SEAWISE POLICY BRIEF ON

EVALUATION OF FISHERIES MANAGEMENT STRATEGIES

PURPOSE OF THIS BRIEF

Developing interdisciplinary knowledge on how existing and potential management strategies perform against ecological, economic and social objectives is essential for the practical realisation of Ecosystem Based Fisheries Management (EBFM) in Europe.

This brief outlines SEAwise's work, drawing together research from across the project's multiple work themes, to evaluate the efficacy of current fisheries management strategies across Europe and the potential of alternative strategies to deliver on EU policy objectives. Working to improve our ability to predict the effectiveness of a range of management strategies, under various climate change scenarios, we have also developed guidance for the development of a flexible, evidence-based framework in support of regionally tailored EBFM.

KEY POINTS

- By evaluating the efficacy of management strategies against existing EU fisheries and marine policy objectives, SEAwise established baselines to ensure consistency across indicators. Our assessment shows that, despite improvements in reversing overfishing, most fisheries-related policy objectives have not been met.
- Drawing together the enhanced sub-models produced under SEAwise's multiple work themes, our models highlight that regionally tailored, multi-fleet, and climate-aware strategies that address technical interactions, socio-economic trade-offs, and long-term sustainability are crucial to sustainable fisheries management.
- Notably, across case studies, flexible approaches (such as PGY (Pretty Good Yield) and tailored strategies from case studies) showed promise in achieving a balance between socio-economic and ecological objectives.
- Ongoing dialogue and structured exchange with stakeholders through dedicated review workshops proved essential to refining model assumptions, identifying priorities, and ensuring that proposed management approaches are grounded in practical knowledge and shared goals, identifying also future research needs.
- Employing Multi-Criteria Decision Analysis (MCDA) to summarise complex model outcomes was determined to be an effective tool for identification of trade-offs, and ranking management scenarios based on priorities.
- SEAwise has developed guidance, derived from the combined results of our modelling work, that can be utilised to design regionally specific and adaptive EBFM plans that improve on the existing management regime and are robust under future environmental change (i.e. climate change).

KEY RECOMMENDATIONS

- **Pursue customised, regionally-specific management measures.** Our research highlights there is no one-size-fits-all when it comes to management. The effect of management measures and the impact of climate change vary across regions, fleets and stocks. Whilst the need for regionalisation is already reflected in policy, steps need to be taken to enact this in practice, with management reflecting localised concerns and priorities.
- **Account for regional variation in climate impacts and fleet-specific vulnerabilities through adaptive management.** Based on simulations, we found climate change produced impacts on fisheries that were regionally-specific and predominantly negative, though for specific species, localised positive impacts were observed.
- **Targeted implementation of technical measures is critical.** Modelling undertaken by SEAwise demonstrates that technical measures produce diverse outcomes across regions, underscoring the need for targeted measures where they are needed most to address specific objectives.
- **Leverage the strength of multi-species, multi-fleet models to enable actionable, ecosystem-informed management advice.** Our research demonstrates that these models offer a practical step beyond single-stock assessments towards EBFM. Nonetheless, further exploration on the use of such tools within management is needed, and offers an exciting area for ongoing research.
- **Draw on tools, such as Multi-Criteria Decision Analysis (MCDA), to illuminate trade-offs and incorporate preferences within management decision-making.**Through testing the efficacy of the MCDA approach, we found this to be a useful tool to summarise outputs from a wide range of scenarios, identify trade-offs and evaluate management approaches based on specific preferences.
- **Integrate SEAwise's Standard Operating Procedure for EBFM Plan Design** in support of development of EBFM plans that are tailored to priorities and pressures at regional level.

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SEAWISE AT A GLANCE

Involving 24 universities and research organisations from across Europe funded under Horizon2020, the **SEAwise project has worked to deliver the knowledge needed to support fishers, managers, and policy makers in the practical implementation of Ecosystem Based Fisheries Management (EBFM)** across European waters.

Building on the recognition that societal and ecological objectives are interdependent under EBFM, SEAwise has assembled a new knowledge base that captures the social, economic and ecological complexity of European fisheries. Drawing on this to develop predictive models, tools, and ready-for-uptake advice, SEAwise's work enables stakeholders to evaluate the potential trade-offs of management decisions and forecast their long-term impacts.

Through this, SEAwise has laid the foundation for a whole-ecosystem approach to management in Europe – one that would equip both fisheries and management with the resilience needed to successfully navigate future challenges and change.

BACKGROUND

As part of our efforts to support operationalisation of Ecosystem Based Fisheries Management (EBFM), a key objective for SEAwise has been the development of the tools needed to assess and anticipate how different fisheries management strategies might affect the whole fisheries ecosystem, across social and ecological dimensions, and establish the most effective recommendations for sustainable management.

One of the leading principles laid down in the EU's Common Fisheries Policy Regulation (CFP), a commitment to EBFM is also enshrined in related legislation such as the Marine Strategy Framework Directive (MSFD) and the EU's Maritime spatial Planning (MSP) Directive. Whilst at the same time explicitly acknowledging the need to improve the knowledge base in support of the same and to keep in mind both socio-economic and environmental objectives, this principle is also reaffirmed in the Action Plan set out in the 2023 Fisheries and Oceans package (1), and more recently in the EU's Ocean Pact (2).

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Locating fisheries within the broader socio-ecological system as part of our Evaluation of Fisheries Management Strategies theme, SEAwise has worked to develop well-informed, evidence-based recommendations in support of bringing EBFM from policy objective to practical reality. Evaluating current management across Europe's regional fisheries, and assessing a range of alternative management strategies, under different climate scenarios, this work weaves together knowledge developed across the project's work themes to: 1) improve our ability to predict the effectiveness of management plans, 2) holistically assess the impacts of existing management plans and alternative management strategies over time, 3) test case study-specific strategies related to key concerns within our regional cases, 4) offer guidance on the design of regional EBFM plans.

This brief synthesises this work, outlining key recommendations in support of practical realisation of EBFM, and ultimately sustainable and resilient European fisheries.

PERFORMANCE OF EXISTING MANAGEMENT PLANS

To inform improvements to fisheries management across European waters, and facilitate progress on implementing EBFM, understanding the capacity of existing management plans, targets, and indicators to deliver on the objectives of the CFP and MSFD is critical. To establish a baseline for our analysis, SEAwise evaluated progress on achieving the ecological, social and economic sustainability objectives stated within these key pieces of fisheries-related policy, reviewing this in the context of SEAwise's four case study regions of the North Sea, Western Waters region, Mediterranean Sea, and the Baltic Sea (3).

Based on this assessment, we identified that most policy objectives have not been met. While measures aimed at reducing fishing mortality have, over the past 20 years, been effective at reversing overfishing in EU waters, they have not yet succeeded in restoring stocks to sustainable levels (3). Management measures, such as those outlined under the EU Habitats Directive aimed at restoring biodiversity, have also been largely ineffective – resulting in broader objectives remaining unmet (3). Further, many of the objectives outlined in the

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CFP and MSFD (notably on social aspects and the ecosystem effects of fishing) remain unsupported by assessment indicators and agreed threshold levels, hampering informed decision-making and evaluations of progress (3).

Building on this, SEAwise modelled a range of plausible management scenarios (see Box 1) across our case study regions to test their efficacy against CFP and MSFD indicators (4, 5). This analysis identified where additional or alternative measures may be needed to deliver on management goals, and also highlighted areas of potential trade-off between them (4).

SEAWISE'S CLIMATE AND ALTERNATIVE MANAGEMENT SCENARIOS

MANAGEMENT SCENARIOS:

- **Status Quo:** A continuation of current fishing effort levels.
- **FMSY-min:** Fishing according to a strict implementation of landing obligation and Maximum Sustainable Yield target, whereby fleets must stop fishing once the first species in their target mix reaches FMSY levels.
- **PGY (Pretty Good Yield):** Fishing according to a more flexible MSY approach consistent with the Multiannual Plans for mixed-fisheries, whereby fishing can continue until, for example, an upper range of FMSY is reached. This approach aims to mitigate the 'choke effects' induced by the Landing Obligation.
- **Case-specific:** Entailing region-specific measures relating to changes in active versus passive gear allocations, closed areas, and technological changes.

CLIMATE SCENARIOS:

Scenarios were tested under both current conditions and future climatic projections to examine how severe (RCP8.5, equivalent to around 5 degrees of warming) and moderate (RCP4.5, equating to around 2.5 to 3 degrees of warming) scenarios, and resulting changes in fish productivity, might alter outcomes.

Across sub-regions, we found that if current fishing effort continues without additional measures, many stocks risk falling below critical levels (4). We projected that an FMSY-min approach performed well against many MSFD indicators – such as reducing bycatch of Endangered, Threatened, and Protected (ETP) species – but risked producing negative socio-economic outcomes, indicating a significant trade-off (4). By contrast, a more flexible PGY approach was projected to deliver stronger overall performance across ecological, social, and economic indicators (4). Through reducing effort compared to current levels, the PGY approach was found to reduce 'choke effects' in regions where the Landing Obligation was in force (particularly for mixed demersal fishery fleets) and, in some cases, improve catches and profits (4). As such, **we determined that the PGY-based management approach, in some cases, could offer a more balanced pathway to achieving sustainable fisheries in line with a wider range of EU objectives.**

Drawing on SEAwise's modelling advancements of social and ecological dynamics under climate change (for example see our policy brief on Ecological Effects of Fisheries), we bolstered the above analysis through also evaluating case study-specific management strategies with CFP and MSFD indicators (5). We also explored their efficacy regarding global indicators, such as carbon emission reduction (5). This work highlighted large uncertainties in many cases and, as such, our findings here should be interpreted in the context of models used and assumptions made (5).

Nonetheless, as an illustrative example, across the Western Waters region, again our modelling indicated that the strict FMSY-min approach was most effective at addressing ecological and conservation objectives but that this came at a socio-economic cost (5). For example, in the Bay of Biscay sub-region, although more restrictive management scenarios ensured achievement of Fmsy target , all simulated measures led to lower Gross Value Added (GVA), wages, reduced landings, and negative impacts on food security (5). Similarly, trade-offs were also apparent between indicators for case-study specific scenarios. In the Bay of Biscay our case-specific scenario, aiming for more stability in fishing effort, provided higher landings and socio-economic benefits, but led to only minor differences in stocks' good environmental status and global indicators (5). On climate change, conflicting findings highlighted the difficulty of predicting how future environmental change may materialise across the full complexity of fisheries systems (5).

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MODELLING SOCIAL-ECOLOGICAL COMPONENTS

SEAwise's work from the outset has been an interdisciplinary and iterative endeavor, mirroring the holistic scope of EBFM. Over the course of the project, models and sub-models (i.e. those that focus on the specific dynamics at play within an element of the socio-ecological system, such as fisher behaviour or predator-prey interactions) have been enhanced and integrated with the ultimate aim of establishing management strategies best suited to addressing the regionally specific social-ecological challenges facing fisheries across Europe.

These multi-species, multi-fleet models have generated vital insights on the impact of existing and potential management strategies not only on fished stocks and landings, but also on the associated impacts to marine ecosystems and for fishing fleets and coastal communities (6,7,5,8). They have also allowed us to respond to specific stakeholder concerns which were identified at the project's outset, such as exploring the ramifications of the Landing Obligation within regions where it is in effect both now and in the context of future climate change (see Box 2). For more in-depth insights on the findings from these model interactions, see our other Policy Briefs.

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LANDING OBLIGATION AND CHOKE EFFECTS

Under the EU Landing Obligation, to prevent discards of unwanted fish at sea, catch of species regulated through catch limits or minimum size must be landed and counted against quotas – with catch of undersized fish are not permitted to be sold for direct human consumption. However, as avoiding all unwanted catches can be very difficult in some fisheries, certain exemptions apply. For example, discarding may be allowed where a species is proven to have high discard survival levels, or further selectivity is difficult to achieve. These exemptions are defined in regional discard plans (9).

One unintended effect of the Landing Obligation, particularly for multi-species fisheries where fishers catch multiple species at the same time, is that of "choke" species – when the total allowed catch is reached for one species and the fishery has to close, to prevent vessels from continuing to fish for the other species they have allocations for lest they accidentally catch more of the 'choke' species. SEAwise modelled different management strategy scenarios to investigate which could lead to the emergence of choke species, and thus result in missed fishing opportunities and economic losses for fishers (i.e 10).

STAKEHOLDER SCOPING

Provision of effective recommendations for management requires utilisation of existing knowledge and lessons learned; key to this are the insights of stakeholders. To this end, SEAwise has worked to draw on the expert input of the fishing industry, policymakers, fisheries managers, and advisory organisations, to ensure the knowledge gaps we address and management advice tools we develop are truly useful and applicable across our Case Study regions, and on the wider European policy stage.

Building on earlier project scoping to identify priorities, in its final year SEAwise conducted a series of regional workshops to present and discuss findings with stakeholders (fishing industry, policy makers, fisheries managers, NGOs, and advisory organisations). The input from these workshops, conducted primarily with the EU's Advisory Councils (ACs), enabled us to finetune our modelling and SEAwise's predictive management advice tools (11,12). Feedback elicited from these workshops were incorporated in final project evaluations, and saw the development of additional scenarios, adjustment of model parameters, and clarification of previously reported results (particularly in relation to uncertainty and model assumptions, in addition to more descriptive explanation of the consequences of proposed changes) (11,12).

For example, in our sub-region of the Eastern Ionian Sea, input from stakeholders led to further exploration of key issues affecting the mixed demersal fishery (12). We explored alternative scenarios with a different allocation of effort reduction, together with the simulation of a more extreme warming scenario. Alternative allocations scenarios, entailing an effort reduction, resulted in better ecological outcomes than those simulated previously (12). Beyond this, recognising the substantial contribution to landings from the small-scale fleet in the region, SEAwise applied management strategies to both the small and large-scale fleets (12) **Overall, these developments highlighted the need for more nuanced strategies, including spatial and métier-specific measures, to ensure effective, equitable management** (12)**.** Moreover, given the minimal regulation of the small-scale fleet and their substantial role in hake exploitation, these findings emphasised that future policy must prioritise its monitoring and management (12).

Elsewhere, in the Celtic Sea, new simulations excluding key choke species (cod, whiting) resulted in choke risks shifting to haddock and other species. While landings for the large-scale fleet increased in the short term, for the small-scale fleet outcomes declined with negative impacts across several social indicators. Over time, the benefits to the large-scale fleet also diminished, with no improvement in social indicators seen in the long term. These findings show that **within this context short-term fixes, over time, undermine long-term viability, and spotlight the need to consider fleet-specific vulnerabilities and interactions when adapting management strategies in mixed fisheries under climate-related uncertainty** (12).

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Ultimately, this endeavour supported model refinement and illuminated the importance of ongoing dialogue and structured exchange with stakeholders to identify priorities, ensuring that proposed management approaches are grounded in practical knowledge and shared goals. Key to ushering in more effective fisheries governance (see our related policy brief), this stakeholder dialogue was crucial in our development of detailed, ready-for-uptake findings on effective management strategies, whilst at the same time identifying future research needs.

TRADE-OFFS, CONTEXT-SPECIFICITY AND REGIONALISATION

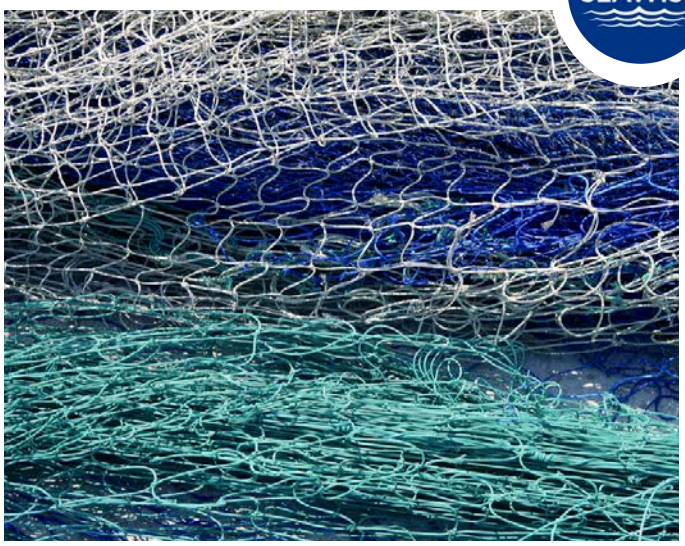
Drawing on the full suite of SEAwise research and scoping, as part of our final evaluations we assessed the broader ecosystem impacts of existing management plans and alternative management strategies over time – testing case study-specific strategies relating to key concerns raised within our regional cases.

Here a range of different climate and management scenarios were assessed, including measures relating to catch limits and efforts controls, gear changes, reduction in trawling effort, and spatio-temporal closures of specific areas. For example, across the North Sea, Celtic Sea and Bay of Biscay and study regions, we simulated the impact of phasing out trawling, projecting the effect of a 50% reduction in trawl effort in addition to various additional measures for other gear types.

According to our assessment, the effects of management measures and impacts of climate change varied significantly across regions, fleets and stocks, **highlighting – in keeping with our previous evaluations – the need for context-specific, regionally tailored approaches** (13). On the whole, climate change effects were mainly negative – however, some positive impacts were observed at the local-level for some areas (e.g. whiting in the North Sea) (13).

In line with our previous analysis, different scenarios entailed different social and ecological trade-offs. Applications of the FMSY-min scenario resulted in improved ecological outcomes, but at the expense of reduced landings and economic performance in some regions, for example. On the other hand, while a Status Quo scenario provided stability, it produced the least ecologically sustainable outcomes. **Flexible approaches, such as PGY (Pretty Good Yield) and tailored strategies from case studies, however, showed promise in achieving a balance between socio-economic and ecological objectives (13).**

We also found that the social-ecological system



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was more resilient to climate change when fish populations were in good status, and this was generally realised when FMSY-min or PGY approaches were implemented on top of full implementation of a landing obligation (13). **Technical measures produced diverse outcomes across regions, signposting the importance of targeted implementation (13).**

Whilst the multidimensional nature of SEAwise's models allowed us to more realistically capture the dynamics at play within European socio-ecological fisheries systems, it also presented a significant challenge when summarising results for use by policymakers, managers, and stakeholders. To address this, and summarise information from scenarios, Multi-Criteria Decision Analysis (MCDA) – a structured approach to help decision-makers rationally choose between multiple options where there are several, sometimes conflicting, options – was employed (13). This analysis also allowed for the identification of trade-offs and ranking of scenarios, based on the preferences of stakeholders (13).

The employment of the MCDA approach revealed that the 'best management options' were largely determined by regional priorities – whether economic or environmental (13). In other words, ultimately, priorities – whether based on stakeholder perceptions, societal values or policy goals – will determine what constitutes 'best management'.

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GUIDELINES FOR EBFM PLAN DESIGN

Notwithstanding priorities, it is possible to provide guidance on the design for an internally consistent EBFM plan. Providing a framework for SEAwise's stepwise approach and drawing together the project's iterative strands of work, SEAwise has worked to develop such guidance, applying this to the project's regional cases to monitor progression on objectives. In doing so, it has sought to **offer a flexible, evidence-based framework in support of regionally tailored EBFM, in line with regional priorities (14).**

As part of this process, we developed a typology for management interventions encompassing the social (e.g. policy landscape) and ecological system (e.g. management measures) relevant to an ecosystem-based approach to management (14). This was coupled with an evaluation of the performance of these interventions under different climate change scenarios across our Case Study regions by utilising a range of models, assessing these model outcomes against socio-economic and ecological indicators relating to objectives set out across the CFP and MSFD (14).

Adopting this approach facilitated development of testable ecosystem-based management measure categories, with comparison of future indicators to the present-day baseline (i.e. the current EBFM plan) utilised as a measure of effectiveness, based on specific objectives and regionally relevant management scenarios across our regional case studies (14). As part of these efforts, a Standard Operating Procedure (SOP) was developed to guide the design of regional EBFM plans – outlining steps from the identification of objectives, pressures, and management measures to a coherent, internally consistent and contextually tailored EBFM plan (detailed in the figure below).

In doing so we have sought to design a plan that can contribute to achieving EU fisheries policy objectives, which is tailorable to the specificities of SEAwise's regional case studies. **Building on this, our SOP could be employed in the future to develop regionally tailored management plans. With continuous assessment and refinement of measures and strategies based on regional monitoring, this flexible, evidence-based framework could contribute to effective, adaptive EBFM in the context of dynamic environmental and changing climate conditions, ultimately contributing to ecologically, economically and socially sustainable fisheries.**

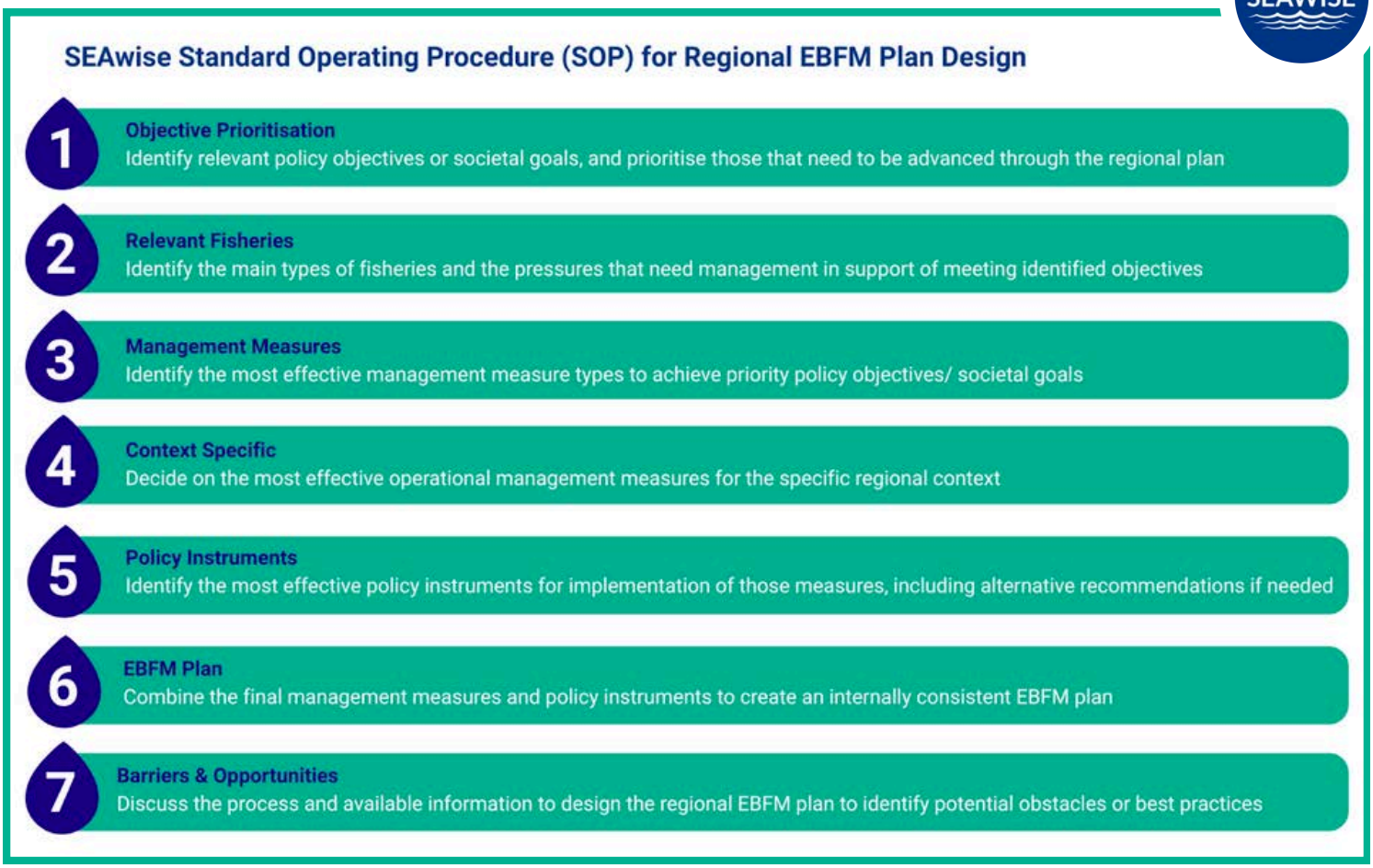

Figure 1. SEAwise SOP for Regional EBFM Plan Design

CONCLUSIONS

The evaluations conducted as part of SEAwise demonstrate that there are no pan-regional EBFM panaceas.

Instead our iterative, knowledge building approach indicates that for management to function effectively and in support of policy objectives, a suite of management measures, tailored to fisheries and pressures at the regional level is central to operationalising EBFM and balancing trade-offs in line with those priorities.

Ongoing dialogue and stakeholder engagement is key to ensuring these priorities are also aligned with wider societal goals. Further, continuous assessment and refinement based on monitoring, is required to ensure management remains effective, even in the face of changing environmental conditions.

In support of these efforts, SEAwise's work offers guidance for the development of a flexible, evidence-based framework in support of regionally tailored EBFM, which could be readily applied by decision makers in support of efforts to ensure sustainable fisheries for generations to come.

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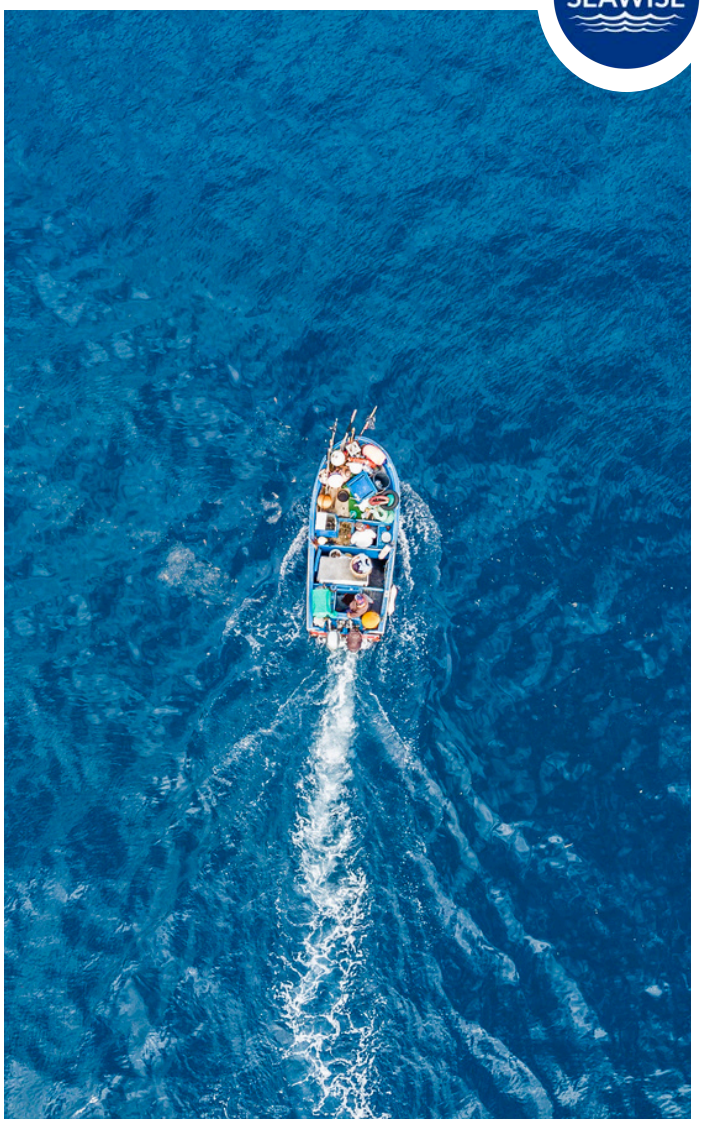

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This policy brief has been produced as part of **SEAwise's work theme on 'Evaluation of Fisheries Management Strategies'.** For further information on this work and to dive into our findings in-depth visit: https://tinyurl.com/EvalofManagementStrat.

This work theme was led by Dorleta Garcia, AZTI, as part of the broader SEAwise project coordinated by Professor Anna Rindorf, DTU Aqua.

This brief sits as part of a broader series of six policy briefs offering an overview of SEAwise's research, coinciding with the culmination of the project in September 2025. These briefs can be found here: https://tinyurl.com/SEAwisePolicyBriefs.

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