Canales et al. 2014) model output for European hake in the GSA 6. A: Biomass and Biomass / BMSY ratio; B: Fishing mortality; C: kobe plot.

d) Final remarks on stock assessment

The different models and scenarios shown in this technical report seek to give an overview of the state of the stocks in the GSA 6. Although diagnoses differ due to divergences in reference values, input data, and the nature of estimated parameters in each model, trends can be compared for orientation on the state of the stocks (Table 2). The different estimates indicate that some stocks are stable or improving and seem not to be overly affected by current fishing pressure (red mullet, blue and red shrimp, deep-water rose shrimp), while others are in need of spawning biomass recovery, and further reduction of fishing mortality may be redundant without allowing reaction time for the stocks (European hake, Norway lobster).

In the official assessments for the GSA 6 performed by the different working groups of the EU-STEFC, stocks are currently evaluated with a4a model (Jardim et al. 2015), with no regard to any complementary information or exploratory analysis from other models or data series. The premise that a benchmark process would be needed for each species in order to even consider a change in the input data used or add a complementary assessment with an alternative model renders the system inflexible and impractical for its application in management. The use of alternative models that are accepted for official advice in other areas (e.g. SPiCT for blue and red shrimp in GSAs 1 and 5 at GFCM) should not need a process that may have to be scheduled years in advance and can last over a year. On the other hand, we consider of utmost importance to distinguish between actual fisheries data and model estimations. In the case of the GSA 6, the biomass levels estimated by length-based models, when taken at their absolute value, contrast with the fisheries data that indicate, for instance, that red mullet abundance is in an uninterrupted increasing trend since the decade of the 2010s when cod-end mesh size changed to 40-mm square (yet a4a assessment still estimates the Spawning Stock Biomass, SSB, between Blim and Bpa). A similar case is the blue and red shrimp, with stable abundance and LPUE values for over a decade but SSB still estimated between Blim and Bpa and a 68% reduction in catches recommended by official assessments (STECF 24-10).

In the case of hake, there seem to be aspects of the population that are not being correctly interpreted by length-based models, and it is clear that this stock needs a more careful approach, as agreed upon in the different ad-hoc working groups held during this year (GFCM 2025). In any case, the fact that during the last 20 years, European hake has consistently been among the top three demersal landed species in weight in the N GSA 6, is in contradiction with the absolute estimates of spawning biomass values by length-based models (Table 2, ICATMAR 25-04). In this sense, a benchmark process is in sight to review input data and methodologies and agree on good practices. In the meantime, the current perspective of numerically basing the management of a multispecific fishery on one model output of a single species seems not to be appropriate given the uncertainties around key aspects such as the correspondence between length and age in the case of hake (Piñeiro et al. 2009, 2003 and references therein, Morales-Nin et al. 1998). The matter is even more concerning when we take into account the consequences of these recent decisions over the entire fishery system encompassing three EU Mediterranean countries.

If the mechanism of the "choke species" is reconsidered, there should be clear directions about how the management measures will be crafted in the context of a multispecific fishery, be it through an average of fishing mortalities of the rest of species of interest, or with a different strategy.

Table 2. Most relevant species in landings for the Catalan bottom trawl fleet in 2024, percentage of landings represented by each species and variation percentage in landings by species for the year 2024. Landings are reported in tons (t).

Species (Landings)	Name (Lan.)	t	% (t)
Mullus spp.	Mullet nei	671.95	10.47
Trachurus spp.	Jack and horse mackerels nei	649.91	10.13
Illex coindetii	Broadtail squid	568.19	8.86
Merluccius merluccius	European hake	443.32	6.91
Aristeus antennatus	Blue and red shrimp	389.50	6.07
Squilla mantis	Spottail mantis shrimp	297.35	4.63
Eledone cirrhosa	Horned octopus	286.39	4.46
Parapenaeus longirostris	Deep-water rose shrimp	269.31	4.20
Micromesistius poutassou	Blue whiting	252.14	3.93
Lophius spp.	Anglers nei	237.59	3.70

2. Beyond models: other factors influencing the state of the stocks

Stock assessment models are increasing in complexity, and it is becoming more and more difficult for scientists to be technically trained to deeply understand them while keeping a close connection to the field and the actual data for the fishery they are assessing. Furthermore, contrarily to what was anticipated by Hilborn (2003), the decision-making processes, at least in the EU Mediterranean Sea, are currently still based exclusively on model outputs, with the estimated parameters numerically determining the extent of management measures. However, the current models used in official assessments can only incorporate part of the information available on the different species, let alone the interactions present in a multispecific context. The biology and population dynamics of some species are especially difficult to translate into a series of inputs for a model with the available information at present, and the expressions of uncertainty that the models incorporate are not then being translated to the building of management measures. Also, more and more clear relationships are being found between species abundance and distribution and environmental factors that the models cannot see. Including these and other similar relationships in the current or eventual future stock assessment models seems complex, and so it seems reasonable to conclude that models can play the role of useful advisors in orienting about the state of the stocks or their general trends over time, but do not at the moment have enough certainty to dictate numerical parameters for management.

In the case of the blue and red shrimp, the Dense Shelf Water Cascading oceanographic phenomena that occur periodically every 5-7 years sweep organic matter, nutrients, and shrimp individuals to deeper bottoms, where recruitment occurs (Company et al. 2008). These periods where no shrimp could be found in their usual grounds lasted for over 6 months and were identified in the area as a sort of "fishery collapse" related to fishing pressure. The results also showed an increment in landings per unit effort 3 to 5 years after this phenomenon. Neither the initial "fishery collapse" nor the increment of LPUE after 3-4 years are related to fishing pressure.

Similarly, some species are favored by the changing conditions of the Mediterranean Sea (i.e. rising temperature and salinity), like the deep-sea rose shrimp which has widely extended its distribution and increased in abundance

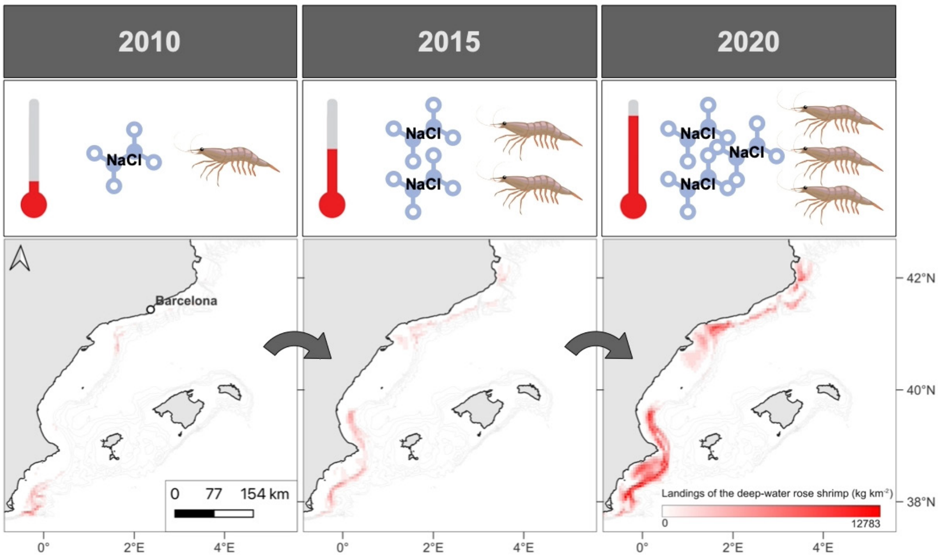


Figure 15. Illustration representing the relationship between temperature, salinity, and abudance and distribution of the deep-water rose shrimp in the GSA 6. Graphical abstract from Mingote et al. 2024.

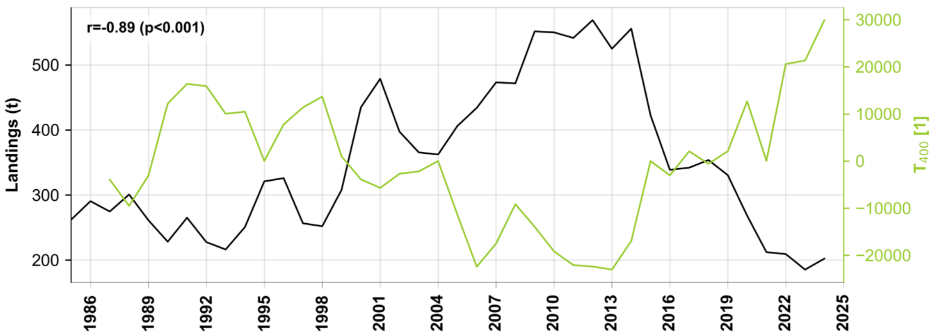


Figure 16. Time series of total yearly landings (t) of the Norway lobster (solid black line, t) from 1986 to 2024, and the temporal pattern of temperature from 1987 to 2024 at 400 m depth. Temporal pattern of temperature corresponds to the dominant mode score values obtained from empirical orthogonal function (EOFs) analysis (Mingote et al., in prep).

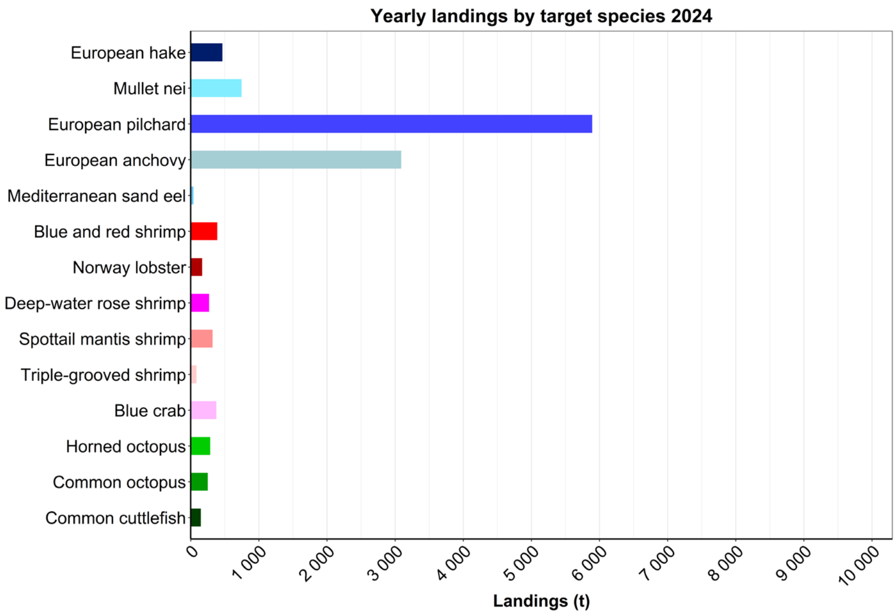


Figure 17. Yearly landings (in t) by species in the N GSA 6 in 2024.

over the last 15 years in direct relationship with these environmental parameters (Fig. 15; Mingote et al. 2024). Other species are hindered by these changes, like the Norway lobster, for which the landings series is inversely correlated to the mean temperature at 400 m depth (Fig. 16; Mingote et al., in prep).

Other species that have changed their distribution and entered the exploited fraction of the catch are the blue crab (*Callinectes sapidus*) in the Ebre Delta, absent until 2016 and now part of the top landed species in Catalonia (Fig. 17), and, more recently, the northern brown shrimp (*Penaeus aztecus*), which saw a sudden spike in landings at the end of summer 2024 (Puigcerver et al., in prep.).

3. Next steps: discussion priorities for the European hake benchmark process

In the last Scientific Advisory Committee (SAC) of the GFCM, a benchmark process was agreed upon for European hake in GSAs 1, 5, 6 and 7, starting in autumn 2025. The different ad-hoc working groups on the species have reached a consensus that the information and methods for stock assessment of the species need to be carefully reviewed and discussed.

The first issue that we would like to consider is the definition of the stock limits. Project STOCKMED, which is quoted to have set the combination of GSAs 1, 5, 6 and 7 for European hake in 2015, actually debates on this matter and presents different groupings of the GSAs depending on the parameters analyzed (Fiorentino et al. 2015). The decision of the Scientific and Technical Committee for Fisheries (STECF) to consider the conclusions of this report as established stocks instead of as a work in progress, as suggested by the project report itself, has been called into question by different scientific parties over the years (e.g. Ragonese et al. 2016 and references therein). More recent projects with the aim to settle the matter of European hake stock definition in the Mediterranean Sea, MEDUNITS and TRANSBORAN, have also not come to satisfactory conclusions on the issue. The benchmark process will have to evaluate all the available information and decide on a viable and reasonable configuration of the stocks for the purposes of fisheries management.

Another relevant discussion point is the use of complementary information as inputs for stock assessment models. Updated biological parameters and information presented by sex is of key importance in the case of a species with a marked sexual dimorphism. For instance, the length at first maturity in the N GSA 6 is comprised between 30 and 33 cm for females, and between 23 and 27 cm for males (ICATMAR 25-05), but the parameters are considered with both sexes combined in all assessments up to date. Data from our continuous monitoring program allow us to extrapolate information for separate sexes and use better tailored biological parameters as inputs for the models (Figure 18). This

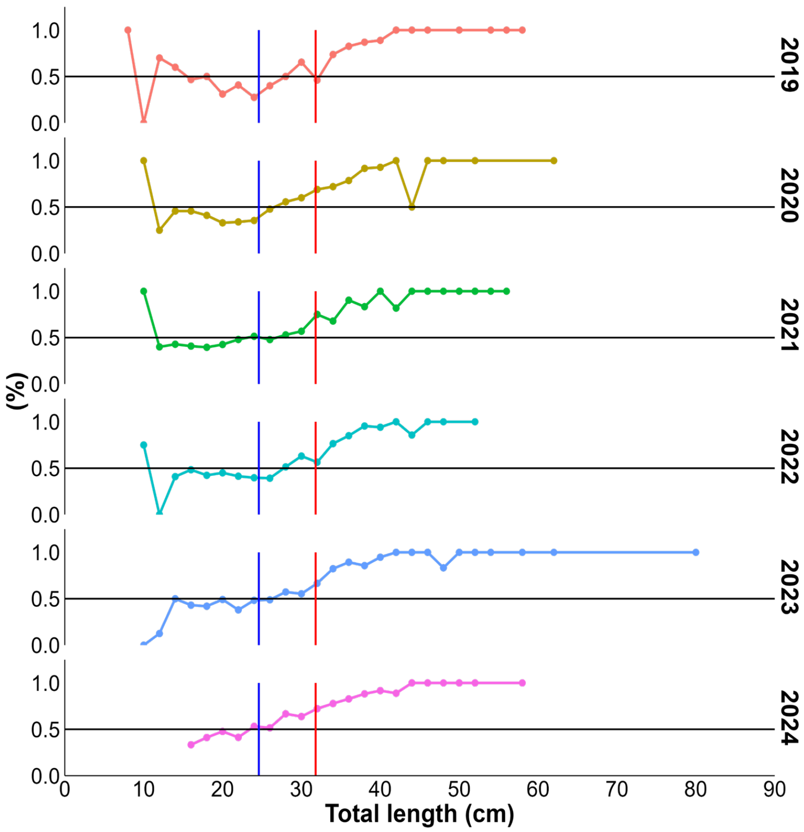


Figure 18. Sex ratio for European hake (in % females) by total length for the years 2019 to 2024 according to ICATMAR on-board sampling data. Vertical lines indicate length at first maturity (L50) for both sexes: blue for males, red for females.

information was presented in the ad-hoc working groups of the species held during this 2025 (WGHKE at GFCM and EWG 25-06 at STECF), and can feed the discussion during the benchmark process.

Lastly, there is a need to treat and complement both the fisheries-dependent and -independent data derived from small-scale fisheries. The current information about hake landings is based on the trawl fleet, which indeed represents 95% of the landings, but is known to target only small to mid-sized individuals. The largest spawners are only fished by longliners, gillnets and other similar gears, but this information needs to be standardized to account for the bias due to non-random allocation of fishing effort over time (Winker et al. 2014). On the other hand, the abundance index used is currently based only on a trawl survey (MEDITS) that can only account for the smallest fraction of the stock. A fisheries-independent survey on small-scale fisheries is needed to assess the abundance of large spawner individuals.

4. Next steps: advances in data collection in the GSA 6

With the objective of complementing and better informing the decision-making and benchmark processes, ICATMAR envisages to expand its fisheries monitoring program mainly with complementary fisheries-independent surveys (with a first cruise this autumn), and the extension of on-board sampling to all modalities of small-scale fisheries (starting next year 2026), all while adhering to open data sharing protocols.

The continuous fisheries monitoring program carried out by ICATMAR started in 2019 with on-board sampling of the bottom trawl fleet (Carreton et al. 2025), and was extended to the purse seine fleet in 2022 (Silvestre et al., in prep.) after a study describing the effort of this fleet (Sala-Coromina et al., in prep.). As for small-scale fisheries, we have participated in co-management committees throughout the N GSA 6, centered either around one species (e.g. common octopus, blue crab) or around the fisheries of a specific area (e.g. Cap de Creus, Ebre Delta). In 2025, the fisheries-dependent sampling of the European eel observatory started in the Ebre Delta, and we are gathering fishers' logbooks, which will be analyzed at the end of the year. The fisheries-independent sampling in this area will be carried out at the end of 2025. In addition, the on-board sampling of all modalities of small-scale fisheries is planned to start in January 2026, after a careful analysis of the different metiers present in the N GSA 6.

To reinforce the ongoing monitoring program, efforts are being put out towards adding fisheries-independent surveys that can complement the data collection surveys currently in place. For bottom trawling, a complementary autumn trawl survey is planned in this coming October on board Spanish research vessel Vizconde de Eza in order to gather information on species that reproduce in different seasons, for instance being able to sample the recruitment of the red mullet on a yearly basis as well as the European hake. The survey would follow the same transects as the current MEDITS survey for comparison. Along the same lines, for purse seine, the plan is to carry out an autumn-winter acoustic survey in 2026 along the same transects as MEDIAS in order to gather information on juvenile and adult distribution in a second period of the year. In the meantime, ICATMAR is developing a project in collaboration with OPP'92, a fishers' commercial association, to gather and analyze acoustic data from fishing vessels for abundance and biomass estimation. The first pilot test was done in May 2025 (Figure 19), with 2-3 sampling days planned every season.

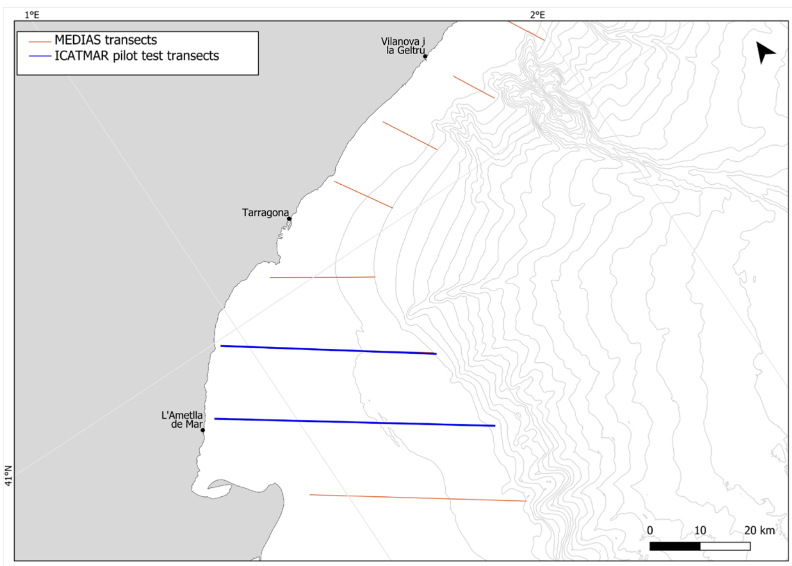


Figure 19. Transects covered during ICATMAR's pilot test of the acoustic survey with fishing vessels in southern Catalonia (in blue) over current MEDIAS transsects covered during the summer survey (in brown).

Overall, efforts continue to be made in the direction of making all of our data comply with the FAIR principles (Findable, Accessible, Interoperable, Reusable). Data from our sampling program can be easily accessed and downloaded through the viewers on our website (www.icatmar.cat; Ribera-Altimir et al. 2023), and we have recently joined EMODnet platform as data providers. In addition, we are deploying the ERDDAP data server on our website to allow the download of our data in a wide range of formats shared by other institutions worldwide.

3

Concerns and considerations about fisheries model change

In June 2025, the European Commission issued a document in which the resilience and competitiveness of the Mediterranean fishing fleet was valued at the same level as the sustainability of exploited populations (COM2025 296). Indeed, it is our understanding that the CFP considers the three aspects of sustainability (environmental, social, and economical) as equally pressing objectives to guide its actions. However, the current socioeconomic tensions, derived from over two decades of reduction in fishing effort with decreasing number of vessels and catches and reinforced by the latest regulations in the Western Mediterranean, highlight the imbalance in the priorities of the management measures applied to date (Figure 1). In this context, there are signs that socioeconomic strain on the fleet may be causing a change in its strategy, behavior and dynamics with potential unintended consequences.

1. The management for the blue and red shrimp

The biology and habitat of the blue and red shrimp provides the stock with some intrinsic, natural recovery mechanisms such as the recruitment and early juvenile habitat below 800-1000 m (Sardà and Company), where they are not available for exploitation, or the periodic episodes of dense shelf water cascading that provide nutrients and organic matter to these deeper grounds (Company et al. 2008). Landings and LPUE trends for the species are stable over the last decade, and abundance index, field observations, and production models diagnosis contrast with the official assessments and estimate that the stock is fished sustainably (ICATMAR 25-06). Yet, it is the only fishery in our zone doubly regulated by means of reduction of fishing days and catch limit, which was reduced to 708.3 t in 2025 (280.9 t in the N GSA 6). In 2025, with the firm implementation of the catch limit in sight, the fleet is changing behavior and some practices are making their way into the fishery dynamics that had not been observed before.

For instance, the percentage of blue and red shrimp discards has spiked during the first months of 2025 in comparison with the previous years, with 7.22% of the species catch discarded (Figure 20). When reported to the total catch of 2024, if this trend continues it would represent a total discard of 65 t of blue and red shrimp in 2025. This is clearly related to an avoidance of surpassing the catch limit, since in this situation fishers prefer to keep only larger, better-priced individuals, and to discard the smaller ones. This is a practice that was not observed in previous years, and is expected to exacerbate as vessels attain their catch limits and the high season for landings and price of the species approaches (Figure 2). On the other hand, the new measure of the compulsory use of 50 mm cod-end mesh size, which ensures that fished individuals fall over the Minimum Conservation Reference Size (MCRS), will certainly help the management of this species over the coming years.

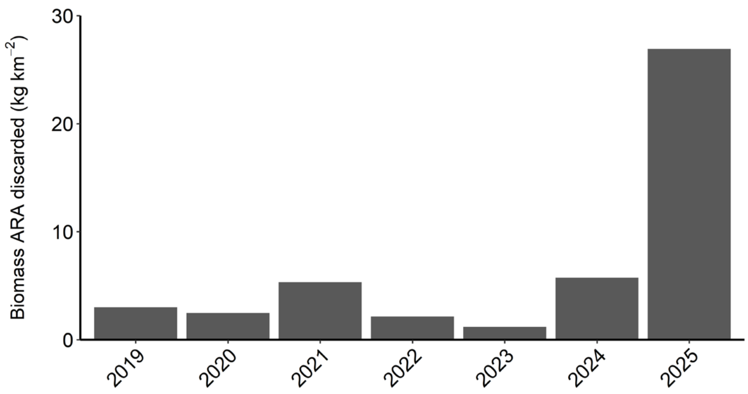


Figure 20. Biomass of blue and red shrimp discarded (in kg/km2) in the years 2019-2024, and in the first half of 2025. Data from ICATMAR on-board monitoring program.

Also, the fishing strategy of the fleet dedicated to this species is changing. In some ports, the hauls over blue and red shrimp grounds are becoming fewer and shorter, with a single haul per day when the usual number were 2 to 4, in favor of longer hauls over more coastal bottoms targeting other groups of species, which include the other four species of interest of the WMMAP. In parallel, some ports, namely in those where blue and red shrimp is a predominant fraction of the landings (Palamós, Roses, ICATMAR 25-04), are seeing an increase in days dedicated to the mixed metier (Figure 21), indicating an effort displacement away from deep-sea grounds and onto coastal areas. Besides, as of July 14th 2025, 69.5% of the catch limit allowance for 2025 had already been landed in Catalonia (Figure 22), when the yearly peak period of landings for this species has not yet arrived (typically in July-August, Figure 2). When these vessels run out of catch allowance for blue and red shrimp, they will be left to spend their remaining fishing days working over coastal bottoms, causing a displacement of the fishing effort and more impact on these coastal populations.

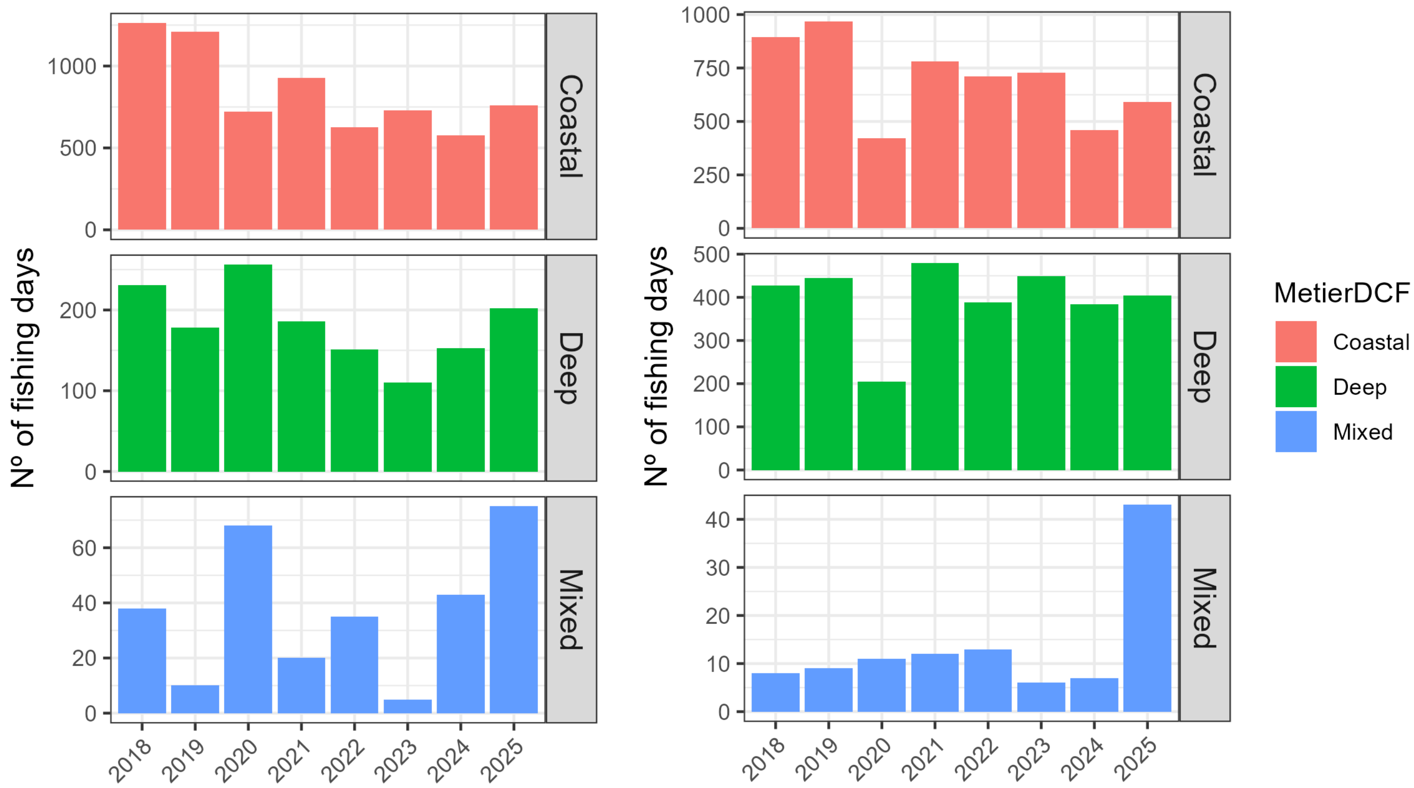


Figure 21. Total fishing days dedicated to the Coastal, Deep-sea and Mixed metiers in the months of January to May of 2018-2025, for the ports of Roses (left) and Palamós (right).

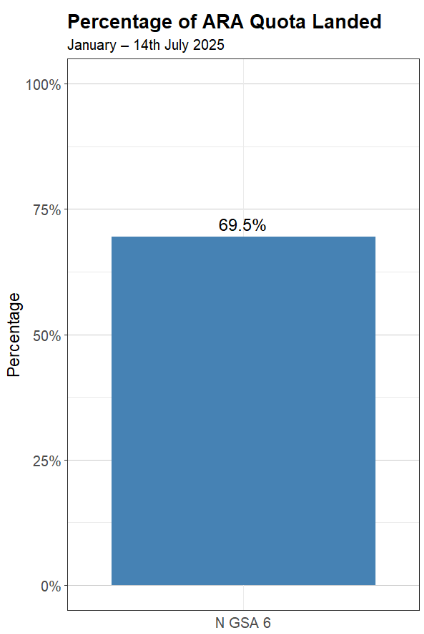


Figure 22. Percentage of the blue and red shrimp quota landed the northern GSA 6. Data from January to July 14th 2025.

The main risk of these changing practices is that the vessels focused on the blue and red shrimp are the largest fraction of the fleet, and their catch in one fishing day is larger, also when working over coastal bottoms. In 2024, vessels focused on the blue and red shrimp, defined as vessels that spend 80% or more of their yearly fishing days in the deep-sea metier, landed in average around 30 kg of hake per day when fishing in the coastal metier, while the rest of the fleet landed in average 20 kg of hake per day when working on the same grounds (Figure 23). In summary, the fishing effort exerted by the fleet on coastal grounds is increasing despite the limitation in fishing days.

On the other hand, both the spike in blue and red shrimp discards and the displacement and increase of the effort on coastal grounds are intensified by the fact that Landings Per Unit Effort (LPUE) values during the first five months of 2025 are higher than those in the same period of previous years for the species of interest of the WMMAP (Figure 24). It is worth noting that the working days during this period have remained essentially constant over the last few years, and so the increase in LPUE values in 2025 is likely to indicate more biomass present at sea.

Finally, another risk of this double regulation is the proliferation of illegal practices, when in an attempt not to surpass the species quota, some fishers may choose to sell part of the catch out of auction, or under a different species name. The fisheries monitoring programs and stock assessment processes currently in place are strongly based on the reliability of the landings data. These practices were hardly present in Spanish ports in the last decades, but once they start to appear, the robustness of the data will be compromised, and it will be very challenging to analyze the dynamics of the catches and the fleet behavior, preventing a good understanding of the state of the stocks.

The fact that this double regulation that is causing deep shifts in the fleet behavior is applied to a species that, according to abundance indexes, catch data and production models, is not in apparent need of stronger measures than others, raises the question about its suitability and effectiveness for the current fisheries model.

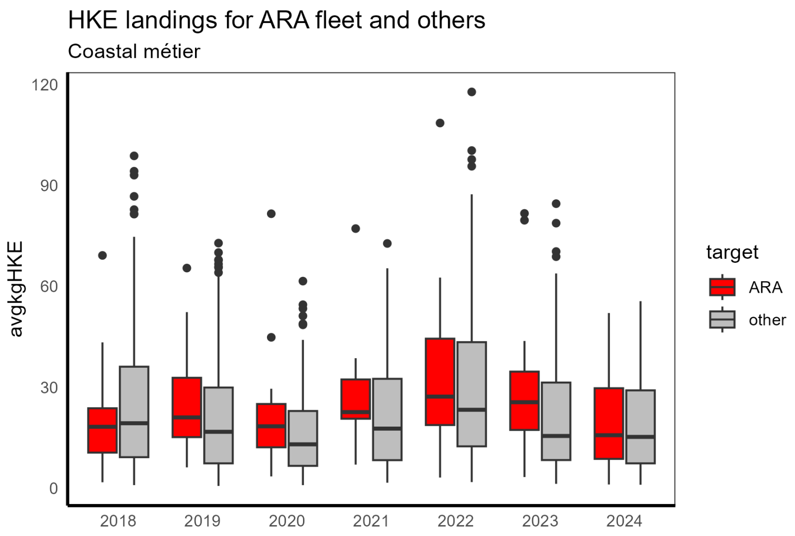
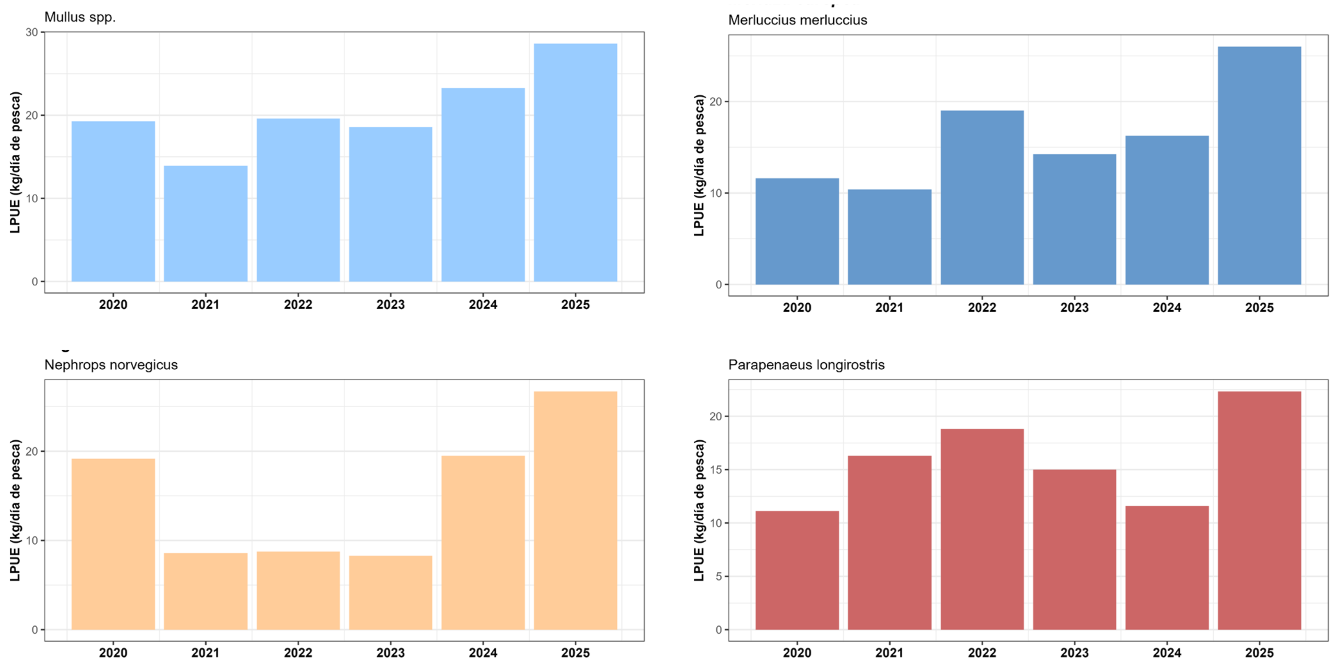


Figure 23. Average daliy European hake landings (in kg per vessel per day) for the fleet dedicated to the blue and red shrimp (target: ARA) and the rest of vessels (target: other) in coastal metier days for the years 2018 to 2024. The fleet dedicated to the blue and red shrimp has been defined as the vessels that dedicate at least 80% of their yearly fishing days to the deep-sea metier.



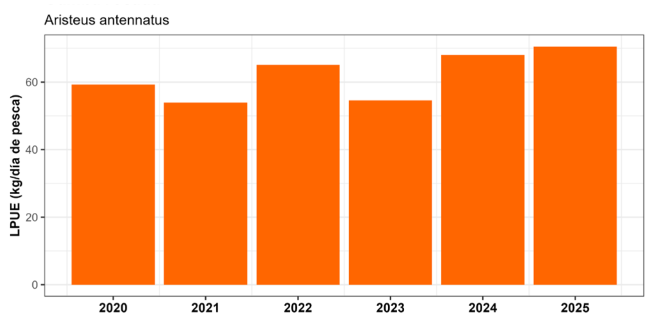


Figure 24. Landings per unit effort (LPUE, in kg per fishing day) during the months of January to May of the years 2020 to 2025, for the five species of intrest of the WMMAP. From top to bottom and left to right: red mullet, European hake, Norway lobster, deep-water rose shrimp, blue and red shrimp.

2. Rethinking the process timeline

At present, the data being collected during the first months of 2025 will be analyzed at the end of 2026 and the corresponding measures will come into effect during 2027 (Figure 25). This prevents an adaptive and flexible management strategy that can respond to observed changes in the system. Although fisheries data need validation and cannot be interpreted without a comprehensive thought process, the current strategy could be appropriate for establishing long-term measures, e.g. in place for a minimum of three years, and the process could be punctualitzed by more agile interim procedures that can analyze recent data and watch for short-term effects of the measures. A clear example of the need of this system is this year's issue with the catch allowance restriction for the blue and red shrimp coexisting with increased values of LPUE of the species.

Figure 25. Timeline of process from data collection to implementation of new regulations within the WMMAP.

Mid-term stability of measures would facilitate the analysis of their effects, since data series after each measure change would be longer and more robust. Besides, biological processes need time to reflect the effects of management measures, especially for long-lived species such as the European hake of the blue and red shrimp. In addition, a certain stability in management measures would also facilitate the engagement of the sector in the co-design and implementation of measures, since the concern about socioeconomical viability of their activity can hinder efforts for sustainability. In parallel, a complementary, agile data-analysis process is possible with the current data collection programs in place, and can monitor for undesired effects or reinforce positive trends.

3. Changes in the fleet structure: towards more inequality?

During its transition period, the WMMAP has not managed to revert the trend of small and medium vessels falling out of business, while the largest segment of the fleet holds a certain stability (Figure 26). The initial assignation of fishing days was done according to historical values reported by the sector, and so small vessels that were limited by weather constraints and workers who had decided to observe temporary closures were assigned less days. Also, the reduction in fishing days has been stronger for smaller fleet segments (Figure 27).

Besides the segregation of the fleet in segments, its division in two metiers, coastal and deep-sea, is also contributing to more inequality, having direct consequences in terms of assigned fishing days and income. This division is, in fact, a fabrication of the regulations, since traditionally all fishers chose in which grounds to fish on the basis of market profitability, weather, or other considerations. However, the vessels that did not declare historical deep-sea catches in the years immediately prior to the implementation of the WMMAP have not then been assigned any fishing days for the deep-sea metier, even if they could have worked in these grounds.

With the raising inequality, and pushed to a difficult situation, skippers of small, coastal vessels are making the decision to sell their boats to skippers of larger vessels that can also handle the deep-sea metier (data are still being analyzed at present). These larger vessels can use the fishing days corresponding to both vessels, directly causing an increase in fishing effort. This is made possible by the fact that skippers of large vessels are in a better economical position and can buy other vessels due to the differences in income between metiers (Figure 28A). This difference has always been present, but it has been intensifying over the last few years (Figure 28B). This shift clearly favors the concentration of wealth into a fewer number of people, a model that diverges from the traditional structure of the Mediterranean fleet (small companies, family-owned businesses, strong fishers' associations). Also, the loss of these smaller, more coastal vessels reduces the traditional diversity of Mediterranean auctions and fishers' associations, with a consequent cultural shift.

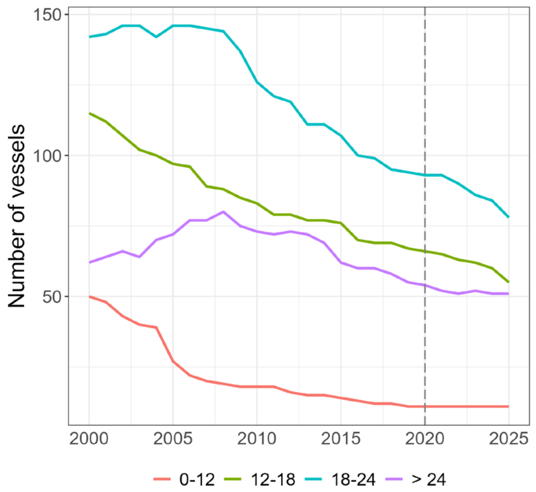


Figure 26. Number of trawling vessels from 2000 to 2025 by LOA segment in the N GSA 6. Vertical dashed line indicates onset of WMMAP.

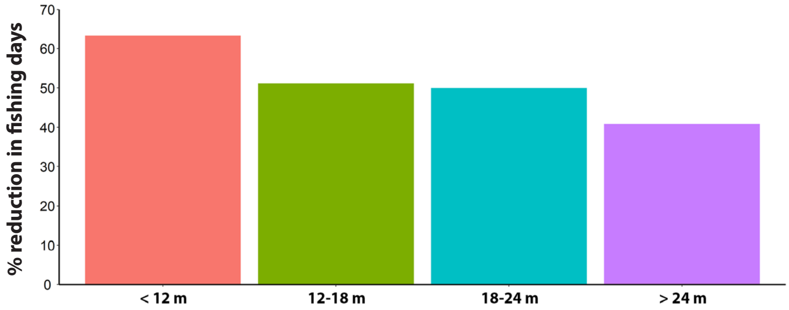


Figure 27. Accumulated percentage of reduction in fishing days from 2015 to 2024 by LOA segment in the N GSA 6.

Segregation both in LOA segments and metiers results in more inequality in fishing opportunities and in income, since large vessels and deep-sea metier are already more profitable (Figure 24A). Within the fishing sector, this is a source of growing social conflict due to the increasing inequality among fleet segments and metiers. For these reasons, assigning a fixed number of fishing days to every vessel could probably eliminate these inequalities and reduce tensions in an already strained sector. In line with our proposal of a rollover of the assigned fishing days of 2024 while focusing on other management measures (ICATMAR 24-07b), an approximate assignation of 170 days per vessel, regardless of LOA segment or metier, would probably address this situation and provide relief and stability to promote investments in sustainability measures.

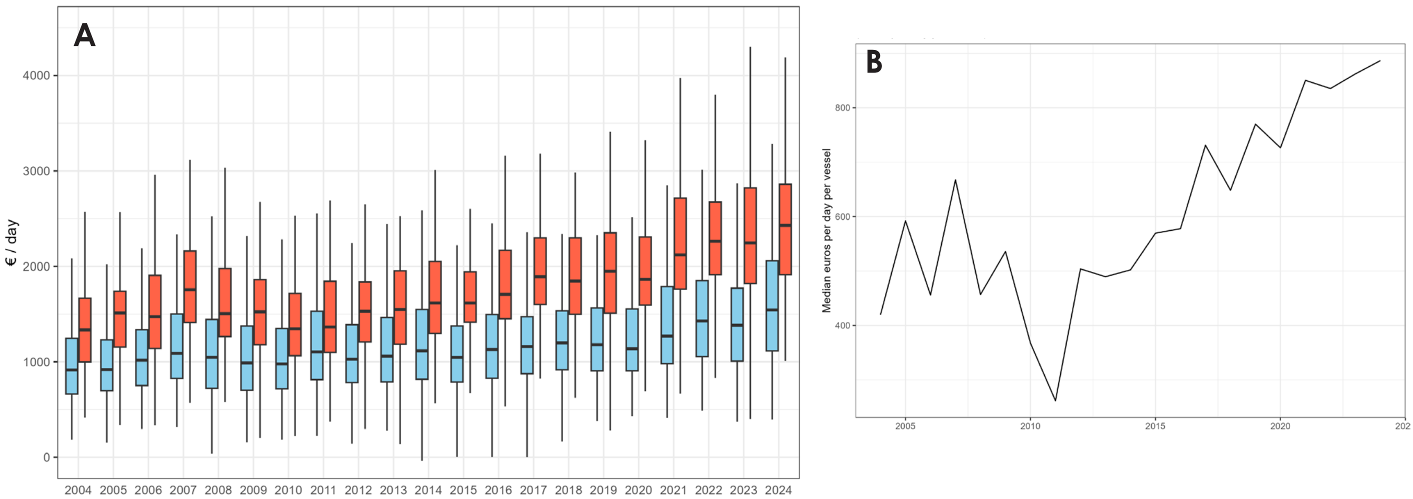


Figure 28. Difference in daily income per vessel between dee-sea (red) and coastal (blue) metiers in the N GSA 6 from 2004 to 2024. A: Average daily income, in euros per day per vessel, for each metier. B: difference between the median values of the daily income deep-sea and coastal series. In 2004, the difference between the median values of both metiers was around 400€: in 2024, the difference has risen to almost 900€.

Summary

In summary, over the last 20 years, the bottom trawl fleet has seen a reduction of 50% in fishing days, and of 40% in number of vessels. Ecosystem-based approaches such as the co-design of permanent closures and the use of low-contact otter boards, have been implemented through participative initiatives, with little institutional support. Gear selectivity has only been made compulsory for the Spanish Mediterranean fleet in June 1st 2025, and now time is needed for the measures to affect the stocks while work is done on regulations to protect large hake spawning individuals. Meanwhile, the combination of an exceptional limitation on fishing days and a catch limit for blue and red shrimp is causing deep changes in fleet behavior and structure, and increasing fishing effort on coastal grounds. This is a direct consequence of a single species model output driving the management of a multispecific fishery, when models are being questioned about their ability to understand the complex dynamics of certain marine populations. Socioeconomic tensions are scaling, and the trawling fleet is expected to stop working at the end of summer, with no option left for the workers but to leave the fishing sector, putting even more strain on its generational replacement. Furthermore, investments in these small businesses (in aspects of such importance as safety) are being held because of economic difficulties. As a result, we are beginning to observe a shift from a traditional Mediterranean fisheries model based on "one skipper, one vessel", to an industrialized model where wealth and effort are concentrated in a few large companies. In this context, derived from the management measures issued in 2024 EU agreements, we raise the question about the need to further reduce fishing effort (in days) or to enforce a double regulation such as that of the blue and red shrimp. The effort on the part of all stakeholders in the fishery to implement a variety of management measures during the WMMAP has been commendable, and so it might be time to stand by, observe the effects of these ongoing measures, and work on the management of the spawning stock over the next few years by stepping up to regulate small-scale fisheries. Further insistence in reaching MSY for a species that is no longer a target does not seem like a reasonable objective, except if the aim is to restructure Mediterranean fisheries beyond the current model. In our understanding, the objectives of the CFP, for which we have worked and continue to do so, focus on management of fisheries for healthy stocks that can be sustainably exploited, and to our knowledge do not instruct the reconversion of the sector.

4

Final remarks: advice for fisheries management in the N GSA 6

In conclusion, we present the following advice for fisheries management in the N GSA 6:

- Provide more support for ecosystem-based approaches (e.g. permanent closures, low-contact otter boards, or similar). In the framework of the new EU restoration regulation, compensation could be offered to fishers' associations that plan restoration actions in closures.

- Establish a legal framework for stakeholder engagement and participative initiatives.

- Simplify the regulation while preserving fleet diversity: avoid segregation of the fleet in length overall (LOA) segments or in coastal and deep-sea metiers. All vessels could be assigned the same number of days (not favoring larger vessels or more avid fishers), and choice of metier could be left to skippers as per usual practice prior to the WMMAP (not favoring inequality between coastal and deep-sea metiers). This would largely reduce social conflict in the ports and promote stability to encourage investments in sustainability measures. Explicitly ban and control the exchange of fishing days/quotas between vessels.

- Promote both stability and flexibility in measures: mid-term (~ 3 years) measures complemented with agile mechanisms based on fisheries data to allow reaction to observed changes.

- Flexibilize the process to change, refine, or rediscuss aspects on stock assessment practices at an official level (STECF). Benchmark processes, while needed, are long-winded and cannot be the only way to reassess methodology.

- Rethink the use of length- or age-based models for the WMMAP species, especially in the cases where there is no agreement on the relationship between length and age (European hake). Comparative analysis of different models shows that, while the absolute values of estimate parameters may differ, trends are consistent and can orient the advice. Production model (SPiCT) estimates are more in line with abundance data and field observations in the GSA 6.

- Switch from model-based management to encompass all other scientific information, e.g. peer-reviewed articles and knowledge gathered from on-board observation, in a true science-based management. Stock assessment model outputs can provide guidance, but should not numerically determine the management measures.

- Avoid double regulation (reduction in days and catch limitation) for blue and red shrimp in order to prevent undesired increase of fishing effort in coastal areas.

- Give time for measures on the bottom trawl fleet to affect the stocks, and in the meantime reinforce management of European hake spawning stock, implementing management measures to the small-scale fleet.

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