Access to space and water for marine aquaculture

Technical study

Produced by the European MSP Platform under the Assistance Mechanism for the Implementation of Maritime Spatial Planning - December 2022

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LIST OF ABBREVIATIONS

AAC	Aquaculture Advisory Council
AM-MSP	Assistance Mechanism for Maritime Spatial Planning
APAs	Aquaculture Production Areas
AZA	Allocated Zones for Aquaculture
AQUAMIS	Aquaculture Information Management System
CFP	Common Fisheries Policy
CINEA	European Climate, Infrastructure and Environment Executive Agency
CLAMS	Coordinated Local Aquaculture Management System
DAFM	Department of Agriculture, Food and the Marine
DDTM	Direction Départementale des Territoires et de la Mer
DECC	Depart of Environment and Climate Change
DG MARE	Directorate-General for Maritime Affairs and Fisheries
DIRM	Direction Interrégionale de la Mer
DLGH	Department of Local Government and Housing
DMAPs	Designated Maritime Area Plans
DSF	Documents Stratégiques de Façade
EATIP	European Aquaculture Technology and Innovation Platform
EGD	European Green Deal
EIA	Environmental Impact Assessment
EMFAF	European Maritime Fisheries and Aquaculture Fund
EMODnet	European Marine Observation and Data Network
FAO	Food and Agriculture Organization
FEAP	Federation of European Aquaculture Producers
GIS	Geographic Information System
GFCM	General Fisheries Commission for the Mediterranean
ICZM	Integrated Coastal Zone Management
IMTA	Integrated Multi-Trophic Aquaculture
LSI	Land-Sea Interactions
MAP	Maritime Area Planning
MARA	Maritime Area Regulatory Authority
MEAs	Maritime Economic Activities
MSFD	Marine Strategic Framework Directive
NMPF	National Marine Planning Framework
MNSP	Multi-annual National Strategic Plans for aquaculture
MS	Member State
MSP	Maritime Spatial Plan
MSP(D)	Maritime Spatial Planning (Directive)
NGOs	Non-Governmental Organizations
ODSS	Operational Decision Support System
OECM	Other Effective area-based Conservation Measures
OMC	Open Method of Coordination
OWF	Offshore Wind Farm(s)
PAqAT	Plano para Aquicultura em Águas de Transição
PSOEM	Plano de Situação do Ordenamento do Espaço Marítimo
SEA	Strategic Environmental Assessment
SRDAM	Schéma Régional de Développement de l'Aquaculture Marine
SSFA	Special Spatial Framework for Aquaculture
WFD	Water Framework Directive

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EXECUTIVE SUMMARY

The objective of this technical study was to identify the main trends and practices for the allocation of marine space for the development of aquaculture across the EU, within the Maritime Spatial Plans (MSPs) produced to date. Based on consultation with EU Member States, the study presents the main enablers, blockers and model practices for the provision of space and water for the establishment of marine aquaculture. The geographic scope of the study is limited to EU Member States, and provides analysis of two non-EU case studies, focusing on Norway and the UK. The different approaches and procedures for allocating marine space to aquaculture are examined through various aspects (competent authorities and licensing procedures, inclusion of marine aquaculture and zoning provision for the sector in MSPs, spatial monitoring of allocated zones, etc.). No consideration is given to the market analysis, technical and financial feasibility, or post-development monitoring of performance.

Results showed that within the available EU MSPs, aquaculture is considered one of the key maritime economic activities (MEAs) of the EU blue economy. However, even where the activity was integrated into MSPs through different types of zones (exclusive or flexible ones), a number of improvements for access to space and water for the sector are needed. In particular, regarding the involvement of aquaculture stakeholders in the MSP consultation process and the visibility of the space allocated to marine aquaculture, as well as the coordination between competent MSP and aquaculture authorities.

Also, the continuous evolution of aquaculture production models (e.g., offshore aquaculture, seaweed production) and their associated needs regarding space allocation, are not sufficiently considered within the MSPs. Climate change will be especially crucial for the development of all types of aquaculture production (fish, shellfish and algae), where impacts need to be fully anticipated and integrated into the zoning process of the MSPs. As a result, MSPs are not forward looking enough to anticipate the changes to come in terms of the required space allocation for marine aquaculture.

Based on findings and main observations from national questionnaires and interviews with EU MSs, as well as desk study research and consultation of aquaculture stakeholders at European level (FEAP and AAC), a set of recommendations are provided for the effective and streamlined planning of marine space for aquaculture and integration of aquaculture into maritime spatial plans. The recommendations proposed primarily target EU Member States and planners in order to improve licencing processes for aquaculture and MSPs to support the sector by allocating/securing space for sustainable production in accordance with the existing and emerging needs of the EU Blue Economy (i.e., Farm2Fork, EGD) to support the implementation of their respective Multi-Annual National Plan for aquaculture. However, the recommendations contained may provide relevant insights for MSP practitioners, and/or aquaculture authorities outside the EU.

These recommendations were discussed and agreed with aquaculture experts during a validation workshop held on 26th October 2022 and supports the current update and subsequent implementation of the strategic guidelines by the European Commission for a more sustainable and competitive EU aquaculture for the period 2021 to 2030.

1. CONTEXT

As the world's population increases, the need for food, of which seafood plays a major part, will also increase significantly. In 2020 global aquaculture production (encompassing all activities related to the cultivation of plants and the rearing of animals in marine or inland waters, including finfish and shellfish farming as well as algae) reached a record of 122.6 million tonnes, including 68.1 million tonnes coming from marine and coastal aquaculture and 35.1 million tonnes of algae[1]. The development of marine aquaculture and the opportunities it offers to meet a wide range of objectives have been increasingly promoted and highlighted: contribution to food security, decarbonisation of the economy through the development of low-carbon production systems, support to economic development and innovation for coastal communities and contribution to biodiversity preservation through, for example low-trophic aquaculture, etc.

To meet the increasing demand for aquatic food and to ensure that EU fish stocks are allowed to recover, the development of aquaculture (marine and inland) is supported through the EU Common Fisheries Policy (CFP) to ensure that fishing and aquaculture activities contribute to long-term environmental, economic, and social sustainability[2]. As a consequence, the European Maritime Fisheries and Aquaculture Fund 2021-2027 (EMFAF) provides specific financial support to ensure the sector develops sustainably. The European Commission recently adopted new "Strategic guidelines for a more sustainable and competitive EU aquaculture for the period 2021 to 2030"[3] (**see Box 1**), providing a long-term approach for the development of sustainable aquaculture in the EU and guidelines for the development of the sector in EU Member States (MSs). These guidelines were supported in Europe through the H2020 program[4].

These guidelines are transcribed at the national level through the elaboration of Multi-annual National Strategic Plans for aquaculture (MNSPs). The strategic guidelines are in line with the development objectives set by the EU Green Deal, including the development of sustainable food systems. The potential of EU aquaculture to support the development of sustainable fish and seafood production is also highlighted by the Farm to Fork Strategy.

Aquaculture is supported by the EU's Open Method of Coordination (OMC) that facilitates the exchange of best practices in sustainable aquaculture across the EU, as well as the Aquaculture Advisory Council (AAC) that provides advice to the European Commission and Member States on any new legislative, regulatory or legal measure at European or national level that affects aquaculture. In addition, the Aquaculture Assistance Mechanism, launched in June 2022, aims to support the implementation of the strategic guidelines adopted in 2021, providing technical expertise, training, and developing an on-line knowledge base within the Aquaculture community. More recently the European Commission has launched two initiatives on algae: (i) a platform to promote the production and use of algae in the EU and to foster cooperation and (ii) a new initiative to support algae production and consumption in the EU, through the Communication "Towards a Strong and Sustainable EU Algae Sector »[5].

The "Strategic guidelines for a more sustainable and competitive EU aquaculture" set major objectives for the sector, including building resilience and competitiveness through access to space and water, ensured through the implementation of coordinated spatial planning at the national level and involving relevant stakeholders (**see Box 1**).

[1] FAO (2022).
[2] "The scope of the CFP includes the conservation of marine biological resources and the management of fisheries targeting them. In addition, it includes, in relation to market measures and financial measures in support of its objectives, fresh water biological resources and aqua culture activities, as well as the processing and marketing of fishery and aquaculture products, where such activities take place on the territory of Member States or in Union waters" REGULATION (EU) No 1380/2013 of the European Parliament and of the Council of 11 December 2013
[3] COM(2021) 236 final
[4] European Commission, DG RTD, Dimitrova, N., Doneva, T., Hranilovic, M., et al. 2020.
[5] COM(2022) 592 final

Box 1 - EU Strategic guidelines for a more sustainable and competitive EU aquaculture for the period 2021 to 2030 – 'Space and Water'

The EU strategic guidelines identify access to 'space and water' as a factor contributing to build resilience and competitiveness for the aquaculture sector, especially through coordinated planning based on the designation of areas suitable for aquaculture. It provides the following recommendations:

- Coordinated spatial planning should encompass not only marine aquaculture, including transitional (brackish) waters, but also freshwater as well as land-based aquaculture (inc. Recirculating Aquaculture Systems, RAS).
- It should anticipate the development of offshore aquaculture, where natural conditions allow.
- Special attention should be given to the development of aquaculture with a lower environmental impact (such as combining certain types of farming to further reduce the emissions of nutrients and organic matter into the environment), and the integration of suitable aquaculture activities (notably those offering ecosystem services) into protected areas such as Natura2000 areas.
- Spatial planning should always ensure the implementation of relevant EU legislation and make available special areas for organic aquaculture and the production of molluscs.
- Planning should also take into account the adaptation of aquaculture to climate change, as well as the potential of certain types of aquaculture to mitigate the impact of climate change
- Spatial planning should be based on the designation of areas suitable for aquaculture through a process involving coordination among different relevant authorities at different levels. This process should start with the mapping of existing and potential aquaculture areas in a way that is consistent with existing environmental planning.
- Mapping should include a process to identify the potential to restore abandoned aquaculture facilities or convert existing industrial facilities to aquaculture. It should also seek to promote synergies between different activities & multiple uses of space, such as encouraging aquaculture development in combination with the development of offshore wind power.
- The designation of areas suitable for aquaculture should be based on clear and transparent criteria and tools to identify new areas. Those tools include: (i) evaluating impacts on the ecosystem through a strategic impact assessment; (ii) setting water-quality requirements (in particular for farming of molluscs); (iii) evaluating potential synergies and conflicts with other activities; (iv) determining the area's 'carrying capacity'; and (v) defining the necessary distance of aquaculture sites from pollution sources.
- The designation should be accompanied by setting up an appropriate mechanism to: (i) monitor and collect data on the environmental impacts of aquaculture activities; (ii) and monitor water quality (notably for areas used to farm molluscs).

Source: Strategic guidelines for a more sustainable and competitive EU aquaculture for the period 2021 to 2030

In 2021 with its communication "on a new approach for a sustainable blue economy in the EU"[6], the EC promoted the transformation of the "EU's Blue Economy for a Sustainable Future". This communication sets out a detailed agenda for the blue economy. Among the objectives," sustainable aquaculture is to complement the natural limits of wild captures and algae production as an alternative to agriculture" to ensure sustainable food production**.**

Maritime Spatial Planning (MSP) is a tool to support the development of the blue economy and to respond to the greater demand on maritime space. Through the integrated management of maritime activities MSP aims to reduce conflicts, manage competing interests at sea and minimise their impacts on the environment. The EU Maritime Spatial Planning Directive[7] (MSPD) establishes a framework for the development of maritime spatial plans (MSPs) across Europe.

Public consultation involving both citizens and stakeholders is a fundamental part of the maritime spatial planning process. Within the MSP process, each Member State defines objectives and areas

[6] COM(2021) 240 final
[7] DIRECTIVE 2014/89/EU

for the development of activities considering national specificities and priorities. Among the sectors to be considered, the MSPD specifies that "Without prejudice to Member States' competences, possible activities and uses and interests may include aquaculture areas [...]"[8]. To date, 15 MSs have adopted[9] their maritime spatial plans complying with the deadline fixed by the Directive, or within 1 year after the deadline.

Considering the increasing competition for available marine space between developing activities, the development goals set by the European Union for the development of marine aquaculture are likely to face challenges regarding access to space and water. It also raises questions in terms of sustainability and the impact on marine ecosystems and reaffirms the need to sustainably transform seafood systems.

The objective of the study is to identify "enablers", "blockers" and "good practices" for the provision of space and water in the marine environment for the establishment of marine aquaculture. The study looks at how this provision is accounted for within the EU Member States' MSPs that have been endorsed to date. In this study, "maritime spatial plans" are considered as the national implementation of the EU MSPD and declared as such to the EC. It also aims to present how EU Member States and several third countries deal with access to space and water for marine aquaculture in all other relevant aspects (e.g., definition of site location, licensing, monitoring, etc.).

From these enablers, blockers and good practices a set of recommendations is proposed for the effective and sustainable allocation of space to aquaculture activities. The proposed recommendations support the current update and subsequent implementation of the Commission's guidance document for access to space for marine and freshwater aquaculture.

This study considers only access to space and water for marine aquaculture [10]. Therefore, freshwater production is not included. The study focuses specifically on the allocation of space for the development of marine aquaculture within national legislation and related documentation and the procedures / process that must be followed in order to secure the space required for sustainable development. In this study, the term 'water' refers to seawater suitable for aquaculture production (e.g., with high environmental quality in compliance with the Marine Strategic Framework Directive[11] and Water Framework Directive). The various forms of production (e.g., different production systems cultivating finfish, shellfish and algae), their respective relationship/dependency upon the space (e.g., distance to the seashore) and associated environmental needs are taken into account in the study where possible, based on MSs responses to the questionnaire. No consideration is given to market analysis or the technical and financial feasibility of aquaculture sites.

The geographic scope of the study is limited to the EU Member States, where the study looks at the procedures in place in those countries for establishing specific zones/sites for marine aquaculture, spatial monitoring of allocated zones to marine aquaculture activities and licensing of sites for marine aquaculture. In line with the scope of the MSP Directive, freshwater areas are excluded. The study also seeks to include examples of successful practices from third countries within the analysis (UK and Norway).

[8] DIRECTIVE 2014/89/EU
[9] COM(2022) 185 final
[10] E.g., offshore, coastal and estuarine areas of full seawater and brackish water.
[11] In particular regarding Descriptor 8. Concentrations of contaminants give no effects and Descriptor 9. Contaminants in seafood are below safe levels

2. METHODOLOGY

The following study comprises four phases as follows.

Phase 1: Rapid Screening of national MSPs and Strategic Aquaculture Plans.

A 'simplified' inventory of Maritime Spatial Plans was undertaken based on the study of the implementation by EU Member States of the Maritime Spatial Planning Directive (MSP Directive) commissioned by the European Commission. As such collaboration with members of that study team was agreed in order to benefit from synergies associated with their review of the MSPs already undertaken.

The following core documents were part of the screening exercise for each MS:

- (Draft) National Maritime Spatial Plan(s) for each Member States (where available)
- Multi-annual National Strategic Plans' (MNSPs) for aquaculture (2013 – 2020 or 2021 – where available)
- Aquaculture and Spatial Planning 'Best Practice' Reports (e.g., FAO, GFCM etc)
- Relevant outputs from the Aquaculture Advisory Council (AAC).
- Specialist studies contracted by the EU related to the topic of Aquaculture and MSP as well as results of EU-funded projects on aquaculture and access to space.

Work initially started with countries where MSPs were available in English. Where English versions were not available, MSPs in the original language were used with the support of machine translation and native speakers where possible. Where MSPs were not available the respective Multi-annual National Strategic Plans for aquaculture were used as the primary source for the screening assessment. All available MSPs are accessible on the European MSP Platform.

In addition, the practices included on the European MSP Platform were screened and 18 potentially relevant practices relating to the allocation of space and planning of aquaculture developments were identified, which were included within the rapid screening exercise.

A screening data sheet / questionnaire was prepared (see **Annex 1** - Template questionnaire sent to EU Member States) to collect MSs' information based on relevant aspects related to both the national Maritime Spatial Planning process (e.g., stakeholder engagement, integration of aquaculture in the plans) and the key objectives targeted by the Multi-annual National Strategic Plans for aquaculture and how they implement the EU Strategic guidelines for aquaculture (e.g., assessment of marine aquaculture impacts, determining areas' carrying capacities, etc.). The team undertook a review of the relevant documentation in order to rapidly populate the screening datasheet with initial findings. It should be noted that in many cases the documentation screened was unable to respond to the questions posed by the study. As such the cooperation of MSs in Phase 2 was critical (see below).

Phase 2: Member State Engagement and Meetings

To validate the data and information collected as part of the screening exercise and to further develop the knowledge base, the study team sent the populated datasheets / questionnaires to the MSP Focal Points for each of the MSs and the relevant aquaculture Focal Points (where known) and invited them to participate in online meetings. In addition to the validation of screened information, this allowed collection of additional information which was not available from the documentation reviewed, and importantly identified valuable and innovative national practices (see boxes) regarding allocation of space to marine aquaculture. Participants to these meetings from the study team included Assistance Mechanism MSP Sea basin experts together with MSP and aquaculture experts. For MSs who did not participate in the meetings, or were unable to provide additional detail, the AM MSP team undertook analysis based on the information collected during the screening exercise. Responses to some specific questions also proved to be challenging and resulted in simple yes/no responses.

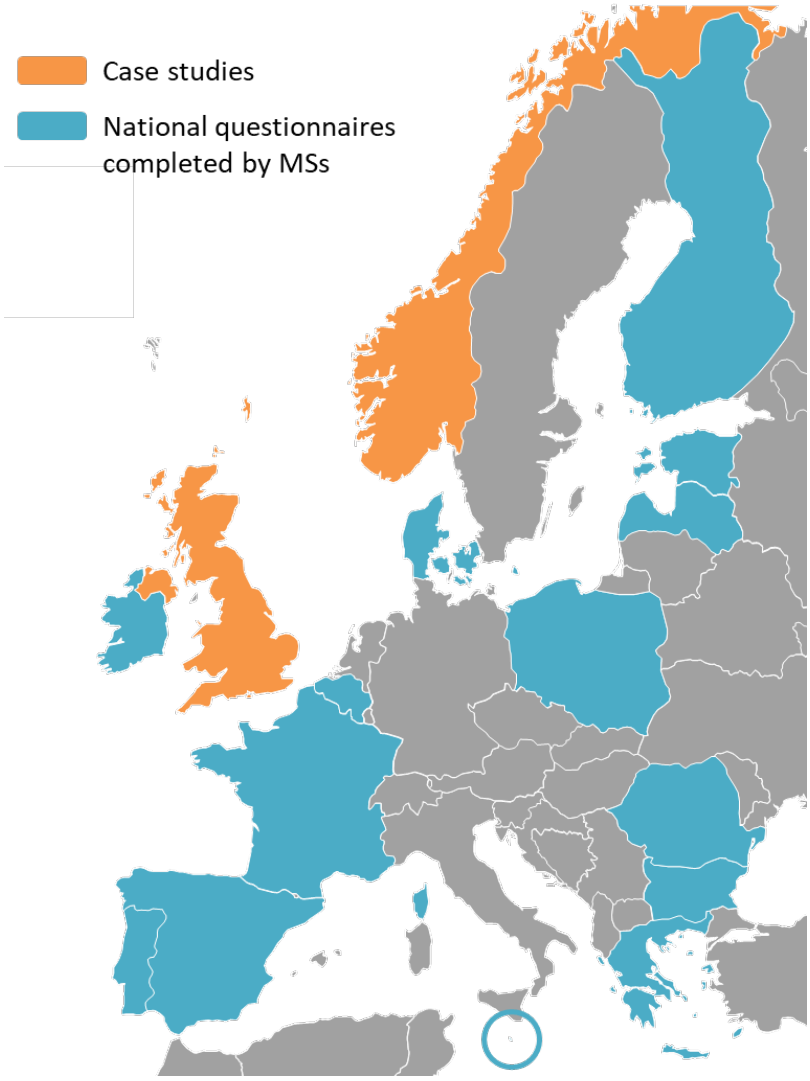


Figure 1 - Data collection through MSs questionnaires and case studies

Source: Assistance Mechanism for Maritime Spatial Planning (AM-MSP)

In addition to the data collected through the questionnaires and MSs interviews (see figure 1 above), organisations representing the aquaculture industry at European level were consulted (FEAP, AAC, etc.) to share their views on the recommendations provided in this document.

Phase 3: Analysis of findings and '*Validation*' Workshop.

The findings of both the screening exercise and the member state interviews were analysed in order to identify the commonalities and in particular the blockers and enablers to the successful allocation of space for establishment of marine aquaculture systems. Where evident that a few MSs have been particularly successful / streamlined in the process of allocating space for marine aquaculture, the analysis will seek to identify in greater detail the key enablers. The team also prepared case studies from outside of the EU (Norway - see **Annex 2** - Norway case study **-** and the UK - **Annex 3** - United Kingdom case study) to provide a contrasting approach which has been successful.

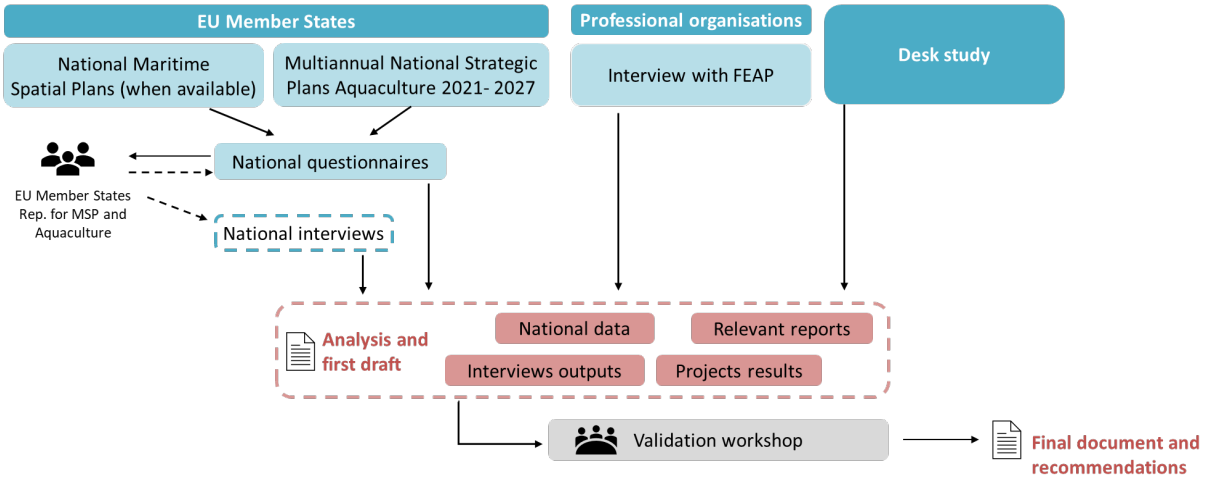
Finally, a workshop was held in October 2022 with CINEA / DG MARE and representatives of ongoing and completed studies and research projects relevant to the topic to share and discuss findings and agree on the general form of recommendations to take forward. The workshop had a number of key objectives:

- Provide the opportunity to share the results of the study.
- Act as an efficient way to incorporate evidence from other studies / projects represented to both support and provide contrasting findings to our own.
- Agree with DG MARE on the broad recommendations to be developed as part of the final reporting to ensure consistency with core policies.

Phase 4: Recommendations and Reporting.

On the basis of the workshop outcomes, recommendations were drafted ensuring that they are consistent and in line with the prevailing DG MARE policies, the new strategic guidelines for sustainable aquaculture, the OMC etc.

Figure 2 - Overview of the methodology



Source: Assistance Mechanism for Maritime Spatial Planning (AM-MSP)

3. ACCESS TO MARINE SPACE AND WATER FOR MARINE AQUACULTURE IN EU MEMBER STATES: MAIN TRENDS AND PRACTICES

This section presents the findings and main observations from 14 national questionnaires and 7 interviews with EU MSs, together with the two non-EU case studies for Norway and the UK and examines the different approaches for allocating marine space to aquaculture in their MSPs and MANPs.

The following part provides an overview of the common approaches identified across the European Union and highlights the main trends and practices. It does not intend to compare individual Member States.

3.1. Aquaculture and MSP

According to the MSP Directive "*the main purpose of maritime spatial planning is to promote sustainable development and to identify the utilisation of maritime space for different sea uses as well as to manage spatial uses and conflicts in marine areas*". The MSP Directive explicitly recognises aquaculture to be one of a number of 'maritime economic activities' (MEAs) for inclusion in MSPs that, as part of an overall ecosystem approach, create "*a framework for consistent, transparent, sustainable and evidence-based decision-making*". A few considerations regarding the expectation of the MSP Directive and its transposition into national laws:

1. The geographical scope of MSPs is 'marine waters' but this may exclude coastal waters falling under a Member State's town and country planning, provided that this is communicated in its maritime spatial plans. Given much of the EU's aquaculture is currently coastal, this is a significant clause[12] which may allow MS to exclude aquaculture from fine-scale spatial planning at a local level. This is also an issue noted in the Norway case study (see **Annex 2** - Norway case study).
2. Possible "activities and uses" include "aquaculture areas". This suggests that aquaculture is high on the EU's blue economy 'agenda' (it is one of five blue economy sectors in the 2012 EU blue growth strategy showing high potential for job creation and innovation), and also encourages MS to designate sea space specifically for aquaculture.
3. "Each Member State shall designate the authority or authorities competent for the implementation". This suggests the intention of having a single authority managing the spatial planning of multiple sectoral interests in an objective and coordinated manner.

Notwithstanding the above, the MSPD is deliberately non-prescriptive about how aquaculture (or any other blue economy sector) is included in national MSPs. More aquaculture-specific guidance was made available separately through projects like the EU Horizon 2020 project AQUASPACE (that has developed a number of tools to support ecosystem-based spatial planning of aquaculture) and MARSPLAN I & II cross-border MSP planning projects for the Black Sea (Bulgaria and Romania) which developed specific case studies for the major challenges within the Romanian and Bulgarian maritime space, including aquaculture[13].

The 2021 'Strategic guidelines for a more sustainable and competitive EU aquaculture for the period 2021 to 2030' includes a strong emphasis on aquaculture's "*access to space and water*" and on the importance of coordinated spatial planning to achieve it[14]. Provided in May 2021, the opportunity for their integration in the process of the establishment of the first series of national MSPs has been limited since the finalisation of the MSPs was due in March 2021. Nevertheless, as highlighted by the "Assessment of the relevance and effect of the MSPD in the context of the European Green Deal", they should be fully considered for the next generation of Plans as EGD objectives.[15].

[12] DIRECTIVE 2014/89/EU Chapter 1: Article 2.1 L257/140

[13] http://www.marsplan.ro/en/results/case-study/430-aquaculture-and-fisheries-in-the-cross-border-area-romania-%E2%80%93-bulgaria.html

[14] COM(2021) 236 final

[15] https://cinea.ec.europa.eu/publications/assessment-relevance-and-effect-maritime-spatial-planning-directive-context-european-green-deal_en#files

3.2. Multiannual National Plan for development of sustainable aquaculture (MANPs)

In accordance with the CFP[16], in 2013 the Commission adopted non-binding strategic guidelines for the sustainable development of EU aquaculture, where four priority areas were defined to unlock the potential of EU aquaculture:

i. administrative procedures,

ii. coordinated spatial planning,

iii. competitiveness and

iv. a level playing field.

To support this goal, each Member State was encouraged to develop a Multi-Annual National Plan (MANP) and indicate its own aquaculture growth objective in the period covered by the plan. In the draft outline for MANPs for the development of sustainable aquaculture' which was annexed in the strategic guidelines, the question of access for space and water was mainly addressed through the simplification of administrative procedures (permitting, licensing) and the development through coordinated spatial planning.

A first series of plans was produced by each EU MS for the period 2014-2020 and another one for 2021-2027. The second series produced by EU MS considered the EU's 2021 'Strategic guidelines for a more sustainable and competitive EU aquaculture for the period 2021 to 2030[17].

The MANPs stated that the majority of planning, licensing and regulation in the marine environment had been carried out on a sectoral and demand-driven basis even if Strategic Environmental Assessment (SEA), Environmental Impact Assessment (EIA) and Appropriate Assessment (AA) had been applicable cross-sectorally and undertaken in accordance regulatory requirements.

The first series was produced when the MSP directive was just coming in to force and most of the EU MS had only just initiated the process to define their respective MSP with a legal basis. Therefore, beyond the declaration to consider MSP as a potential enabler, very few actions were identified in some MNAPs, such as the upgrade of the national legal framework (e.g., Portugal) or the launch of studies to define the case to support the sector in the MSP process by developing synergies and muti-use approaches (e.g., Ireland).

In the second series, most of the MANP's have kept an objective related to permitting, in particular to simplify it or to accelerate the previous program period. Most of the EU MS have defined objectives where MSP is mentioned (usually under the 'access to space and water' theme) as a core component to support the development of the sector, through: (i) confirming existing sites and/or (ii) the identification of new production sites (e.g., Spain, France). MSP is also mentioned in reference to the development of multi-use (e.g., Estonia, Poland, Portugal) and the coordination with other sectors (e.g., Romania). Such evolution illustrates (i) the full consideration of the MSPD at the national level and (ii) the integration of the sector within the blue economy and (iii) the need to find solutions to reduce conflicts to support the development of the sector which still faces increasing competition for space allocation.

In their MANPs (2021-2027), and from their questionnaire responses, the EU MS have explicitly mentioned that they contribute to the MSP process for the benefit of the sector as space and water are common goods which are managed by public authorities. This shift to integration in the sectoral strategies illustrates the limits of mono-allocation of space to reduce conflicts and to develop synergies.

[16] REGULATION (EU) No 1380/2013 of the European Parliament and of the Council of 11 December 2013 – Article 2
[17] COM(2021) 236 final

3.3. Aquaculture authorities, governance and licensing procedure

The public sector governance of marine aquaculture and MSP is quite diverse between Member States, from central to local regarding the coordination of the decision making for planning and licensing, as illustrated by the following examples:

- In Ireland aquaculture is largely centralised through the Aquaculture and Foreshore Management Division (AFMD) of the Department of Agriculture, Food and the Marine (DAFM). AFMD is responsible for the licensing and regulation of Aquaculture in accordance with the Fisheries (Amendment) Act 1997 as amended, and applicable EU legislation. It is also responsible for the management of the foreshore through a system of leasing and licensing in respect of Fishery Harbour Centres and aquaculture/fishery related issues.
- In **France,** the Directorate of Maritime Fisheries and Aquaculture of the French Ministry of Agriculture and Fisheries at the national level both elaborates and implements the marine aquaculture policy and strategy (design, develop and apply regulations), as well as being responsible for implementation of the MSPD. All related actions are then implemented by State administration at the sub-national level by the *Direction Interrégionale de la Mer (DIRM*) and at the local level (department) by the *Direction Départementale des Territoires et de la Mer (DDTM). DDTM is* responsible for drawing up structural plans (SDS) and contributes to the support of the sector and ensures the implementation of the regulations.
- In **Spain,** the ten coastal Autonomous Regions are responsible for the planning and development of marine aquaculture, with the national Dirección General de Ordenación Pesquera y Acuicultura (within the Secretaría General de Pesca) coordinating these regional plans and international affairs. Therefore, the MSP provides guidance for the sector's spatial development, but its implementation at the local level remains the responsibility of the Autonomous Regions.
- In **Portugal** there is a hybrid model, with aquaculture on the mainland being managed centrally, but the autonomous archipelagos of Madeira and the Azores being managed separately at local level.

In **Denmark**[18], aquaculture is managed by two ministries, the Ministry of Environment (for the cultivation of fish as far as it relates to the environment) and the Ministry of Food Agriculture and Fisheries (which managed the cultivation of fish and shellfish).

The licensing procedure for Marine aquaculture is also managed at different scales depending on the country, whether led by a central authority (e.g., **Portugal**[19]**, Croatia**[20]) or by decentralised state services at local level (e.g., **Greece**[21]**, France**) and therefore implies various competent authorities. In all consulted Member States, competent aquaculture authorities were involved during the MSP process.

Marine aquaculture is generally allowable in the maritime space through licensing or permitting procedures applicable for all species (fish farming, shellfish farming, and algae) as it requires a permanent or quasi-permanent allocation of the space. It should be noted that some countries only have experience in licensing one type of marine aquaculture species (e.g., in **Finland** there is no experience of licensing aquaculture activities other than fish farming, mainly for rainbow trout). Licensing procedures can also include additional authorisations if the applicant is planning to build infrastructure on land (e.g., **Poland**[22], **Croatia**). The permitting process can be related to the space (maritime public domain) and the environmental impact assessment regarding the planned production type (e.g., **France**[23]).

[18] Information collected from the questionnaire provided by Denmark
[19] Information collected from the questionnaire provided by Portugal
[20] Information on Croatia were received following the review of Draft Report
[21] Information collected from the questionnaire provided by Greece
[22] Information collected from the questionnaire provided by Poland
[23] Autorisations d'exploiter pour les cultures marines (AECM)

Box 2 - Facilitating access to space for marine aquaculture investors in Estonia

In **Estonia**, where the aquaculture sector is not well-developed and mainly land-based, there is a strong willingness to boost marine aquaculture (mainly fish production). The costs and thus need for investment from the private sector are significant and represent an obstacle to the development of the sector. Also, the licensing procedure is quite long (2 years or more) mainly due to the required Environmental Impact Assessment process. To address these issues, the government plans on identifying and selecting specific areas at sea suitable for marine aquaculture to conduct studies as well as environmental impact assessments. These areas will be subject to public calls for tenders for the establishment of marine aquaculture production and aim at providing a 'turnkey' system for start-ups and companies, facilitating the sector's access to space and development.

Source: MS interviews

In most cases the establishment of marine aquaculture farms requires an Environmental Impact Assessment in line with national legislation, which may be systematically required in the licensing procedure (e.g., **Spain**[24]), or on a case-by-case base (e.g., **Poland**[25], **Finland**[26]**, Croatia**). In some EU MS, complementary assessments for marine aquaculture projects may be required for particular species, mostly for fish farming (e.g., **Ireland**[27]), or if the project site is located in a protected area such as Natura 2000 site (e.g., **Spain**[28] and **Belgium**[29]). For example, in Spain development of marine aquaculture facilities for the cultivation or fattening of commercial species must have approval from the Ministry for the Ecological Transition and the Demographic Challenge regarding the compatibility of the activity with the corresponding marine strategy[30]. In some MSs, based on specific cases, a permit or licence can be obtained without having to perform an EIA. For example, in **Bulgaria**, after initial assessment, if the impact of the activity is considered negligible, an EIA is not required. Also, in **France**, after initial assessment, the identification of potential impacts on a case-by-case basis can lead to exemption of an EIA. However, regarding environmental impacts, the establishment of aquaculture farms must comply, wherever possible, with the environmental objectives defined in the MSFD.

Overall, it seems that the establishment of MSP has not changed the legal framework for licensing/permitting of marine aquaculture or space allocation as it is at a more operational level (i.e., project scale) than strategic level (i.e., global allowance of activities). Certainly, this is the case for **Belgium** which has a long tradition of maritime spatial planning, and who adopted its first plan in 2014, and where conditions for the development of aquaculture were embedded into the MSP. However, as MSP is newly endorsed in a large majority of Member States, it is too soon to identify the effect of MSP on the sector across the EU.

For planners and the sector, MSP is expected to facilitate and speed up licensing and permitting processes, in particular thanks to the consultation of stakeholders on the MSP and its strategic environmental assessment in accordance with the MSPD with states that "Directive 2001/42/EC of the European Parliament and of the Council establishes environmental assessment as an important tool for integrating environmental considerations into the preparation and adoption of plans and programs. Where maritime spatial plans are likely to have significant effects on the environment, they are subject to Directive 2001/42/EC. Where maritime spatial plans include Natura 2000 sites, such an environmental assessment can be combined with the requirements of Article 6 of Directive 92/43/EEC, to avoid duplication" [31].

[24] Information collected from the questionnaire provided by Spain
[25] Information collected from the questionnaire provided by Poland
[26] Information collected from the questionnaire provided by Finland
[27] Information collected from the questionnaire provided by Ireland
[28] Information collected from the questionnaire provided by Spain
[29] Information collected from the questionnaire provided by Belgium
[30] Information received following from Spain following review of Draft Report
[31] Cf recital 23 MSP Directive.

3.4. Inclusion of the aquaculture sector and site provisions in MSPs

In various EU Member States, aquaculture plans or zoning plans were already in place before the MSPD and the endorsement of national MSP (e.g., **Finland**[32], **Portugal**[33], **France**[34]), see **Box 3** below.

In **Greece**, the establishment of Areas of Organized Development of Aquaculture Activities started to develop 20 years ago[35]. The determination and mapping of "Areas suitable for Aquaculture Development", known as "P.A.Y.", then contributed to the development of the "Special Spatial Framework for Aquaculture Development" (S.S.F.A.), approved in 2011[36]. In application of this framework, "Areas of Organized Development of Aquaculture", known as P.O.A.Y., within the already determined P.A.Y.s, started to be designed, each operating with a specific management body. Six of them have already been authorized, each with a Presidential Decree. To ensure coherence, the S.S.F.A. (current or revised) will be considered and included in MSP plans (under development).

Box 3 - Integration of marine aquaculture plans and areas in MSPs in Portugal, France and Ireland

In **Portugal** Aquaculture Production Areas (APAs) created in 2008 have been absorbed into the national MSP (Plano de Situação do Ordenamento do Espaço Marítimo, PSOEM). This plan now includes the existing APAs plus new potential areas identified under the PSOEM. It is notable that the APAs have defined environmental carrying capacities and can also define what type of aquaculture activity might be used in that area. Also, the Aquaculture in Brackish Waters Plan for mainland Portugal (PAqAT), published in September 2022, aims to organize the activity, promote its sustainability in accordance with territorial plans, and identify current and potential areas for aquaculture purposes.

In **France**, in the long term, the current SRDAMs (regional marine aquaculture development schemes) will disappear and be fully included in the DSFs (French MSP defined at sea basin level). This integration is part of the DSFs Action plan under the "Aquanet" actions of which implementation started in Autumn of 2022. Full integration into the DSFs will give more visibility to the use of marine aquaculture areas (even if management is carried out at the local level) and facilitate the development of the sector, taking advantage of the legal compliance of all the plans related to the sea under the geographical scope of the DSF.

In Ireland the National Marine Planning Framework (NMPF) specifically includes aquaculture, with three supporting 'Aquaculture Policies' (covering (i) sustainable aquaculture development, (ii) consideration by non-aquaculture activities in aquaculture areas and (iii) linkages to land-based coastal infrastructure) together with an analysis of interactions with other activities. Maritime Spatial Planning is currently through the Department of Housing, Local Government and Heritage (DHLGH), but regulatory implementation will be transferred to a new statutory organisation, the Maritime Area Regulatory Authority (MARA). There is a well-established model for local spatial planning of aquaculture in Ireland through the Co-ordinated Local Aquaculture Management System (CLAMS), but this is outside the MSP process. The Maritime Area Planning (MAP) Act excludes aquaculture (which is under the remit of the DAFM, see earlier text).

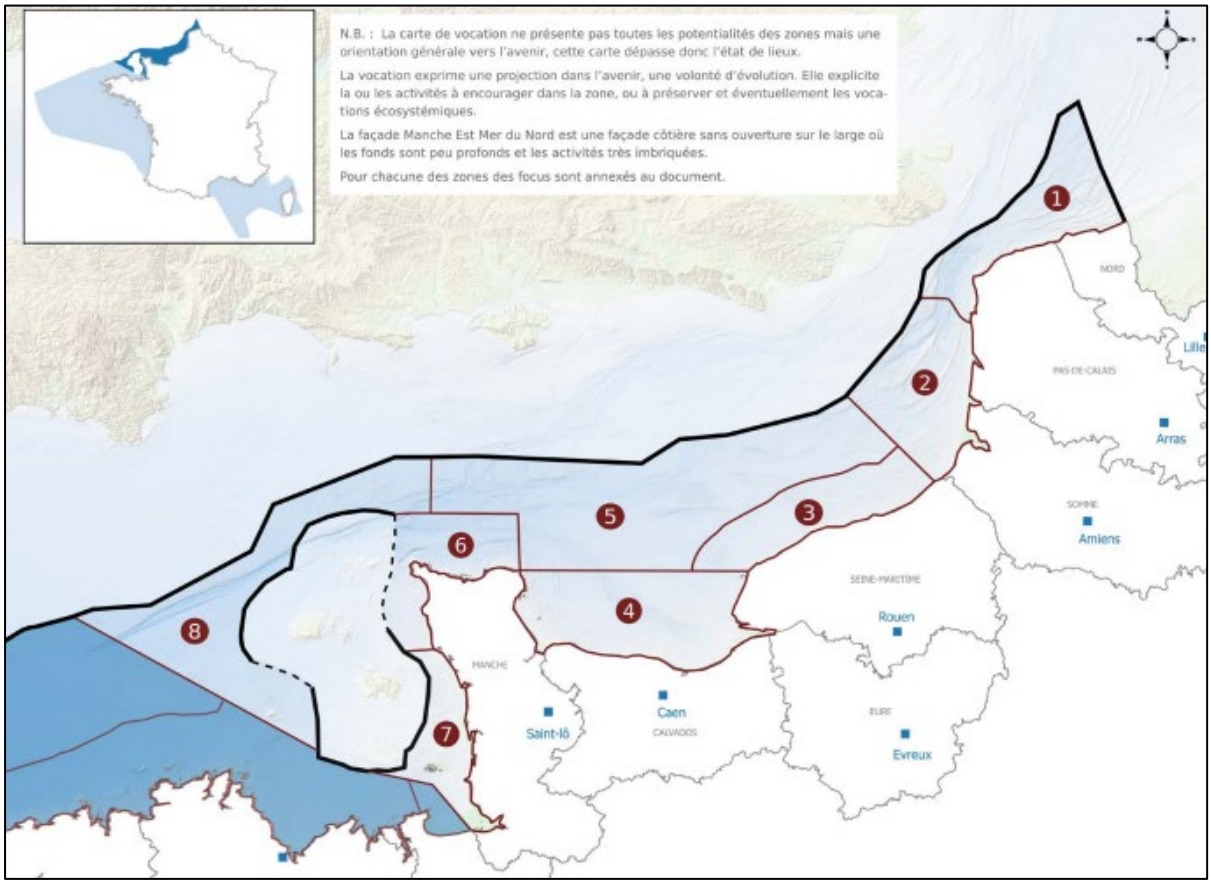
Source: MS interviews

Maritime spatial plans can have a binding effect on marine aquaculture development sites in some countries, where marine aquaculture can only be established in designated/dedicated areas (e.g., **Denmark**[37]), such as Allocated Zones for Aquaculture (e.g., **Croatia**). In **Finland**[38] [39], although

[32] Information collected from the questionnaire provided by Finland
[33] Information collected from the questionnaire provided by Portugal
[34] Information collected from the questionnaire provided by France
[35] Decision 17239/2002, CG 1175/11-09-2002
[36] *Common Ministerial Decision 31722/4.11.2011 (GG 2505 B') "Approval of a Special Framework for Spatial Planning and Sustainable Development for Aquaculture and its S.E.I.A. study*
[37] Information collected from the questionnaire provided by Denmark
[38] According to screening of Finland's MSP
[39] Information collected from the questionnaire provided by Finland

sites have been identified as potentially suitable for marine aquaculture it does not guarantee that permits will be issued, due to case-by-case considerations. In **France**[40], each MSP (*Document Stratégique de Façade - DSF*) includes vocational areas dedicated to marine aquaculture and since these MSP are legally binding, any marine aquaculture plan or project at the regional or local level must comply with the geographical scope of the DSF, which can include a wide range of administrative levels. For example, and as illustrated in **Figure 3** below, the DSF for the East Channel-North Sea basin covers two regions, seven counties (Départements) and around 20 local administrations (Intercommunalités).

Figure 3 - French MSP (DSF) for the East Channel-North Sea basin (aquaculture being possibly developed in zone 1,2, 4, 6 and 7)



In other countries, maritime spatial plans are flexible and new areas for marine aquaculture can be identified or created afterwards, such as in **Portugal**[41], where new areas can be secured by an applicant through the elaboration of an Allocation Plan and EIA. The newly established area will then lead to an update of the PSOEM (national MSP) and PaqAT.

On the contrary, marine aquaculture may be excluded from certain areas, such as in **Estonia** where prohibited areas for marine aquaculture were designated, mainly for conservation reasons (national parks) and also for reasons related to navigation of vessels and military activities.

Finally, some MSPs do not define specific areas for aquaculture but provide guidelines for the development of the sector (e.g., **Estonia**[42]**, Latvia**[43]). In **Belgium**, although the industry is considered small compared to other maritime economic activities, in addition to a number of specific zones allocated to aquaculture, sustainable aquaculture can also be developed within the five more generic 'Commercial and Industrial zones'. Other countries also include marine aquaculture in multi-

[40] (cf. L219-4 environment code)

[41] Information collected from the questionnaire provided by Portugal

[42] Information collected from the questionnaire provided by Estonia

[43] Information collected from the questionnaire provided by Latvia

use areas in MSPs, providing opportunities for the sector's development (e.g., **Poland,** see box 4 below).

Box 4 - Multi-use areas for the development of marine aquaculture in Poland

In **Poland** the marine aquaculture sector is poorly developed as aquaculture is mainly focused on land. Therefore, planners have not allocated spaces dedicated to aquaculture but considered marine aquaculture development within the framework of multi-use areas, where the activity is allowed in several basins in the Polish MSP, taking into account that the sector's development will require infrastructure which can be shared with other maritime activities.

In Poland the regulation for licensing process for offshore wind farms includes a specific selection criterion for enabling other activities to take place in the same space. This criterion is not mandatory but will provide positive scoring to the applicant, aiming to encourage investors to include multi-use in their offshore wind farm (OWF). If investors are declaring that their OWF will allow other activities, this will be written in the permit to make sure the declaration will be fulfilled. These co-located activities can include marine aquaculture, as marine aquaculture is an allowed activity in the MSP (depending however on the investors' willingness).

Also, in order to ensure opportunities for the sector's development, but also for other sectors, planners have defined areas for future uses in which marine aquaculture could be potentially developed.

Source: MS interviews

The type of species targeted in these areas is often not specified in MSs maritime spatial plans, except in some countries such as in **Portugal**[44] (class level specification), **Finland**[45] (where potential areas for aquaculture only consider fish farming) or in **France** (in existing production areas). In **Denmark**[46], there is a defined level of specification for the areas where aquaculture can be developed, as the MSP includes:

- Development zones for marine fish farming (Ah)
- Development zone for cultivation and transplantation banks for the production of mussels and oysters (Ak)
- Development zone for the farming of mussels and oysters in the water column (Ao)

It is evident from the MS interviews that when defining provisions for marine aquaculture sites in MSPs, the aquaculture sector was consulted during the MSP process in all MSs. In addition to governmental entities, the consulted stakeholders generally included professional organisations, professional aquaculture producers, port organisations as well as researchers and NGOs. Responses from Member States did not provide detailed information on how the sector was directly involved in the zoning process for aquaculture. Responses gathered suggested that zoning was discussed during the sector's consultation within the MSP process, through broad public consultations (such as public hearings and online public consultation) and/or dedicated sectoral meetings and interviews during the MSP process.

The role of the sector in the definition of aquaculture areas likely varied according to the approach adopted by each Member State (e.g., bottom-up or top-down approach) for the preparation of the MSP. In **France**, a permanent governance body for blue economy was set at the national (Conseil national de la mer et des littoraux) and subnational levels (Conseil maritime de façade) where sector representatives are members[47].This governance body was at the core of the definition of the Maritime Spatial Plans. Discussions and events between the aquaculture sector and other maritime activities were also organised in some MSs (e.g., meetings between fisheries and OWF investors in **Poland**, multi-sectoral roadshow events in **Ireland**[48]).

[44] Information collected from the questionnaire provided by Portugal
[45] Information collected from the questionnaire provided by Finland
[46] Information collected from the questionnaire provided by Denmark
[47] Conseil national de la conchyliculture (CNC) - Conseil National des Pêches Maritimes et des Elevages Marins (CNPMEM) and their regional declinations (CRC and CRPMEM)
[48] Information collected from the questionnaires provided by MSs

3.5. Zoning for marine aquaculture in MSPs

In addition to considering existing aquaculture sites, Member States have used several criteria in defining areas for marine aquaculture in their MSPs:

- Environmental features (water quality, bathymetry, wave amplitude, renewal rate of sea masses, etc.)
- Operational needs (distance and access to the coastline, industrial and port facilities, etc.)
- Interactions with other maritime activities (tourism areas, shipping corridors, seabed areas for recharge of beaches, areas of special archaeological interest, etc.).
- Economic and social criteria (availability of workers and experts, technical human resources, denseness of holiday settlement, growth potential, economic viability, etc).

Even though the MSP does not include land components, most planners have considered the land-sea interactions in particular for port infrastructure and connectivity as no maritime activity is viable without a land interaction. For aquaculture, we must consider port facilities but also the required storage space for food stock, breeding or shellfish depuration or conditioning before sale which also require access to water onshore. As a consequence, access to space is vital, both maritime space but also onshore space. The competition with other sectors, but also the multi-use of space must be addressed at sea and onshore.

Box 5 - GIS model for the identification of best suitable areas for fish farming in Finland

The FINFARMGIS modelling method, which is based on combining ecological, social and economic criteria in the spatial data set, was used to examine the potential for aquaculture sites in Finland.

The FINFARMGIS fish farming location optimisation model considers the eight environmental criteria (water flow, depth, openness of the marine area (index-, distance to the bird islands in the Natura 2000 areas, distance to underwater reefs in the Natura 2000 areas, ecologically important areas, distance to other fish farming facilities, ecological classification of coastal waters), one economic criteria (operational distance) and two social criteria (areas excluded from fish-culture, denseness of holiday settlement).

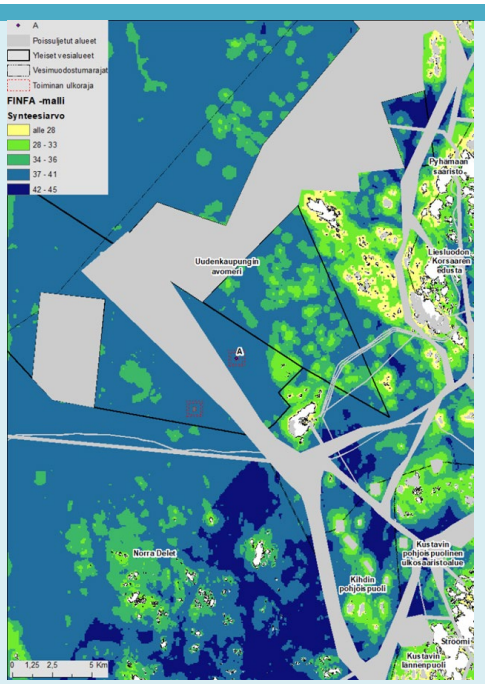
FINFARMGIS links to the national MSP GIS in the following ways:

a) It has been used to designate potentially suitable areas for marine aquaculture for the national GIS,

b) It shares some data layers from the national MSP to help exclude areas where fish farming is not possible, for example national parks, conservation areas or shipping lanes' and

c) outputs generated by the model for specific sites are a primary form of evidence considered by the seven Regional State Administrative Agencies in licensing and environmentally permitting[49] aquaculture in Finland.

Source: Interview with LUKE Institute



Source : https ://www.luke.fi/sites/default/files/2021-12/Finfarmgis%20esite.pdf

[49] Licenses tend to be long-term, non-restrictive permissions to operate. Permits are shorter-term and often come with conditions and requirements

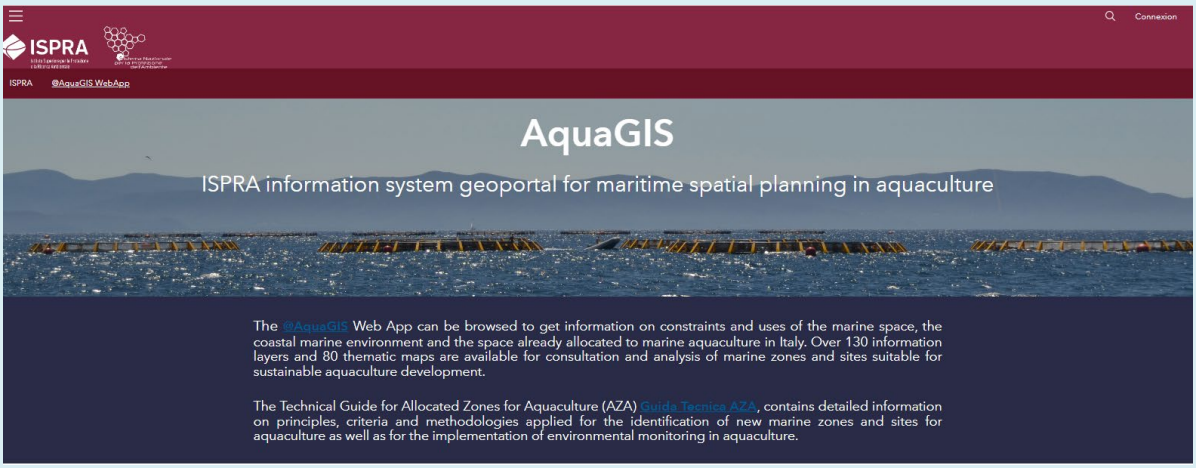
Box 6 - Tools for the identification of Allocated Zones for Aquaculture (AZAs) in Italy

In Italy, the Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA) developed initiatives in accordance with GFCM and EU policies, to support national and regional authorities in the establishment of Allocated Zones for Aquaculture (AZAs), through two complementary tools:

A Technical guide for the Ministry of Agriculture (General directorate of fisheries and aquaculture), published following wide consultation of public authorities, aquaculture producers and scientific experts, to provide methodologies for the zoning of AZAs, siting and environmental monitoring and guidance for the sustainable development and integration of marine aquaculture into MSP.

A GIS tool for the identification of suitable marine areas. The AquaGIS model, designed with several partners at national and european level (EMODnet, Copernicus), gathers more than 132 layers (including environmental and infrastructural constraints, anthropic pressures, areas of exclusions, etc.), to identify available zones for marine aquaculture. Within these zones, a second analysis highlights "priority areas" based on suitable criteria (including social aspects) for the development of both fish and shellfish farming. The tool is currently being developed at the national scale but allows for the identification of new areas for aquaculture development at the regional scale. AquaGIS meets both the demand from regions to have the best available information to develop AZAs and the need for MSP to include aquaculture activities.

Source: Interview with ISPRA



Beyond the criteria listed above, some MSs considered additional rules. In **Portugal** there is spatial segregation of the different forms of aquaculture (e.g., bivalves are within 1 nm of the coastline and finfish 1.5 nm), although the licensing process is the same. In **Belgium** there is a presumption against any species that might increase nutrient loads, and thus finfish farming is effectively discouraged by the MSP and conversely, shellfish and macro algae encouraged.

In all MSs, the best available information and expert knowledge was used to identify marine aquaculture areas and to draft the MSPs. Geographic information system (GIS) tools were also sometimes used to identify suitable areas for aquaculture, such as in in Finland (See **Box 5** and **Box 6** above).

Outside the MSP context, such tools were also developed in the framework of European-funded initiatives. For example, the Baltic Blue Growth project (2016-2018) aimed at establishing fully operational mussel farms, developed an Operational Decision Support System (ODSS) to assess the optimal locations for mussels farms and their environmental impact. This tool allows users to separate/extract information for any hypothetical farm areas by drawing a polygon on the map, offering information on the predicted biomass yield and nutrient removal service, local physical and chemical parameters, and important human uses in the indicated area[50].

[50] https://www.submariner-network.eu/images/20190418_BBG_Factsheet_ODSS.pdf

Even though environmental condition criteria were taken into account for the establishment of potential marine aquaculture zones, the suitability of sites for the sector regarding future climate change impacts was poorly considered in the first round of MSP definition. Some EU MSs have already considered climate change impacts on aquaculture sites in their MSP action plans (e.g., **Spain**[51]) or are planning to do so through their MSP revision (e.g., **France**, **Latvia**, etc.). If not specific to aquaculture, climate change was broadly considered in some MSPs, especially taking into account national strategies for climate change. For example, in Ireland, the Department of Agriculture, Food and the Marine – DAFM – published an Agriculture, Forest and Seafood Climate Change Sectoral Adaptation Plan in 2019 which sets out challenges and responses in relation to climate change and aquaculture.

When defining zones for marine aquaculture, potential conflicts with other maritime activities can have a strong influence on the process. Indeed, some MSPs define exclusive zones for aquaculture (e.g., **Malta**[52]) which receive low social acceptance. Conflicts with other maritime activities leading to appeals or litigation can contribute to slow the licensing process. But in most countries co-location of activities at sea and on the coast is encouraged. The integration of multi-use areas in the zoning process is an opportunity to ensure better social acceptance and synergistic approaches to the maritime space and also to support innovation[53]. In **Bulgaria** for example, "Multi-Functional Zones" have been defined in the MSP aimed at reducing conflicts, supporting the efficient use of marine spaces and better coordinating sectoral maritime policies. The **Portuguese** PSOEM also includes three zones for multipurpose platforms where marine aquaculture could be developed (see also **Box 4** on Poland).

New opportunities for the development of aquaculture within multi-use areas are increasingly being developed. This is the case for example with the UNITED project (2020-2023), which is a research project co-financed by the European Union Horizon 2020 programme aiming to develop demonstrators in the marine environment to support multi-use of maritime activities. Four out of its five pilots include marine aquaculture:

- Aquaculture and tourism in Greece
- Blue mussels, seaweed and offshore wind energy in Germany
- Offshore wind and flat oyster aquaculture and restoration in Belgium
- Offshore seaweed and floating solar energy in Netherlands

All pilot sites are targeting several issues, including technology, economy, environmental, societal and legal policy and governance.

Within the framework of the ongoing eMSP NBSR Project the concept of "Maripark" for aquaculture[54] is being developed, aiming to create designated offshore zones for public/private cooperation and partnership, including provision of infrastructure, in view of developing commercial activities. These zones and infrastructure would be designed by public authorities. Even though this concept is still under development Mariparks could support the development of the Blue Economy.

Another example of multi-use can be the combination of marine aquaculture and nature conservation which can be combined by developing aquaculture activities in marine protected areas such as Natura 2000 sites (e.g., **France**[55], **Spain**[56], **Ireland**[57], **Portugal**[58], **Denmark** [59], **Belgium** or **Bulgaria**). In France, marine parks already include/allow marine aquaculture activities (e.g., Parc marin des Perthuis Charentes).

[51] Information collected from the questionnaire provided by Spain
[52] Information collected from the questionnaire provided by Malta
[53] European Climate, Infrastructure and Environment Executive Agency (2021)
[54] https://www.emspproject.eu/how-to-build-maripark/
[55] Information collected from the questionnaire provided by France
[56] Information collected from the questionnaire provided by Spain
[57] Information collected from the questionnaire provided by Ireland
[58] Information collected from the questionnaire provided by Portugal
[59] Information collected from the questionnaire provided by Denmark. Areas are allocated in the Danish MSP for aquaculture within certain Natura 2000 areas. Environmental assessments will determine if specific projects can co-exist with Natura 2000 areas

However, it is likely that it may require additional environmental impact assessment to ensure that the activity is fully compliant with the legal framework for protected areas. For example, in **Greece**, marine cage farms meet the criteria to be identified as Other Effective area-based Conservation Measures (OECM) as defined in Annex III of Decision 14/8 adopted by the Conference of the Parties to the Convention on Biological Diversity in 2018. Indeed, they are "*operating in a geographically defined space, have a legitimate governance authority, they are managed, are effective, sustained over a long term (usually the licence is for 20 years*[60] *and renewed if certain conditions are met, many of them operate for more than three decades), and there is an in-situ maintenance of biological diversity, information and monitoring*" [61].

3.6. Monitoring of space allocation for aquaculture activities

Specific monitoring of aquaculture space allocation was in some cases included in the MSPs, for example in **Spain** where a common document for the five (draft) MSPs (Planes de Ordenación del Espacio Marítimo – POEM) defines a "Programme for monitoring the planning objectives and effectiveness of the POEMs" and identifies several indicators related to space allocation. These indicators are both sectoral and multi-sectoral [62].

Figure 4 – Sectoral and cross sectoral indicators in the Spanish (draft) MSP related to the monitoring of space allocated to aquaculture

Sectoral (aquaculture specific)	• Evolution of the area of the marine boundary used by the aquaculture sector. • Number and area of new authorised aquaculture sites within areas of high potential for aquaculture. • Area of new authorised aquaculture sites outside areas of high potential for aquaculture.
Multi sectoral	• No. of new authorised uses that are multi-use or multi-platform • No. of new authorised uses that experience interactions with other uses and activities that can be considered as conflicts • No. of new authorised uses that experience interactions with other uses and activities that can be considered as synergies • Area, within each area defined as "priority use" for certain future uses, in which the activity for which it has been defined has finally been developed • Area within each zones identified as "high potential" for certain future uses, in which the activity for which it has been identified has finally been developed.

Source: Planes de Ordenación del Espacio Marítimo, Parte común para las cinco demarcaciones marinas.

The development of Geographical Information Systems (GIS) can be especially useful for the monitoring of aquaculture allocated to existing and new sites, providing information for stakeholders and the public (see **Section 4.6** for more details on the use of GIS in spatial data sharing). In **Ireland**, whilst DAFM operates fairly independently in terms of spatial planning, it shares a common geographic information system with other Government Departments through the Marine Institute.

Box 7 – Development of GIS tool for aquaculture in Ireland

During the summer of 2022, DAFM announced the launch of the first phase of the Aquaculture Information Management System (AQUAMIS) consisting of a publicly accessible viewer portal. The second phase of the project (currently being developed) will deliver an online system with all applications and supporting data being submitted electronically by the applicant. AQUAMIS will

[60] Law 4282/2014 (GG 182 A') "Aquaculture Development", as amended and it is in effect (par. 1 of article 4 and par. 3 of article 20)
[61] Mangi, SC, et al. 2022.
[62] Anexo I: Planes de ordenación: Parte común a las cinco demarcaciones marinas, correspondiente a los bloques I, II, IV y V, incluyendo la representación cartográfica del ámbito de aplicación y la zonificación: https://www.miteco.gob.es/es/costas/temas/proteccion-medio-marino/anexoipoem_r_tcm30-528994.pdf

also be integrated into other government systems including the National Marine Planning Framework online portal and the wider marine spatial planning system (see **Figure 5** below).

Source: Project Marine Newsletters, October 2022, Department of Housing, Local Government and Heritage

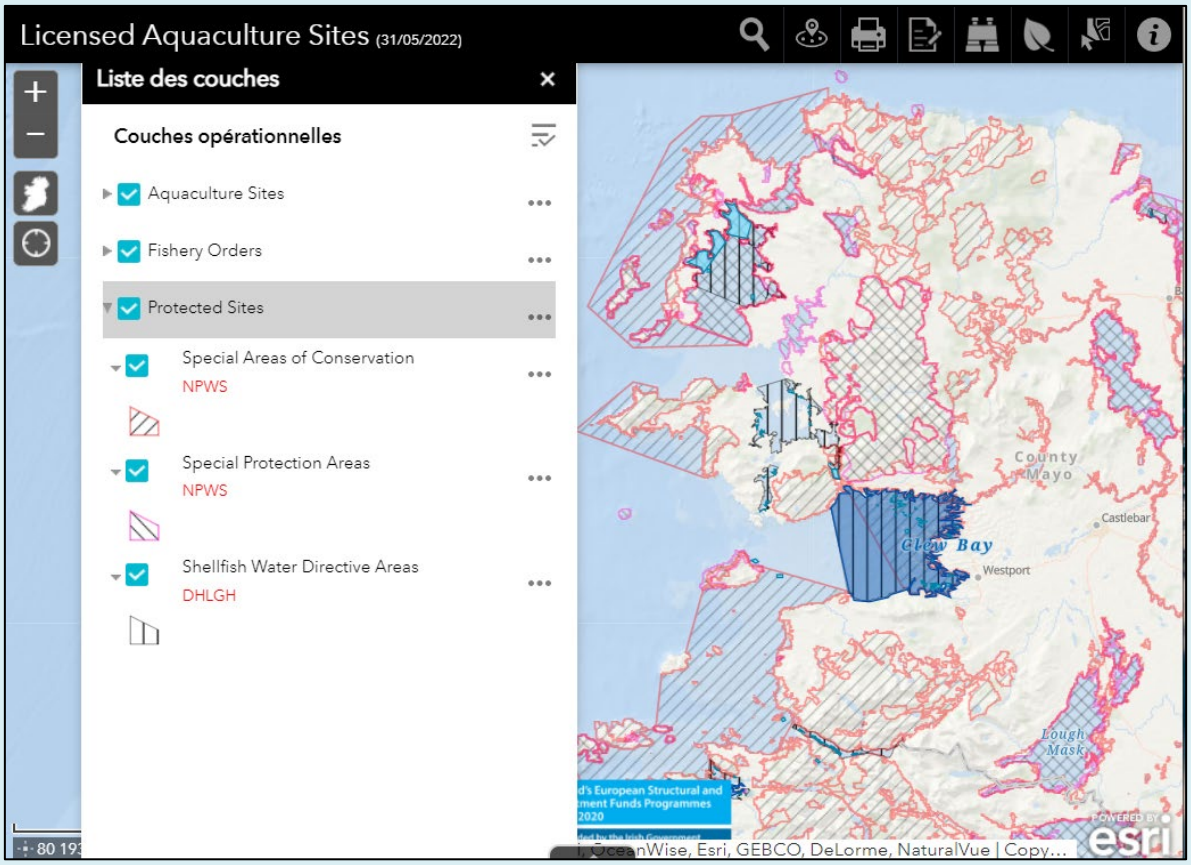


Figure 5: Illustration of the AQUAMIS GIS system showing both aquaculture and protected areas alongside fishery orders in Ireland

Source: AQUAMIS

Several other countries have developed GIS systems, whether for aquaculture licensing or for national MSP (e.g., **Portuguese** geoportal for the PSOEM[63]) to provide a general overview of the spatial allocation to the maritime sectors and to provide a visualisation of both socio-economic and environmental issues (e.g., **France** and the improvement of the Geolittoral portal[64]). **Finland's** Natural Resources Institute Finland (LUKE) have developed the FINFARMGIS model (see **Section 3.5**), which can be used to identify the area best suited to the various stages of fish farming using a spatial data tool. Currently focusing on pen-based rainbow trout production in the Baltic Sea it is mainly aimed at private companies developing marine fish farms. However, it links to the national MSP GIS as described above.

[63] https://webgis.dgrm.mm.gov.pt/portal/apps/webappviewer/index.html?id=102537ae49554da99ba0141e7cc60b52
[64] Member State interview July 2022

3.7. Enablers and blockers for the access to space and water for marine aquaculture

Based on the above information collected from Member States, a number of blockers and enablers for access to space and water for marine aquaculture have been identified:

Enablers for access to space for marine aquaculture

- Establishment of MSP securing the production areas once it is endorsed through provision of space for the sector (either as sole user or as a recognised user in a multi-use scenario).
- Access to offshore zones (if compliant with the type of production and associated costs) with OWF (in some cases incentivised) and other compatible maritime economic activities (MEAs).
- Creation of development opportunities for the sector through multi-use areas
- Integrated decision-making process for space allocation (from national to local)
- Integrated land and sea planning across different MEAs.
- The Strategic Environmental Assessment produced within the MSP is a pre-requisite ensuring the environmental viability of the activities planned, including the development of aquaculture projects.
- Development of sectoral and cross-sectoral GIS for the designation of aquaculture areas and for public consultation.
- Hierarchical development of fine-scale MSP at local levels under the technical and political framework of national MSP.
- Good representation by professional bodies (at local and/or national scale) in countries where the sector is well developed, and who have been consulted as part of the MSP process to consider the existing and future interests of the sector

Blockers to access for space for marine aquaculture

- Aquaculture can have a lower degree of priority at national level alongside other maritime economic activity (MEA), especially OWF or coastal tourism.
- Time consuming licensing procedures due to multiple actors in decision-making (MSP and sector-specific)
- Insufficient engagement of the aquaculture sector in the MSP process can result in low levels of consideration of the sector's priorities.
- Low social acceptance, possibly as a result of insufficient public consultation of new aquaculture sites, can result in delays to the licensing process or inability to develop site.
- MSP may be insufficient at the fine scale to be useful to local authorities in planning inshore aquaculture development.
- Environmental conditions less suitable for marine aquaculture in specific sea basins (e.g., Baltic Sea)
- Environmental status not suitable for marine aquaculture species due to land pollution.
- Reluctance of investors due to potentially unviable business model (as production costs at sea are higher than on land) even if there is government support (subsidies with low prices for space licence). Therefore, investors may prefer land production.
- Conflict with other maritime activities and uses which can be exacerbated by the MSP process – in particular where exclusive use of space is requested by aquaculture producers, in particular in nearshore areas
- Conflict with land activities (i.e., coastal tourism) onshore due to the need for land and infrastructure for onshore storage and processing
- Lack of sharing of spatial data on aquaculture activities (e.g., planned, active and inactive) between sectoral managers (e.g., aquaculture, shipping, etc.) and the agencies responsible for MSP

4. FUTURE CHALLENGES TO ENSURE ACCESS TO SPACE AND WATER FOR THE DEVELOPMENT OF MARINE AQUACULTURE

Beyond the blockers identified through Member State consultation (**see section 0**), several key challenges strongly impact the potential for aquaculture to access space and water in the future.

4.1. Climate change

As already mentioned above, climate change has not been sufficiently considered in Member States' MSPs with regards to the potential negative impacts on aquaculture in general. However, planning should be key tool to "*take into account the adaptation of aquaculture to climate change, as well as the potential of certain types of aquaculture to mitigate the impact of climate change (e.g. carbon capture or preservation of ecosystems that provide protection against extreme weather events)"* as highlighted in EU Strategic guidelines for a more sustainable and competitive EU aquaculture.

Beyond the statements for the production and in particular in the definition of adequate areas, space and location specificities for each type of farming, it is all the more important to consider climate change effects on the selection of production type and space allocation in a prospective approach with a mid/long term perspective.

Indeed, direct and indirect climate change drivers can be responsible for changes in aquaculture, whether in:

- **short-term** (e.g., loss of production or infrastructure due to extreme events, diseases, toxic algae and parasites and decreased productivity due to sub-optimal farming conditions) or,
- **long-term** (e.g., scarcity of wild seed, limited access to freshwater for farming, limited access to feeds from marine and terrestrial sources, decreased productivity due to sub-optimal farming conditions, eutrophication and other perturbations)[65] [66].

As highlighted in the FAO synthesis of current knowledge, adaptation and mitigation on the "Impacts of climate change on fisheries and aquaculture"[67], existing adaptation measures are available to mitigate the impacts of climate change or increase the resilience of the sector. Such mitigation actions can include:

- a **change in cultivated species** (e.g., acidification can be a boost for sea algae production)
- the **identification of new areas** for marine aquaculture (e.g., areas with natural protection for fish farms and structures against extreme events). In this regard, the EU's Climate Adaptation Strategy also provides a framework for territorial adaptation to climate change to support policy development at all levels and sectors[68].

The current, largely 'first generation' MSPs have mainly focused on the static planning of existing aquaculture methods. With climate change, both the spatial situation of aquaculture, and the systems used, are likely to change as the sector adapts and realigns to changing environmental conditions, requiring the next generation of MSPs to be more flexible. A recently published report to the Aquaculture Advisory Council (AAC) on European aquaculture's Climate Change Adaptation and Mitigation (Huntington, 2022)[69] recommends that "*MSPs and their updates should include the spatial management for more resilient and/or environmentally sustainable systems e.g., offshore or semi-contained pens, as well as promoting integrated multi-tropic aquaculture (IMTA) and coexistence with other maritime economic activities*".

4.2. National blue economy priorities

Space availability for marine aquaculture will depend not only upon national commitments and priorities regarding the existing economic weight of the sector and its potential development, but

[65] Pernet Fabrice, Browman Howard I (2021).
[66] FAO (2018)
[67] *Ibid*.
[68] COM (2021) 82 final.
[69] Huntington, T. (2022)

also on that of other maritime sectors in accordance with national blue economy priorities (when defined with dedicated strategies) and also EU regulations and strategies:

- **Marine protected area objectives** defined in the EU Biodiversity Strategy which targets an increase in the EU's network of marine protected areas to 30% of EU waters by 2030, of which 10% should be strictly protected.
- Due to the current drive for EU energy security, catalysed by the recent war in Ukraine, many MS have **strong political drivers for offshore energy development**. In some cases, according to aquaculture stakeholders[70], this has been noted to make aquaculture less able to access sea space which might be used for offshore energy development, especially considering the recent move to offshore aquaculture[71]

These examples highlight the **potential for conflicting policies**. For instance, in Finland there are two current and related policies, one for growing marine aquaculture (mainly rainbow trout in pens) and the other to reduce nutrient inputs into the marine environment. It is therefore important that marine aquaculture development is fully aware of this and mitigates its nutrient inputs accordingly (e.g., through moving to semi-enclosed / enclosed pen systems or utilising nutrient remediation through IMTA).

In some MSPs there is only limited recognition that there are potential synergies between different maritime economic sectors such as aquaculture and fisheries or aquaculture and offshore energy. The ability to recognise the need for common infrastructure (e.g., ports, engineering facilities, seafood supply chain facilities etc) would help develop blue economy clusters. This said, **MSPs have a critical role to play in allocating space to different MEAs and fully integrating environmental carrying capacities,** in the most efficient and synergistic way possible, and it is important that different sectoral interests are considered and balanced in future MSP updates as the blue economy evolves.

4.3. Production constraints and conditions for space allocation

The connectivity of services along the value chain of aquaculture between the sea and the shore and the need to access production sites (frequency) are to be considered in space allocation in accordance with the type of production. Beyond the sensitivity of species, it is also important to recall that aquaculture production facilities need to be resilient against extreme events. The identification of "secure" sites needs to be considered in the allocation of space.

The development of marine aquaculture is highly dependent on the good quality of the surrounding environment and the impacts of anthropogenic pressures from land. In particular, shellfish farming requires high water quality to minimise food safety risks and associated producer costs (e.g., depuration). Locating marine aquaculture production close to the shore therefore requires a need for robust monitoring of water quality and a reduction of these pressures.

The following table recalls the level of dependency of key conditions for marine aquaculture production which have a direct impact on the location of the production sites per species. However, it is important to consider that these needs will be different depending on whether intensive aquaculture (e.g., sea bass farming) or extensive aquaculture (e.g., seaweed farming) is to be developed.

Much has been made of the need to move aquaculture offshore[72]. There are a number of drivers for this as summarised in the case study in **Box 8** below. This focuses on England, as the coastal waters are particularly crowded (e.g., coastal development, wind farms, high levels of human activity) compared to elsewhere in the UK.

[70] Interview with FEAP, July 2022

[71] Offshore aquaculture has been defined as the farming of finfish, shellfish or algae: (i) greater than 3 km from the shore, (ii) greater than 50 m water depth, (iii) not normally visible from the shore, (iv) with up to a 5 m wave height and (v) only accessible in 80% of weather conditions

[72] FAO (2022).

Figure 6: Production constraints for different aquaculture groups

Conditions	Cultivated Species		
	Finfish	Molluscs/bivalves	Macroalgae
Requirement for space (surface area)	Medium	Medium (coastal zone)	Very high
Distance to the shore for production	Short	Very short (oyster)- Short medium (mussels)	Low (except when co-located with OWF)
Frequency to access	Daily (feeding if not automated)	Weekly/monthly (oyster) Low for mussels	Low
Access to the land	Medium (port close to the farm)	High for oyster (refining) Medium for mussels	Low (port)
METOC[73] condition sensitivity	High (wave) Temperature	Temperature Acidification (pH) / Salinity	Low
Environmental sensitivity	Mid/low – need of water circulation under the cages	High with land pollution	Low (except at very largescale)

Note: High (red), Medium (orange) or Low (green) level of production constraints for each aquaculture species.

Source: Assistance Mechanism for Maritime Spatial Planning (AM-MSP)

Box 8 – Drivers for moving aquaculture offshore in England

The inshore waters of England are very crowded:

- Moving offshore increases the potential for scalability / provides room for expansion
- Inshore there is the higher risk of unwanted interactions with other activities e.g., with sensitive habitats as well as accidental / criminal damage to aquaculture facilities

Inshore waters are particularly vulnerable to terrestrial pollution:

- Spikes in pathogens from storm run-off tend to affect inshore waters more but offshore waters are not immune, inc. from ship-borne pollution
- Inshore waters are also more vulnerable to eutrophication from agricultural run-off

Inshore there tend to be dynamic and changeable environmental conditions

- Offshore sites tend to be more stable in terms of salinity, seawater temperature, etc.
- They also have clearer water, with less silt and better light penetration for photosynthesis

Inshore waters may have poor or variable flushing rates

- Some inshore sites have poor flushing rates, inhibiting growth and limiting the sites' carrying capacity.

Source: Huntington, 2021[74]

However offshore sites also have a number of challenges, including:

- **Hostile physical environment**
  - Wave climate, strong currents – all have implications for mooring, stock containment and operations

[73] METeorological and OCeanographical

[74] Huntington (2021).

- But engineering solutions for these are relatively straightforward.

- **The logistical challenges are more pervasive**
  - Longer transit times to / from farm
  - Need for larger work boats and support facilities e.g., food storage
  - Implications for other logistics e.g., port facilities, farm security, etc.
  - All these have an impact on cost and profitability.

- **Lack of knowledge and information**
  - Modelling of growth and other farm performance is still lacking for a number of different systems and development options.
  - Many husbandry techniques will need to be changed or adapted for offshore farms.

MSPs have an essential role in addressing many of these challenges, especially given the expansion of aquaculture offshore will often bring it under national rather than local jurisdiction. This might include:

- spatial zoning for particular types of aquaculture systems
- the integration of models for wave climate, storm frequency, current and wind speeds that will facilitate the development of all offshore MEAs (including aquaculture)
- the identification of spatial synergies across MEAs for either co-development or land-sea access integration (e.g., ports, maintenance trips, etc).

4.4. Development of sector's environmental sustainability

Even if Environmental Impact Assessments (EIA) are implemented for marine aquaculture production in almost all Member States, the environmental sustainability of the whole activity will have to be improved and reinforced. The willingness to increase the role of aquaculture in food security and economic development of coastal territories must also be coherent with the need of the sector to **fully contribute to the achievement of the good environmental status of the marine ecosystem**. As highlighted by the FAO through its recent "Blue Transformation" initiative, the expected increase of aquaculture in global food production requires *"new, sustainable and equitable aquaculture development strategies"*[75] especially to contribute to achieve the Sustainable Development Goals.

Regarding the protection targets set in the EU Marine Strategy Framework Directive (MSFD) and the restoration objectives defined in the recent "Proposal for a regulation of the European Parliament and of the Council on nature restoration"[76], which will have to be achieved by EU Member States, the development of the sector and the establishment of marine aquaculture **areas will increasingly depend on the ability to reduce/compensate the environmental impact of aquaculture activities**. The long-term sustainability of the sector is an important factor in the social acceptability of the activity[77] among coastal communities.

In this context, the selection of aquaculture production type and associated zoning will be a key factor to **determine all the associated social and environmental impacts to ensure its acceptance and resilience.** This includes a good understanding of the environmental context, taking into account its carrying capacity in each selected area before any settlement[78]. Therefore, as suggested in **Section 4.2** above, MSPs have a key role to play here, especially at the finer level of detail, where they can be integrated with environmental carrying capacity studies across defined water areas (e.g., bays, rias or fjords).

[75] FAO. (2022).
[76] COM(2022) 304 final
[77] Hofherr, J., Natale, F., Trujillo, P., (2015),
[78] European Commission (2018)

4.5. Production evolution and technical innovation

Many MSPs do not reflect the changing nature of aquaculture techniques (e.g., a move offshore, the development of closed / semi-closed containment systems) and production types (to lower trophic species such as macroalgae). As discussed in **Section 4.1** it is important that MSPs are forward looking, anticipating and flexible to new spatial needs and managing possible conflicts with other sectors as these changes occur, especially in the face of climate change adaptation.

Some MSs are considering the possibility of developing IMTA within zones dedicated to aquaculture in their MSPs. However, IMTA in Europe is still in the experimental / pilot stage, and aquaculture licensing procedures at the national level are mainly single species oriented. There are a number of blockers to the uptake of IMTA including:

- A lack of proven full-scale technical IMTA models, especially in marine systems (IMTA could be developed at much larger scales e.g., bay level)
- High cost of multiple systems /crops that makes them financially unviable, especially at small scale, where the extra costs of infrastructure / operation out-weigh any incremental income. This can be over-come by increasing scale. For small-scale IMTA it might be possible to price in the ecosystem services provided through public compensation funding.
- Mismatch in production cycles
- Overly precautionary licensing restrictions due to a lack of regulator experience with IMTA systems.

The other major technical development relevant to MSP is the pan-European interest in **macroalgae (seaweed) farming.** A study by North Sea Farmers[79] examined the potential for seaweed farming in the North Sea, mainly in association with offshore wind farms. They aim to have 400 square kilometres of seaweed farms in Dutch waters between offshore wind farms by 2030, reducing emissions up to 1.6 million metric tons of CO_2. Their study found that the European seaweed market is growing rapidly from €840 million in 2020 and that sales were projected to increase to between €2 billion and €3 billion by the year 2030. Vincent et al (2020)[80] has an alternative development scenario, considering that European seaweed production in 2030 will be 8 million tonnes (fresh weight), creating 115,000 new jobs. Seaweed products have a wide range of applications from human and animal food to pharmaceuticals to bio-packaging and biofuel.

This said, seaweed farming needs to be developed carefully. It is mainly reared in the upper water column and thus large farms will need a large surface area (Vincent *et al*'s scenario of 8.3 million tonnes seaweed production would require 263 square kilometres of sea area). It is therefore essential that seaweed farming is included as a priority aquaculture species in MSPs to ensure that these potentially large units are well integrated into the marine space. As noted by the North Sea Farmers' case discussed above, **there is also the need to integrate seaweed farming into the spatial planning of other compatible MEAs**, in particular offshore wind farms. Indeed, Vincent et al (2020) note the need for a more streamlined regulation of new seaweed farms in European waters and that "*There is, however, significant potential for these regulatory processes to be streamlined at a national level. Part of the solution relies on a clearer integration of seaweed in national marine spatial plans that coordinate and manage the different uses of the ocean in areas within national jurisdictions"* and that *"At the state level, proactive and science-based mapping of sites suitable for seaweed farming will accelerate the process when farm licence applications are received*".

4.6. Spatial data sharing

Although the EU is advanced in terms of marine environmental data sharing (e.g., via the European Marine Observation and Data Network), nationally, there is still a lack of sharing of spatial data on aquaculture activities (e.g., planned, active and inactive) between sectoral managers (e.g., aquaculture, shipping, etc.) and the agencies responsible for MSP. Addressing this would help

[79] See https://innovationorigins.com/en/european-seaweed-farms-are-the-future/

[80] Vincent, A., Stanley, A. and Ring, J., (2020)

different sectoral managers to better understand the actual nature of marine economic development and therefore avoid conflicts (or develop synergies) where possible. The question of data sharing was also raised by the European Aquaculture Technology and innovation Platform (EATiP), during two workshops[81] co-organised with Copernicus and EMODnet, where the need for collaborative aquaculture platforms to create networks between public bodies and private stakeholders was highlighted.

A key tool for data sharing is GIS. GIS use specialised software to layer spatial and associated data across a wide range of areas, including basic, essentially static information such as bathymetry, shoreline topography and jurisdictional boundaries with more dynamic information such as environmental conditions (e.g., tidal, currents, water temperatures, benthic habitat mapping, etc) and infrastructure development (e.g., roads, ports, pipelines, undersea cables, etc). On top of this can be layered spatial information on MEAs e.g., the boundaries of aquaculture operations with their associated metadata (e.g., ownership, characteristics, etc). GIS data layers can be shared within and between organisations, as well as with the public, often through online data portals.

There are numerous advantages to sharing MSP-related GIS data. In relation to aquaculture this can allow regulators to ensure that their permitting and licensing of aquaculture operations is consistent with marine spatial planning at both national and local scales. It also allows different sectors to avoid spatial conflicts with others requiring similar sea space, and to identify opportunities for co-location. GIS systems also allow physical MSPs to be rapidly updated. This said, careful consideration must be given to the collection and sharing of MSP-related GIS data, including:

- Technical aspects: to share GIS data, despite the innate compatibility of most GIS software there is a need to agree a wide range of protocols for data gathering, data input and information outputs (see Gray, 2019). It is worth noting here that the Technical Expert Group (TEG) on Data for MSP is working on issues relating to harmonisation of EU MSP Data sets.
- Data protection and privacy issues: some information will inevitably be private or commercially or nationally sensitive and thus cannot be shared, at least in detail. Individual sectors may also be reluctant to share certain spatial information with a national MSP GIS – for instance aquaculture regulators might not want to share individual operator information or license conditions with a wider audience. Therefore, data sharing protocols and agreements have to be established in advance.
- Cost: although a GIS can be based on a single PC, larger data sets will need to be stored on servers. National MSP GIS will require constant update and data quality assurance, requiring specialised technicians. As such, these larger systems are expensive to both establish and maintain. It is important that a suitable strategy is developed that identifies and maps out data providers, data users and associated service providers across the public and private sectors and ensures the most cost-effective and efficient solution possible.

This might vary from Member State to Member State, depending on the institutional structures and expected data exchange. For instance in **Ireland** the Marine Institute is the accepted marine data manager and they have developed (i) the 'Marine Atlas' (https://atlas.marine.ie)[82] as part of the national reporting for the EC's Marine Strategy Framework Directive on the environmental status of the seas and oceans around the country, (ii) participated in the SIMCelt project on MSP in the Celtic Seas developing a framework for the assessment of cumulative impacts of human activities in the Irish Sea and (iii) developed Ireland's Marine Renewable Energy Portal in association with the Sustainable Energy Authority of Ireland.

[81] European Aquaculture Technology and Innovation Platform (2020) and European Aquaculture Technology and Innovation Platform (2020)
[82] See dedicated page

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

The 2021 *Strategic guidelines for a more sustainable and competitive EU aquaculture for the period 2021-2030*, the MANPs for aquaculture, as well as the development of Maritime Spatial Plans, will support the development of marine aquaculture as part of the EU's blue economy, fulfilling a number of expectations regarding food security, environmental protection, climate change mitigation, economic resilience and innovation.

The key findings and conclusions of this study are as follows:

1. **Aquaculture is well considered in the available MSPs across the EU**

Aquaculture is recognised to be one of the key maritime economic activities (MEA) of the EU sustainable blue economy thanks to its high potential to create sustainable jobs and value to meet the EGD[83]. This said, it is evident that aquaculture has differing levels of policy priority across the EU, with ocean energy becoming prioritised in recent times. This is reflected in some MSPs where aquaculture development is clearly of a lower priority to other MEAs.

From the data collected during MSs questionnaires and interviews, countries were seen to have taken one of two different approaches: (i) Member States in which marine aquaculture is a mature sector (e.g., France, Spain, etc.) and where the sector was fully integrated into the MSP though areas aligning with existing sites and activity and (ii) Member States in which marine aquaculture is emerging or is undeveloped and within MSP does not benefit from dedicated areas but is encouraged through multi-use areas (e.g., Bulgaria, Poland**, section 3.5**).

2. **Not all MSs have the same capacity to contribute to the development of the sector**

This is due to several reasons, including regionally distinct environmental conditions (e.g., less suitable environmental conditions in the Baltic Sea for the sector's development), production costs and investor engagement. However, is important to highlight that MSs, even though creating the enabling conditions for the sector's development by reserving/allocating space for the sector, are depending on private stakeholders' willingness and ability to invest in marine aquaculture. Indeed, socio-economic factors may hinder the sector's access to maritime space independently of the EU MS action (e.g., technical and financial viability).

3. **Most MSPs are non-prescriptive in terms of spatial allocation for aquaculture.**

In most cases, areas are identified as of high potential for different species and more rarely, different production systems, but aquaculture is rarely prioritised for these areas (e.g., in the form of allocated zones for aquaculture – AZAs).

4. **National MSPs may exclude coastal aquaculture when it is covered at local level.**

'Marine waters' fall under the MSP but these may exclude coastal waters falling under a Member State's town / country planning regime, as long as this is communicated in its MSP. Furthermore, spatial planning for coastal areas is often delegated to local government, who again have varying levels of involvement and integration with the national MSP. This is particularly relevant to aquaculture, given that most of the activity is currently positioned in coastal waters and for reasons described above, may be excluded from the existing plans.

5. **There is a risk of policy inconsistency and conflict due to the diversity in the institutional structure for aquaculture and MSP.**

The licensing and permitting of aquaculture generally remain solely in the aegis of the fisheries sector management, both at national and local levels. The degree to which this is guided by the national MSP is variable, but most MS do have spatial development policies and associated guidelines that are coherent across different departments and jurisdictions. Also, there is considerable diversity

[83] COM(2021) 240 final

in the institutional structure of marine spatial planning in the EU. The MSP Directive asks that "*Each Member State shall designate the authority or authorities competent for the implementation*". This suggests the intention for having a single authority managing the spatial planning of multiple sectoral interests in an objective and coordinated manner. Most MS might have one entity responsible for assembling the MSP, but in reality, aquaculture zoning remains the responsibility of the aquaculture managing authority, with varying levels of coordination with the MSP process. This said, there can be a degree of potential policy inconsistency (**see section 4.2**).

6. **Many MS are developing geographical information systems (GIS) to support and implement their MSPs.**

The level of integration between sectoral GIS (e.g., for recording aquaculture licensing and permitting information) and national MSP GIS (which compiles data layers from multiple sectors) is variable, but there are some advanced systems being developed to both support aquaculture growth (e.g., movement offshore) and to ensure the risk of spatial conflict with other MEAs is minimised. The adaptive nature of GIS also allows spatial planners to rapidly update mapping with new developments and constraints.

7. **MSPs across the EU are not forward-looking enough regarding the developments affecting marine aquaculture.**

The aquaculture sector is progressively exposed to internal and external changes that will inevitably affect site allocation for the development of the activity. These changes include:

- The adaptation and mitigation planning of the sector with regards to climate change impacts, including the reconsideration of aquaculture sites (existing and potential). MSPs and their updates should include evolutions related to changing environmental conditions under climate change, as well as spatial management for more resilient systems, a process that should be assisted by the MANPs and EMFAF Operational Programmes.
- The move to offshore aquaculture to avoid the crowded coastal space and to capitalise on more stable, albeit exposed conditions away from the coast. This is likely to bring aquaculture out of local planning into national MSP and present a new set of challenges in terms of coexistence with other offshore MEAs, such as maritime transport and offshore wind farm development.
- New technical developments in aquaculture that have the potential to transform the sector in the EU and wider Europe. One key area is that of seaweed farming, where around 250 - 400 square kilometres of sea area might be required by 2030 (Vincent *et al*, 2020, North Sea Farmers[84]). This will pose challenges for the MSP process and therefore MSP plan revisions must be forward-looking, flexible and proactive.

8. **Some Member States are using MSPs to conduct large-scale environmental and other carrying capacity analysis.**

This is a welcome approach to potentially reducing the administrative burden of aquaculture site permitting as much of the EIA and other site-related data will have already been collected and analysed. In some cases, this has been integrated into GIS (see bullet 7), such as Finland's FINFARMGIS modelling approach.

5.2. Recommendations to improve access to space and water for marine aquaculture

The following set of recommendations are designed to build upon the recommended actions in the 'Space and water' Section within the EU Strategic guidelines for a more sustainable and competitive EU development of aquaculture for the period 2021-2030 (see **Section 1)**, as well as earlier EU and other guidance on the subject. The majority of these recommendations need to be implemented at Member State level, but public funding (e.g., via the EMFAF) and EU research funding (e.g., Horizon Europe and European Technology Platforms) could assist in supporting pilot projects

[84] See https://innovationorigins.com/en/european-seaweed-farms-are-the-future/

5.2.1. Aquaculture authorities, governance and licensing procedures

Reducing the administrative burden associated with aquaculture licensing was a primary focus of the previous guidelines and resultant MS MANPs and EMFF Operational Programmes and remains a key constraint to growth in the EU. However, it is recognised that the complex jurisdictional and technical conditions in the busy blue economies of MS are an inevitable reality, and that the MSP process has a role to play in providing a cross-sectoral platform for coordinating spatial planning and a basis for data and information exchange at both vertical (e.g., trans-boundary / national / local) and horizontal (e.g., cross-sectoral) levels. Based on the research conducted and the interviews undertaken, we have the following recommendations:

1. **Finer-scale maritime spatial planning should be conducted to facilitate local development by planners and Member states.**

Given most European aquaculture is currently coastal, it maybe under-represented in national MSPs that don't necessarily include all coastal activities under the jurisdiction of municipal or county authorities. For instance, in Norway, aquaculture is only now being fully integrated into marine spatial planning as it moves offshore. Therefore, a tiered hierarchy of high-level national and more detailed local planning for aquaculture development needs to be achieved, such as in the UK where there are coherent, hierarchical marine plans emerging (see UK case study **Annex 3** - United Kingdom case study). National-level planning can provide consistency and predictability, both favoured by developers. But the advantages of local level planning described above should not be ignored, that is of a hierarchical system that provides a common, top-down framework that allows both (i) the specific planning characteristics of local conditions to be accounted for, and (ii) representative stakeholder consultation to be conducted without compromising national aquaculture and spatial planning policy and strategic objectives. Involving local authorities will also assist in balancing the interests of different sea space users, as well as maximising the opportunities for co-existence (e.g., between aquaculture and capture fishing activities). In addition to local authorities, community engagement should not be overlooked, as social acceptability can highly influence the development of aquaculture sites (section 3.5.). Local planning with community engagement can support the development of small businesses (e.g., creation of aquaculture cooperatives) strongly rooted in the local socio-economic context. This can be facilitated by the development of local blue economy strategies which should be developed as adaptive declinations of the national plans (MSP).

2. **Institutional mapping should be carried out/reviewed by Member States to ensure aquaculture representativeness in MSP governance and improve licencing.**

Stakeholder input mechanisms into marine spatial planning in general – and the role and inclusion of aquaculture in particular – should be formalised. The institutional mapping should be conducted across aquaculture governance, national maritime spatial planning and marine environmental data providers to examine where administrative efficiencies might be gained though coordination and data integration, possibly as part of the evaluation process of MANPs. This mapping process would also assist to develop more integrated and possibly 'one-stop-shop' approaches for aquaculture licensing by identifying institutional and process gaps and overlaps.

It would help to ensure that the sector is properly considered in the MSP governance structure which could be set by EU MS for MSP implementation. The inclusion of local stakeholder groups in both the strategic development of aquaculture (e.g., identifying and establishing aquaculture development areas), as well as permitting and licensing processes, will make marine spatial planning more robust and potentially reduce the time and complexity of licensing and permitting. In the UK the enactment of the Marine and Coastal Access Act 2009 resulted in the formation of the Marine Management Organisation (MMO) which was designed to combine the marine licensing responsibilities of different sectorial bodies. These included the former Marine and Fisheries Agency as well as acquiring several important new roles, principally marine planning and other marine-related powers and specific functions previously associated with the Department of Energy and Climate Change and the Department for Transport, including works related to renewable energy installations

5.2.2. Inclusion of the aquaculture sector and site provisions in MSPs

Despite its importance in both the EU blue economy strategy, as well as in EU food security, aquaculture has previously been under-represented in national maritime planning at MS level. This is possibly due to a historic preoccupation with capture fisheries, which is often more visible and is strongly rooted in coastal economies and culture, and the current focus on offshore wind farming to support EU energy security. There is however a growing realisation that aquaculture has the potential to sustainably expand EU seafood production through an increasingly diverse array of low carbon production systems that can also assist the EU's climate change mitigation and food security strategies. MSP can play a key role in this transformation process by ensuring sea space and water resources are efficiently used across the blue economy. In terms of aquaculture this includes ensuring space as the sector consolidates its activities in inshore waters and expands into the offshore space, both individually and in colocation with other MEAs. Based on the research conducted and the interviews undertaken, we have the following recommendations:

4. **European Green Deal (EGD) objectives should be further included in MSPs.**

Including new aquaculture species and systems that contribute to climate change adaptation and mitigation. This includes realigning existing production as environmental conditions change and diversifying into new, lower carbon species and systems.

5. **Specific policies and guidelines for aquaculture development should be included in MSPs in different production areas.**

These should cover:

- Aquaculture-specific policies: might promote certain species or production systems for different spatial areas e.g., finfish pen culture only in areas exceeding x metres in depth or y kilometres from the shoreline (see UK case study for some examples - **Annex 3** - United Kingdom case study).
- Cross-sectoral policies: guidance on how aquaculture can (i) avoid spatial conflict with other MEAs (e.g., the use of exclusion zones) and (ii) how synergies and co-location opportunities can be maximised (e.g., development of seafood clusters that support both aquaculture and fisheries).

6. **Multi-use concept should be encouraged in MSPs to provide better visibility on spatial synergies between existing/potential maritime activities.**

Opportunities exist for aquaculture to share landside facilities and infrastructure (e.g., slipways, quay space, bunkering) with other marine economic activities (e.g., capture fisheries and offshore renewables) to foster the efficient use of maritime and coastal space. These synergies can be highlighted by the identification and promotion of opportunities for flexible co-development / co-location and the sharing of common resources and facilities across different sectors. In particular, aquaculture has potential synergies with offshore energy, capture fisheries, tourism and environmental conservation. Multi-use can be supported through: (i) dedicated multi-purpose platforms/ multi-use areas (e.g., Portugal); (ii) specific requirements for multi-use in national public calls for tenders for the development of marine renewable energy (see **section 3.4** with the example of Poland); (iii) the support/development of multi-use pilot project targeting aquaculture. Furthermore, the use of incentives, such as taxation, can be used to encourage both aquaculture and OWF investors, as well as other maritime activities to implement multi-use approaches, including IMTA.

7. **MSPs need to be forward-thinking in terms of the direction of aquaculture development and technical change**.

Therefore, they need to include suitable sector analysis as part of the MSP process and to ensure that technical change such as the development of offshore aquaculture or the introduction of closed / semi-closed systems in coastal waters is accounted for in maritime spatial planning. It should take into consideration low-trophic aquaculture (including IMTA) which can be compatible at suitable scales with nature conservation objectives and can potentially co-exist in designated marine

protected areas (MPAs). It could be comprehensively reflected in MSPs as it is to be developed under MANPs and EMFAF OPs.

8. **Spatial implications of climate change on aquaculture should be included in Member State's 'Climate Adaptation Plans'.**

These plans (being developed at national, regional, transnational or sea-basin levels) should provide an overview of the impact of climate change on aquaculture sites and its contribution to climate change mitigation. It is likely that traditional aquaculture will need to re-align with changing environmental conditions as the fundamental impacts of climate change (e.g., sea level rise, sea temperature changes, acidification, storm exposure, etc) take grip. Aquaculture producers who are directly affected by climate change should be consulted during the elaboration of MSs climate adaptation plans.

9. **The integration of Land Sea Interactions (LSI) needs to be fully considered in MSPs.**

Considering that as (i) there is an important need for the sector to have access to port infrastructure for all components of the sector's value chain and (ii) anthropic pressures (e.g., contaminants) are prohibitive for the good development of the sector. Space allocation for the sector needs to be driven with the integration between maritime and land planning. It can be done through the development of Integrated Coastal Zone Management (ICZM) and in connection with the MSP process. It requires the strengthening of dialogue/coordination between competent authorities in all the planning processes.

5.2.3. Zoning for marine aquaculture in MSPs

The new aquaculture guidelines recommended MS to "*Designate areas suitable for aquaculture*". Experience to date suggests that this has been implemented to varying degrees across the EU, from simple area delineation to the exclusive prioritisation of certain types of aquaculture in **allocated zones for aquaculture (AZAs)**. Although the needs and approaches will vary across the different EU MS, based on the research conducted and the interviews undertaken, we have the following recommendations:

10. **Allocation of space needs to be considered in accordance with the sector's interest (i.e., investors) and the existing or targeted production and markets (local, national or global scale).**

Such trends need to be identified for each type of production (fish, molluscs or algae) during the zoning process and consider the relative spatial attributes of different forms of aquaculture (e.g., marine algae tend to have a large spatial footprint, finfish pen culture is in deeper sub-tidal water, etc).

11. **Large-scale (e.g., sea basin) and finer scale (e.g., bays / rias / fjords) biozones or AZAs should be identified and characterised on a proactive basis**.

For instance, if an AZA is characterised in terms of environmental carrying capacity, habitats, and biodiversity, etc, this would allow fast-track but sustainable aquaculture permitting, including EIAs. It would also ensure that cumulative impacts were anticipated and managed.

12. **Efforts should be made to assess at the strategic level (MSP and MPA scales), the environmental impacts of different forms and scales of aquaculture.**

Through existing marine protected area (MPA) regulations and associated management measures in place, it should be possible to identify what types and scale of aquaculture activity might be permitted in MPAs in accordance with the EC guidance on Aquaculture and Natura 2000[85]. These efforts could be mobilized to assist the sector in the licensing procedure.

[85] European Commission (2018)

5.2.4. Monitoring of space allocation for aquaculture activities

Good planning depends on good information. MSPs should be dynamic, living documents that are updated to accommodate both 'on the water conditions' as well as being proactive in allowing or even promoting space for new or expanded activities. Given the anticipated changes in EU aquaculture over the current EMFAF planning period (e.g., move offshore and the expansion of low-trophic aquaculture such as seaweed), the monitoring of existing aquaculture activities and the flexible planning for new areas is essential. Based on the research conducted and the interviews undertaken, we have the following recommendations:

13. **The development of shared GIS systems, including sectoral (aquaculture) and cross sectoral (MSP) data should be implemented in each EU MSs.**

Administrative and licensing procedures still appear to be a major hindrance to the establishment of new marine aquaculture businesses. Common GIS systems, shared by different public authorities (e.g., aquaculture authorities, environmental, other sectoral authorities), contribute to improved coordination between administrations and a reduction in permitting delays. Instead of being used on an *ad hoc* basis, the use of such systems should be mainstreamed since GIS allow new information (e.g., application areas, as well as licensed areas), to be rapidly added and edited.

14. **Aquaculture licensing data should be shared by the authorities responsible for managing the sector with maritime spatial planners.**

These data (past, existing and planned) should be shared electronically to allow near real-time representation of the spatial extent of aquaculture. This could be linked to time-series data, thus allowing spatial trends in aquaculture development to be determined and used in cross-sectoral planning.

15. **The development of a single cross-sector environmental data portal should be encouraged in each MS.**

Member States should further encourage this development for monitoring the footprint of all maritime economic activities, to better inform how these are impacting on the wider marine environment (biological, social and economic). Such data portals enable the better consideration of cumulative impacts in a given area, supporting decision-making for permitting.

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Member States questionnaires

Atlantic	North Sea	Baltic sea	Black sea	Mediterranean
Ireland	Belgium	Latvia	Bulgaria	Greece
France	Denmark	Estonia	Romania	Malta
Portugal		Finland		Spain
Spain		Poland		France

Interviews

Member States		Others
Ireland	Spain	FEAP – The Federation of European Aquaculture Producers
France	Estonia	Luke institute
Portugal	Poland	Lapland region (Finland)
Greece		Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA)

7. ANNEXES

Annex 1 - Template questionnaire sent to EU Member States

SubTask	Questions
Sector and sub-sectors	Which forms of mariculture are considered in your country? Are there any differences to be aware of regarding the following questions?
National Authorities	What is the level of authority that regulates aquaculture development: central? regional? local?
	What are the responsibilities of government departments/bodies/agencies in relation to the development, operation and management of aquaculture? Were they fully involved in the MSP process?
Legal Context and Frameworks	What is the legal framework for the development of marine aquaculture? Is it a sector specific one or is it part of a broader framework?
	What is the status of the Multi-Annual National Strategic Plans for Aquaculture? Are they integrated with the Maritime Spatial Plan or do they include joint actions for MSP and aquaculture, etc?
Licensing, permitting	What are the legal instruments and procedures used to allow use of the marine space (dedicated zoning, licensing, permitting)?
	How is space licensed to different types of farms (e.g. shellfish, finfish, macroalgae)? Is there a difference?
	Did these instruments pre-exist the Maritime Spatial Plan?
	Does the applicant have to carry out the EIA and does he/she receive some help from the local/regional/state administration?
	Are there special cases in which a license, or permit, can be obtained without having to perform an Environmental Impact Assessment (EIA)?
	Are there any other steps required in order develop mariculture farms?
Identification of aqua. as a sector to be included/integrated in MSP	Has the establishment and/or the implementation of MSP plans changed the legal framework for licensing or permitting of aquaculture farms? Did it help to speed up the delivery of permits/licenses for aquaculture operations?
	What is legal link with the MSP if any? How is the articulation/coherence of MSP with sectoral frameworks (including MNAPs) ensured?
	Has the plan a binding effect on the provision of sites?
	Did an aquaculture plan, including zoning provisions, exist before the Maritime Spatial Plan was prepared and established? If yes, is it referred to in the maritime spatial plan? Please provide a short summary of it.
	Which criteria were used to define the areas dedicated to aquaculture? How have planning authorities ensured that the space allocated to aquaculture has the appropriate conditions for this activity? If not why?
Governance/ public consultation	Was the sector consulted prior to the inclusion of aquaculture in the Maritime Spatial Plan? Which stakeholders were consulted ?
	Were stakeholders consulted when establishing **specific zones/sites** for aquaculture in the context of the MSP Plan? How many aquaculture farmers were involved? Was the allocation of sites for aquaculture a bottom-up or a top-down process?
	Did aquaculture stakeholders meet with stakeholders from other sectors and have the opportunity to make the case for using marine space for aquaculture activities?
	Was social acceptance towards aquaculture evaluated during the MSP / zoning process?
Zoning provisions within the MSP	Have specific zones been allocated to aquaculture in your MSP (prescriptive allocation and use)? Or is aquaculture allowed anywhere in the marine space provided it complies with specific criteria?
	Does the Maritime Spatial Plan include areas for further expansion of existing aquaculture activities as well as new activities? Also when not specifically earmarked for aquaculture?
	Has consideration of the suitability of sites allocated for aquaculture under future climate change been considered within the MSP? What provisions are there for changes to the allocation of space for aquaculture in the future as result of climate change?
	What is the level of specification for culture of species in allocated zones / areas?
	Once an area/zone has been defined, is the use of this area/zone attached to specific conditions?
	Are zones allocated for scientific research and trial of aquaculture concepts?
Coexistance of aquaculture with other maritime activities in the MSP	Are synergies and complementarities with other economic activities considered?
	The allocation of space to aquaculture: is it for exclusive use or has multi-use and co-location been foreseen when designating zones for aquaculture?
	Has aquaculture been included in your MSP in combination/multi-use with other activities/uses ? Which ones ?
	Have MSP plans considered the potential of macroalgae farming in combination with other activities (e.g. integrated multi-trophic aquaculture system (IMTA))?

Environmental factors	How has the suitability of zones been established within the MSP?
	Has low environmental impact aquaculture (combining two or more types of farming offering ecosystem services, e.g. further reduce the emissions of nutrients and organic matter into the environment) been considered?
	Are aquaculture zones/areas/sites integrated (notably those offering ecosystem services) into protected areas such as Natura2000 areas?
Economic factors	In addition to environmental conditions, have economic and social factors also been considered when allocating space to aquaculture activities?
	When designating aquaculture zones, is the economic viability of logistics and other servicing facilities/infrastucture to the farm sites being considered?
	Are the economic costs/benefits for coastal communities considered when deciding whether marine space should be allocated for aquaculture instead of other uses?
	Is there an active policy to facilitate investments in aquaculture and so enable the uptake of available marine space?
Social factors	Has the social impact of aquaculture activities be assessed ex-ante?
	Did this assessment include analysis of aquaculture activities on cultural values (e.g. seascapes)?
	Has the possibility of combining aquaculture with other activities, in particular tourism, been considered?
Monitoring and Evaluation	Are aquaculture activities subject to monitoring, assessment and/or evaluation? Is monitoring/evaluation specific to aquaculture activities or as part of the broader monitoring/evaluation of the maritime spatial plan?
	Are there mechanisms in place to monitor the effective use and occupancy of marine space allocated to aquaculture
	Is there an evaluation of the rate of uptake of available space? If not all space is being used, is there an analysis of why this is the case?
	Was the licensing/permitting procedure in place already evaluated in the past?
	Are monitoring, evaluation, assessment activities linked to aquaculture carried out / supported by public authorities or by economic operators? What is the nature of these activities (e.g. environmental impacts)?
	Are there mechanisms in place to monitor the impact of climate change on aquaculture activities (e.g., species' range shift)

Annex 2 - Norway case study

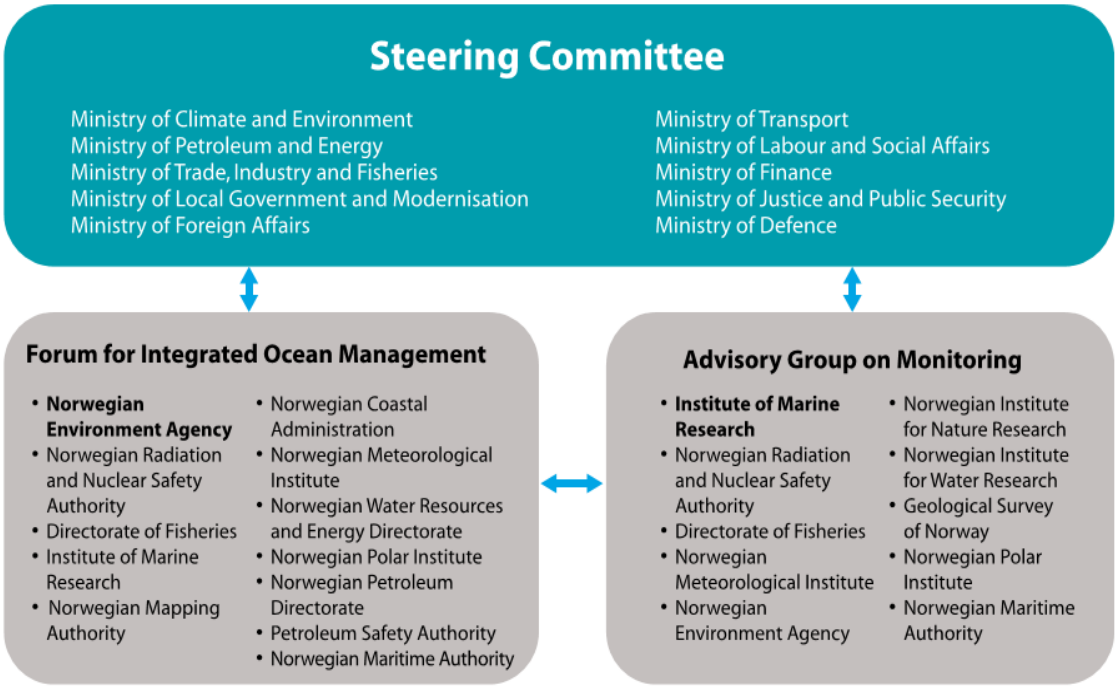
Introduction

Norway has an extensive coastline facing the North Atlantic Ocean and the Barents Sea. The deep, sheltered fjords, pollution-free waters and the gentle warming effect of the Gulf Stream current make it a perfect location for aquaculture, in particular open-water pen farming of salmon.

Norway laid the foundation for integrated, ecosystem-based ocean management in the white paper 'Protecting the Riches of the Sea (Report No. 12 (2001–2002) to the Storting[86] (Royal Ministry of the Environment, 2002). The white paper described the vision of maintaining clean, rich seas so that future generations can continue to harvest the wealth of resources that the sea has to offer and more specifically "inter alia, through the establishment of external conditions that allow us to strike balance between the commercial interests connected with fisheries, aquaculture and the petroleum industry within the framework of a sustainable development". Since 2002 the Storting has approved integrated, ecosystem-based management plans for all three Norwegian sea areas.

Work on the management plans is coordinated by the inter-ministerial Steering Committee for Integrated Ocean Management, which is headed by the Ministry of Climate and Environment (MoCE). Other ministries, including the Ministry of Trade, Industry and Fisheries (and the Department of Fisheries) are also represented (**see Figure 7**: Organisation of the management plan work and government agencies represented in the Forum for Integrated Ocean Management and the Advisory Group on Monitoring in Norway **below**). The executive department for MSP within MoCE is the Department for Marine Management and Pollution Control, who are effectively responsible for marine spatial planning in Norway. It is noted that through the European Economic Area (EEA) agreement, relevant EU legislation, such as the Water Framework Directive, must be transposed into Norwegian legislation.

Figure 7: Organisation of the management plan work and government agencies represented in the Forum for Integrated Ocean Management and the Advisory Group on Monitoring in Norway



Source: Royal Ministry of the Environment, 2002

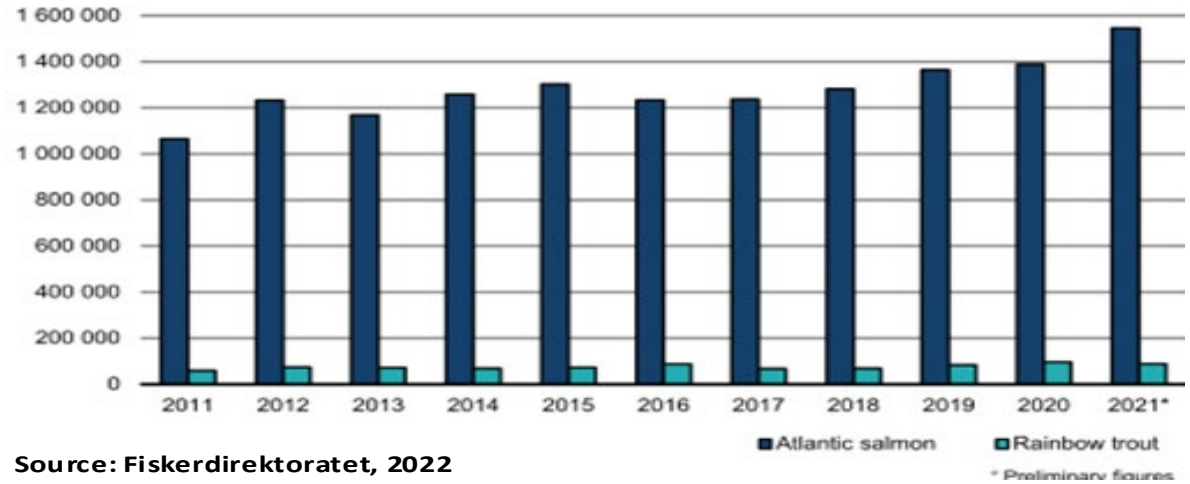
This case study was based on a desk analysis and an interview with Geir Klaveness, Specialist Director in the Department for Marine Management and Pollution Control, MoCE

[86] The Norwegian parliament

Background to aquaculture in Norway

Norway is Europe's largest aquaculture producer. The first large-scale farm was developed in 1970, and production expanded rapidly, mainly due to the excellent growing conditions, an evolving market for farmed salmon and a combination of regulatory and techno-economic advances such as broodstock domestication for good growth and low grilse rates. The country's aquaculture is dominated by Atlantic salmon (around 1.55 million tonnes (mt) in 2021) and rainbow trout (88,831 mt in 2021) which has shown steady but unremarkable growth since 2010 (see **Figure 8** below). Today approximately 160 municipalities along the Norwegian coastline are home to various aquaculture operations (**see Figure 9** towards end of the document).

Figure 8: Sale of Atlantic salmon and rainbow trout in Norway (2011 - 2021)



Source: Fiskerdirektoratet, 2022

Relatively small quantities of other marine fish e.g., Atlantic halibut (2,716 mt) and Atlantic cod (1,622 mt) were also produced in 2021, as well as around 2,163 mt of blue mussels and 101 mt of other shellfish. There is only one company testing IMTA in Norway, producing salmon and macroalgae. Generally, eutrophication is not a challenge in Norwegian, as the fjords and coastal areas are naturally relatively nutrient-poor, with good current conditions and water exchange (Grefsrud, *et al.,* 2021), the need and motivation for IMTA is therefore limited.

In order to gain access for commercial aquaculture in Norway, once *a production license* has been purchased, a *site licence* needs to be granted by County Authorities. Site licences can only be approved for one species at each site, but the Ministry can grant dispensations for producers applying for a licence for IMTA production. The County Authorities have been delegated the authority to grant site licenses pursuant to the Norwegian *Aquaculture Act (2005)*. In practice the sector authorities (the Norwegian Food Safety Authority, the County Governor, the Norwegian Coastal Administration and the Norwegian Water Resources and Energy Directorate) have a *de facto* 'veto right' when it comes to issuing aquaculture site licenses based on their own spatial planning interests. Local municipalities also have an important role in siting aquaculture, as they are the planning authority for near shore sea space (within one nautical mile (nm) from the base lines). The question of prioritising aquaculture (or not) in municipal spatial planning is largely a local political issue. The local authorities are in principle free to facilitate aquaculture should they choose to (or not) (Myklebust, 2016; Risbråthe, 2022).

The Norwegian coast is divided into 13 aquaculture production areas. Recently a production area-based 'traffic light' system has been introduced to address the environmental challenges of marine aquaculture in open net pens. The main indicator is the level of sea lice infestations, whose levels can dictate whether production area biomass limits are raised or decreased. The aquaculture production area biomass limits are informed by computer modelling, such as the Norkyst800 hydrodynamic model and associated web-based decision-support systems (DSS).

Background on marine spatial planning and aquaculture in Norway

The purpose of Norway's management plans is to "provide a framework for value creation through the sustainable use of marine natural resources and ecosystem services and at the same time maintain the structure, functioning, productivity and diversity of the ecosystems. The management plans are thus a tool both for facilitating value creation and food security, and for maintaining the high environmental value of Norway's marine areas" (MoCE, 2021).

The 2002 white paper briefly examines the benefits of including aquaculture – which is recognized to have "huge potential for further industrial and commercial development along the coast of Norway" - in the spatial management plans. It states that "*More growth in aquaculture will mean more demand for suitable space. Good cross-sector processes are to be established to avoid disputes over environmental considerations and other areas of industrial and consumer interests such as transport and open air activities. If we want to achieve the most efficient and sustainable use of space available, we must assess the possibilities of combining the farming of a number of species on the same site*".

The 2002 White Paper notes that escaped fish, sea lice accumulations and the impact on wild fish, and the use of pharmaceuticals and exotoxins (e.g., copper) in aquaculture as particular issues to be addressed in spatial planning.

Since the 2002 paper, three spatial management plans (and one update) have been developed by Norway (see also **Figure 10** towards the end of the document):

1. Integrated Management of the Marine Environment of the Barents Sea and the Sea Areas off the Lofoten Islands. Royal Norwegian Ministry of the Environment (2006, updated 2011).
2. Integrated Management of the Marine Environment of the Norwegian Sea. Norwegian Ministry of the Environment (2009, updated 2017).
3. Integrated Management of the Marine Environment of the North Sea and Skagerrak (Management Plan). Norwegian Ministry of the Environment (2013).
4. Update of the integrated management plan for the Barents Sea – Lofoten area including an update of the delimitation of the marginal ice zone. Ministry of Climate Change and Environment (2015).

Each of these plans has a section dedicated to fisheries and aquaculture activities in the areas and its socio-economic importance. However, they are 'political' frameworks, with the regulatory requirements expected to be provided in the relevant sectoral plans. Unlike EU MSPs, they are not based around geographical information system (GIS) mapping tools. Furthermore, there are no specific spatial planning policies for aquaculture in these plans (unlike the UK MSPs - see UK case study). For instance, the North Sea and Skagerrak management plan specifically states that "*Aquaculture is not regulated in this management plan*" but does recognise (i) that aquaculture is vulnerable to pollution and (ii) the potential environmental impact of aquaculture, including nutrient and organic matter discharges. Furthermore, these plans only apply seaward of the Norwegian baseline that is around 1 nm outside of the outer islands and islets, and therefore exclude the vast proportion of current Norwegian aquaculture that takes place in inshore waters to the landward side of the baseline.

The integrated ocean management plans were updated in 2020 and presented to Parliament in one single document (Ministry of Climate Change and Environment, 2021). A recent June 2022 'Roadmap for a green industry[87]' includes a paragraph that can be unofficially translated as "'*The Government will develop a set of overarching principles for the use of ocean space. This is meant to create predictability and a basis for coexistence across the marine/maritime industries, and at the same time safeguard marine ecosystems and consider the spatial needs of the Armed Forces. These principles will be presented in the next white paper to the Parliament on Norway's integrated ocean management plans*". The next update is planned in 2024 by the MoCE.

[87] Veikart for grønt industriløft - regjeringen.no (https://www.regjeringen.no/no/dokumenter/veikart-for-gront-industriloft/id2920286/)

The 2020 update has been rather more explicit about integrating aquaculture into the spatial management plans. The two key areas include:

1. The move to more offshore aquaculture. An inter-ministerial working group prepared a report on offshore aquaculture and recommended that in areas outside the geographical scope of the *Planning and Building Act*, the central government should open sizeable areas (blocks) for offshore aquaculture under the *Aquaculture Act*. The report also recommends requiring the establishment of safety zones round offshore aquaculture facilities, and that these should be larger than the zones around coastal facilities. These areas would have to undergo strategic environmental impact assessment (SEA). It is recognised that the scale of environmental problems associated with offshore aquaculture also depends upon whether facilities are fixed or mobile, and whether they use open cages or closed systems.
2. Increasing interest in large-scale macroalgae culture which "*will occupy considerable areas, which may create new spatial conflicts and possibly introduce new environmental problems*".

As discussed above, the Country Authorities (and within one nm of the shore, the Municipalities) are currently key players in allocating space to the largely inshore-situated aquaculture in Norway. According to the *Aquaculture Act* site licences may not be granted in contravention of adopted land use plans pursuant to the *Planning and Building Act*, unless the planning authority, e.g., the local municipality, gives its consent (Risbråthe, 2022). The recent 2021 Norwegian *Aquaculture Strategy* states, that in order to meet the government's ambitions for growth in the aquaculture industry, "*it is crucial that sufficient new areas are set aside in the coastal zone*" (Ministry of Industry and Fisheries, 2021). Linkages with Norway's three large-scale spatial management plans is less explicit, suggesting that further integration between national marine spatial planning and aquaculture development at different scales would be beneficial.

The government encourages municipalities to cooperate on coastal zone planning, through inter-municipal planning or even regional plans. Aquaculture is specifically included in regional and municipal planning (see Ministry of Local Government and Modernisation, 2019). Sustainable use of the coastal zone requires management approaches that include larger geographical areas and where decision makers consider the cumulative impact of different human uses on the marine environment. For one fjord or coastal area there are usually several municipalities, hence several decision-making units and coastal zone plans. The borders between municipalities are often drawn in the middle of a fjord and areas designated for commercial or recreational activities in the coastal zone plan of one municipality affect and are affected by activities taking place in the neighbouring municipalities. This is particularly relevant for aquaculture production, where environmental and veterinary regulations require a certain distance between production sites. Municipalities are therefore often too small and unsuitable for area planning in fjords and coastal areas. In recent years there has been an increasing level of inter-municipal coastal planning (Kvalvik & Robertsen, 2017; Risbråthe, 2022).

Following publication of the 2021 *Aquaculture Strategy*, there is an ongoing sectoral process on recommendation of areas for offshore aquaculture outside the jurisdiction of the municipalities, where a public hearing[88] was conducted in late 2022 (Norwegian only). These include establishing better coordination between different interest groups when designating production areas for aquaculture, including considering the use of EIAs and the robust involvement of the relevant state level sector authorities (Risbråthe, 2022). The Strategy also identifies two further areas for improvement in marine spatial planning for aquaculture in Norway, (i) a clarification of which considerations are to be made according to the *Planning and Building Act* and which according to the *Aquaculture Act*, and (ii) to consider whether the current structure of production areas can be adapted to reduce spread of diseases and lice.

Notable features and lessons for the EU

Key issues in marine spatial planning: as described above, the Norwegian high-level marine spatial plans are based on three main sea regions. These three management plans describe a set of elements for evaluating the ecological quality, including indicators and action thresholds which will be used to monitor biological diversity, sustainability of fishing, pollution, and the safety of seafood

[88] See https://www.fiskeridir.no/Akvakultur/Tema/Havbruk-til-havs

harvested in the area. Important issues that are related to aquaculture are (i) sustainability indicators (e.g., sea lice levels and stock escapes), (ii) siting structures, (iii) instruments in the *Aquaculture Act* and (iv) farming technology. However spatial planning policies specific to aquaculture are provided in the *Aquaculture Act*, rather than the spatial management plans.

Further development of aquaculture – Instruments and legal framework: aquaculture – and in particular the growing of salmonids in marine, open water pens – is both a major and mature coastal industry in Norway. However, it is widely regarded to have reached the environmental limits of growth under traditional open systems in coastal waters, hence the introduction of biomass-limited production areas. The new 2021 Norwegian *Aquaculture Strategy* looks to increase growth steadily and sustainably through various approaches such as an increased development of offshore areas outside the one nm zone and through the introduction of new on and offshore technologies, such as closed / semi-closed pens at sea and recirculating aquaculture systems (RAS) on land. The development of offshore aquaculture is likely to be regulated more by a potentially updated *Aquaculture Act* rather than through the spatial management plans. This said, the high risks of potential conflict with other marine economic activities such as shipping and offshore energy would warrant consideration by the regional management plans as they are updated.

Aquaculture and climate change: the new Aquaculture Strategy also looks at climate change adaptation, but mainly through reducing greenhouse gas emissions from salmonid production (e.g., via feeds) and low-emission vessels, rather than any spatial planning approaches. This said, the move offshore into more stable waters is likely to make the sector more resilient to sea temperature rises.

Permitting and zoning: one notable aspect of Norwegian aquaculture is the current focus on local spatial planning of aquaculture and permitting by the municipal and county authorities. This has a number of benefits e.g., a higher likelihood of informed, local consultation for new or expanded farming site licenses and the greater 'social licence' that has evolved through local-level decision-making. However, many in the Norwegian aquaculture industry would prefer a nationally co-ordinated licensing system to "*to avoid politization of the process and to ensure a holistic perspective*" and thus increase predictability and ensure equal treatment (Risbråthe, 2022). Another concern for the industry is that the designation of areas for aquaculture in coastal zone planning does not account for the new technologies discussed above. These new technologies can make aquaculture production in closed or semi-closed facilities possible in inshore areas, without impacting key environmental indicators, such as sea lice levels and organic matter deposition.

Main strengths of Norwegian marine spatial planning vis-à-vis the aquaculture sector: asked what the two greatest strengths of Norwegian marine spatial planning regarding aquaculture are, Geir Klaveness of MoCE suggested:

1. **Good sectoral integration**. The *Steering Committee*, Forum *for Integrated Ocean Management* and the *Advisory Group on Monitoring* (see **Figure 7**) all meet regularly and make practical, operational decisions based on evidence.
2. **Ecosystem-based decision-making**. The spatial management is based around ecological productivity and sensitivity. This helps to provide spatial focus, both on productive areas, as well as those that need ecological protection.

Lessons for marine spatial planning in the EU might include:

1. **MSPs need to be forward-thinking in terms of the direction of aquaculture development and technical change**. Therefore, they need to include a suitable sector analysis as part of the MSP process and to ensure that technical change such as the development of offshore aquaculture or the introduction of closed / semi-closed systems in coastal waters is accounted for in marine spatial planning.
2. **A balance of national and local planning for aquaculture development needs to be achieved.** National-level planning can provide consistency and predictability, both favoured by developers. But the advantages of local level planning described above should not be ignored, that is of a hierarchical system that provides a common, top-down framework that allows both (i) the specific planning characteristics of local conditions to be accounted for,

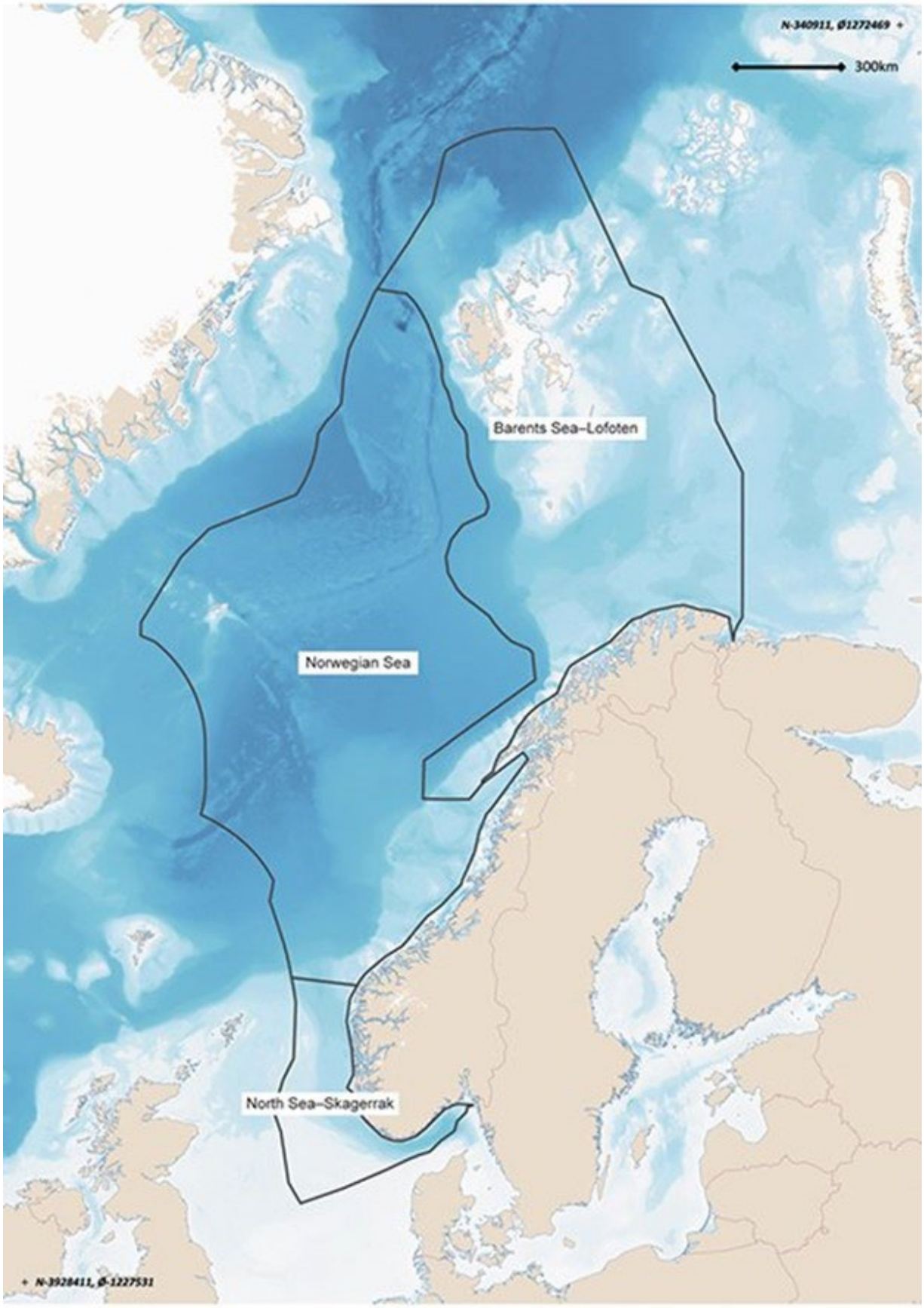
and (ii) representative stakeholder consultation to be conducted without compromising national aquaculture and spatial planning policy and strategic objectives.

Additional figures

Figure 9: Approved locations for aquaculture with various species and purposes that are registered in the Aquaculture Register

Source:
https://portal.fiskeridir.no/portal/apps/webappviewer/index.html?id=bed4faeea84e4d6dbc548d43cc134c96&layer=Akvakulturregisteret

Figure 10: Map of the three management plan areas: the Barents Sea–Lofoten area, the Norwegian Sea and the North Sea and Skagerrak



Source: https://www.regjeringen.no/en/dokumenter/meld.-st.-20-20192020/id2699370/?ch=2

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Annex 3 - United Kingdom case study

Introduction

The United Kingdom (UK) is situated off the north-western coast of continental Europe's mainland. Until early 2020 the UK was a Member State of the EU, operating under the Common Fisheries Policy (CFP) and the associated funding instruments (e.g., the European Maritime and Fisheries Fund running from 2014 – 2020). It comprises England, Wales, Scotland, and Northern Ireland, each of which has its own administration for marine spatial planning (MSP).

The devolved national administrations are responsible for MSP in their territorial waters e.g., out to 200 nm. Prior to Brexit, the UK Government was responsible for implementation of European Union (EU) conservation directives from 12-200 nm, Ministry of Defence-related activities in all UK waters, shipping, coastguard and navigation, oil and gas and customs and excise, in all waters. Both marine spatial planning[89] and aquaculture management are essentially a devolved responsibility for each of these countries, so they need to be examined separately. For the purposes of this case study, we will examine the situation in Scotland and England only.

Background to aquaculture in the UK

Scotland is the main aquaculture producer in the UK, with around 192,000 tonnes (mt) of salmon in 2020, 7,576 mt rainbow trout and 43 mt of other marine and freshwater finfish[90]. The vast majority of this finfish farming is in open water pens on both the west coast of Scotland, as well as in the Western and Northern Isles (e.g., the Hebrides, Shetland and Orkneys). They also produced 8,590 mt mussels and 388 mt Pacific oyster in 2021[91], again mostly in the Highland, Shetland & Strathclyde regions. Total Scottish aquaculture production over the 2020 / 2021 period was around 208,000 mt.

England's aquaculture production is less at 9,370 mt in 2019, mainly of rainbow trout in freshwater (4,768 mt) and mussels (2,930 mt) and Pacific oysters (1,239 mt). This marine aquaculture is mainly from small-scale producers, mainly scattered along the south-west, south and south-east coasts in intertidal / shallow water. The only exception is one larger offshore (c. 10 km) rope mussel farm in SW England. There is also an emerging seaweed farming sector, but it is very small at present.

Marine spatial planning in the UK

Although the UK was part of the EU when the MSP Directive required Member States to produce MSPs by 2021, this process was already well advanced at that point. The framework for developing regional marine plans is the UK-wide Marine Policy Statement (HMG, 2011), a key policy document resulting from Section 44 of the Marine and Coastal Access Act 2009. Section 3.9 of this Policy Statement specifically covers aquaculture and states that:

"marine plan authorities should take account of existing aquaculture activity in the area and seek information on possible future aquaculture operations in areas not previously used, assessing the suitability of those areas for development. Marine plan authorities should also take account of the financial and environmental impact that new aquaculture operations might have on existing marine activities in the area and ensure that activities are consistent with the environmental objectives of the Water Framework Directive (2000/60/EC) (WFD)". The relevant legislation is the Marine and Coastal Access Act (MCAA) 2009[92] , specifically in Section 58, sections 1 & 3.

In **Scotland** Marine Scotland, on behalf of Scottish Ministers, has the primary responsibility for marine planning and licensing from Mean High Water Springs (MHWS) out to 200 nautical miles (nm) and conservation of species to 12 nm. The *Marine (Scotland) Act* (2010) is designed both to provide (i) a new statutory marine planning system to sustainably manage the increasing, and often conflicting, demands on Scotland's seas and (ii) a simpler licensing system, minimising the number

[89] The term *"marine* spatial planning" used here is considered interchangeable with "*maritime* spatial planning"
[90] https://www.gov.scot/publications/scottish-fish-farm-production-survey-2020/
[91] https://www.gov.scot/publications/scottish-shellfish-farm-production-survey-2021/pages/3/
[92] https://www.legislation.gov.uk/ukpga/2009/23/contents

of licenses required for development in the marine environment to cut bureaucracy and encourage economic investment (see for instance the recent 'Griggs' review of the aquaculture regulatory process in Scotland[93]).

Scotland's National Marine Plan specifically includes aquaculture as one of eleven marine 'sectors'. The aquaculture chapter of the National Marine Plan includes 14 specific marine planning policies relating to aquaculture development in Scotland (see **Box 1**).

Box 1: Marine planning policies relating to aquaculture in Scotland

1. Marine planners and decision makers should seek to identify appropriate locations for future aquaculture development and use, including the potential use of development planning briefs as appropriate. System carrying capacity (at the scale of a water body or loch system) should be a key consideration.
2. Marine and terrestrial development plans should jointly identify areas which are potentially suitable and sensitive areas which are unlikely to be appropriate for such development, reflecting Scottish Planning Policy and any Scottish Government guidance on the issue. There is a continuing presumption against further marine finfish farm developments on the north and east coasts to safeguard migratory fish species.
3. In relation to nutrient enhancement and benthic impacts, as set out under Locational Guidelines for the Authorisation of Marine Fish Farms in Scottish Waters, fish farm development is likely to be acceptable in Category 3 areas, subject to other criteria being satisfied. A degree of precaution should be applied to consideration of further fish farming development in Category 2 areas and there will be a presumption against further fish farm development in Category 1 areas.
4. There is a presumption that further sustainable expansion of shellfish farms should be located in designated shellfish waters if these have sufficient capacity to support such development.
5. Aquaculture developments should avoid and/or mitigate adverse impacts upon the seascape, landscape and visual amenity of an area, following SNH guidance on the siting and design of aquaculture.
6. New aquaculture sites should not bridge Disease Management Areas although boundaries may be revised by Marine Scotland to take account of any changes in fish farm location, subject to the continued management of risk.
7. Operators and regulators should continue to utilise a risk based approach to the location of fish farms and potential impacts on wild fish.
8. Guidance on harassment at designated seal haul out sites should be taken into account and seal conservation areas should also be taken into account in site selection and operation. Seal licences will only be granted where other management options are precluded or have proven unsuccessful in deterrence.
9. Consenting and licensing authorities should be satisfied that appropriate emergency response plans are in place.
10. Operators should carry out pre-application discussions and consultation and engage with local communities and others who may be affected, to identify and, where possible, address any concerns in advance of submitting an application.
11. Aquaculture equipment, including but not limited to installations, facilities, moorings, pens and nets must be fit for purpose for the site conditions, subject to future climate change. Any statutory technical standard must be adhered to. Equipment and activities should be optimised in order to reduce greenhouse gas emissions.
12. Applications which promote the use of sustainable biological controls for sea lice (such as farmed wrasse) will be encouraged.

[93] https://www.gov.scot/publications/review-aquaculture-regulatory-process-scotland/

13. Proposals that contribute to the diversification of farmed species will be supported, subject to other objectives and policies being satisfied.

14. The Scottish Government, aquaculture companies and Local Authorities should work together to maximise benefit to communities from aquaculture development.

Source: https://www.gov.scot/publications/scotlands-national-marine-plan/

Scotland's National Marine Plan includes a regional element (e.g., out to 12 nm) that will be developed by Marine Planning Partnerships (MPPs). Eleven such regional plans are envisaged (see **Figure 11 at the end of this case study**), each setting (i) economic, social, marine ecosystem and climate change objectives, (ii) policies for sustainable development of the region and (iii) developing a Statement of Public Participation and carrying out consultation. Applications for planning permission for finfish and shellfish farms – which were determined in accordance with Local Development Plans – will now be integrated into the National Marine Plan.

With regards to marine planning and climate change, the Scottish National Marine Plan considers climate change in two distinct ways: (i) in terms of how actions under this Plan might help *mitigate* the degree of anthropogenic induced climate change and (ii) how actions under this Plan need to be *adapted* to take into account the effects of climate change.

In ***England*** regional marine plans are the main tool for marine planning – these are intended to set out priorities and the direction of future development within a Plan area. There are eleven marine areas and six marine plans around the English coastline with a long-term (20 years) timeframe that are required to be kept under periodic review. The East (2014) and South (2018) Marine Plans were developed first and the North East, North West, South East and South West Marine Plans were all adopted in 2021. These Marine Plans can be viewed online and are accompanied by a geographic information system (GIS) based 'Explore Marine Plans' digital service[94].

One of the adopted Marine Plans, the *South Inshore and Offshore Marine Plan* (HM Government, 2018a) has two policies specifically for aquaculture:

- S-AQ-1: "*Proposals for sustainable aquaculture in identified areas of potential sustainable aquaculture production will be supported. Proposals in existing or within potential sustainable aquaculture production areas must demonstrate consideration of and compatibility with sustainable aquaculture production. Where compatibility is not possible, proposals must demonstrate that they will, in order of preference: a) avoid, b) minimise c) mitigate significant adverse impacts on sustainable aquaculture, d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding*".
- S-AQ-2: "*Proposals that enable the provision of infrastructure for sustainable fisheries and aquaculture and related industries will be supported*".

The East Inshore and Offshore Marine Plans (HM Government, 2014) have a single aquaculture-specific policy, this being:

- AQ-1*: "Within sustainable aquaculture development sites (identified through research), proposals should demonstrate in order of preference:*
    a. *that they will avoid adverse impacts on future aquaculture development by altering the sea bed or water column in ways which would cause adverse impacts to aquaculture productivity or potential*
    b. *how, if there are adverse impacts on aquaculture development, they can be minimised*
    c. *how, if the adverse impacts cannot be minimised, they will be mitigated*

[94] https://www.gov.uk/guidance/explore-marine-plans

d. *the case for proceeding with the proposal if it is not possible to minimise or mitigate the adverse impacts"*

The North East, North West, South East and South West Marine Plans' Aquaculture policies are currently as follows:

- AQ-1: "*Proposals within existing or potential strategic areas of sustainable aquaculture production must demonstrate consideration of and compatibility with sustainable aquaculture production. Where compatibility is not possible, proposals must demonstrate that they will, in order of preference:*
    a. *avoid*
    b. *minimise*
    c. *mitigate significant adverse impacts on sustainable aquaculture production*
    d. *if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.*
- AQ-2: *Proposals enabling the provision of infrastructure for sustainable aquaculture and related industries will be supported".*

It is important, however, not to review these policies in isolation - there are a number of policies that intersect with aquaculture including managing social, economic and environmental impacts that might be relevant to any development (litter, noise, heritage) including aquaculture as well as inter-sectoral interactions (e.g., displacement) and benefits realisation (employment), see Huntington & Cappell, 2020).

Whilst these regional plans in England do have an aquaculture element e.g. showing high-level areas suitable for certain types of aquaculture activity (see **Figure 12 Greater support to marine and inland aquaculture planning at a regional level at the end of the case study**), the *English Aquaculture Strategy 2021 – 2040* (Huntington & Cappell, 2020) recognised the need for regional support to ensure that aquaculture development is well informed of local needs and constraints. This is to ensure that aquaculture is able to work with other marine space users in a proactive yet even-handed way in identifying 'Allocated Zones for Aquaculture' (AZAs[95]) in the Marine Plans. Until the MCAA in 2009 and the resultant regional marine planning process, there was little capacity or willingness for spatial planning and management at regional level. With inclusion of aquaculture within the MSP and all relevant aquaculture policies in all regional marine plans, this has changed. The Marine Management Organisation's (MMO) has conducted work on identifying areas of aquaculture potential in English waters (MMO1184, MMO 2019) and Cefas' conducted a pilot-level regional Aquaculture Mapping Project in Dorset (Kershaw *et al*, 2020 & 2021). The Dorset Coast Forum has recently published a five-year mariculture (all species, including seaweed) strategy (Dorset Coast Forum, 2020) and the Devon & Severn Inshore Fisheries Conservation Area (IFCA) is following suit (shellfish only). Dorset and East Devon Aquaculture[96] - which included funding for a full-time 'Aquaculture and Fisheries Development Officer' - is being managed by the Dorset Coast Forum (with assistance from the Southern IFCA) and is a model for development and replication into other English regions.

Key attributes include:

a. a strategic approach, as evidenced by the publication of a five year strategy.
b. strong linkages with the Southern IFCA that attempts to balance local aquaculture, capture fisheries and marine conservation objectives.
c. working with the Dorset LEP to promote aquaculture as a high potential growth sector.
d. a strong, high resolution spatial planning focus, which includes identifying possible AZAs through consultative, proactive regional planning.

[95] In line with the UK MANP for the development of sustainable aquaculture (Defra, 2015), marine plans in England identify areas for potential aquaculture development, but there is no accompanying scheme for facilitating licencing (SPF workshop, 2020). One solution is the establishment of allocated zones for aquaculture 'AZA' (Sanchez-Jerez et al, 2016), where aquaculture development could be directly aligned with MPA or other marine use objectives.
[96] See https://www.dorsetaquaculture.co.uk/

At a national level the MMO have undertaken various evidence-building projects to support aquaculture in marine planning, including MMO 1305 (MMO, 2013a), MMO 1040 (MMO, 2013b), MMO 1051 (MMO, 2013c), MMO 1128 (MMO, 2017) and MMO 1184 (MMO, 2019).

At present proposed aquaculture activities within England's Marine Plan areas require a marine licence from the MMO. This said, shellfish farming is largely exempt from marine licensing with some exceptions[97]. Licence applications for all marine space use, including aquaculture development, must be evidence-based and applicants must prove that their development is not going to significantly affect other users of the sea, including their conservation value and environmental and other impacts e.g., on navigation. The main focus of the evidence that must be provided in support of an application is the potential impacts to the environment, human health and other marine users from the project.

In discussing the role of MSP in the planning of aquaculture in the UK's marine waters, it is worth considering the challenges the industry faces. This includes EU exit and difficulties in exporting from Class B shellfish waters, a sometimes complex, unclear and challenging marine licensing process. This acts as a significant barrier for new developers and pushback from third parties (e.g., public, other marine users) as marine aquaculture in England is a novel industry and subject to considerable suspicion (Benjamin Coppin, MMO, pers. comm., 04 Aug 2022).

There are also considerable opportunities for aquaculture that need to be included in maritime spatial planning, these include:

- integrated multi-trophic aquaculture (IMTA);
- increased co-existence with wind farms;
- using offshore structures to support aquaculture installations, and
- an overall move of aquaculture offshore into deeper, cleaner and more stable waters.

There are also new species and systems evolving, with considerable interest in large-scale (e.g., with footprints similar to some wind farms) seaweed farming that will present particular challenges to the marine licensing authorities as they balance the allocation of sea space to traditional industries. These include fishing, the rapidly expanding offshore wind sector and novel aquaculture systems such as seaweed farming and closed / semi-closed finfish pen systems.

Notable features and lessons for the EU

1. **Need for hierarchical MSP engagement with aquaculture**: as can be seen from the above, the national level MSPs in both countries contain a series of high level policy statements on the inclusion of aquaculture in the national marine space. These originate from the original UK-wide *Marine Policy Statement* (HMG, 2011), but become increasingly refined and focused to specific marine regions. At the local level, the *Dorset Mariculture Strategy* (DCF, 2020) is fully integrated into the higher-level *South Inshore and Offshore Marine Plan* and provides a detailed strategy for sustainable development of aquaculture in Dorset. The key lessons learned from this are:
    - It is important that Member States' aquaculture development plans, strategies (inc. the forthcoming MNAPs) and associated guidance include a coherent set of development policies that align with marine spatial planning initiatives at different levels.
    - This process can be facilitated by having a hierarchical succession of linked aquaculture-specific policy statements as in England e.g., at national, regional and local marine planning levels. These policy statements will become more detailed and area-specific as they become more fine-scaled.
    - Likewise, associated strategies might also follow a hierarchical approach e.g., the English Aquaculture Strategy (2021 – 2040) at national level and the Dorset Mariculture Strategy (2020 – 2025) at local level.
2. **Benefits of fine-scale spatial planning of aquaculture**: both Scotland and England have strong regional elements to their maritime spatial planning, both sub-dividing their sea areas

[97] https://www.gov.uk/government/publications/marine-licensing-exempted-activities

into eleven regions each. For England this is being taken further, with detailed spatial mapping being trialled within the Dorset and East Devon FLAG area, to identify, refine and improve mapped areas best suited (and with least conflict) to specific types of sustainable marine aquaculture. Based on the work of Kershaw *et al* (2021), investors can now access an online 'Aquaculture Map[98]' with extensive base layers covering existing infrastructure, conservation areas as well as other marine economic activities, and to overlay 'Potential' / 'Unsuitable' areas for 29 different aquaculture systems potentially suitable for the region. The key lessons learned from this are:

- Fine-scale spatial mapping of aquaculture areas within the framework of higher level regional and national marine spatial plans can provide multiple benefits in terms of promoting investor confidence and supporting local development strategies for sustainable aquaculture development.
- Such fine-scale planning will also allow local planning and regulatory authorities to make rapid evidence-based decisions in support of new and renewed aquaculture permitting.
- The allocation of aquaculture development or management areas can be combined with the environmental carrying capacity of the selected zones / areas / species / systems and provide for further development of an ecosystem approach, something that is often beyond the abilities of individual operators.
- Linkages with land-based planning should be considered to support aquaculture development (via an in-depth study of facilities and support to capability) within sections of a coastline that are identified as important for seafood production.

3. **Need for strong stakeholder representation, especially at local levels**: in Scotland *Marine Planning Partnerships* will take different forms in different regions. The core Partnership will be representative but of limited numbers, in order to facilitate decision making. However, this core structure will be supported and informed by a broader framework of groups, focusing on particular issues and engaging the full range of stakeholders and interests. In particular, the involvement of Local Authorities is important and inshore fishing interests will be represented by *Inshore Fisheries Groups,* whose management plans will inform and reflect the regional plan.

The key lessons learned from this are:

- The inclusion of local stakeholder groups in both the strategic development of aquaculture (e.g., identifying and establishing aquaculture development areas), as well as permitting and licensing processes, will make marine spatial planning more robust and potentially reduce the time and complexity of licensing and permitting.
- Involving local authorities will also assist in balancing the interests of different sea space users, as well as to maximise the opportunities for co-existence e.g. between aquaculture and capture fishing activities. This can be facilitated by the development of local blue growth strategies and plans.

4. **A need for greater integration of aquaculture into maritime spatial planning**: neither the Scottish nor the English large-scale marine plans are explicit about how aquaculture might be included in multiple use areas, or how it might co-exist with other similar marine economic activities or marine conservation areas. Indeed, a recent consultation exercise (Nimmo *et al*, 2022) found that some of the main challenges to further developing marine spatial planning included:

    i. the lack of clear prioritisation of marine sectors,

    ii. the requirement for improved inshore fisheries data (i.e., inshore Vessel Monitoring Systems); and

    iii. the recommended pilot studies to incorporate improved fisheries knowledge into marine spatial plan to inform potential aquaculture siting.

[98] https://www.dorsetaquaculture.co.uk/map/

The key lessons learned from this are:

- Marine spatial planning needs to proactively consider potential synergies between different marine economic activities, including aquaculture, and to promote multiple use / coexistence where possible as part of a wider blue growth approach.
- As marine protected areas (MPAs) become better managed, efforts should be made to assess the environmental impacts of different forms and scales of aquaculture to identify what level of aquaculture activity might be permitted in MPAs.
- The roll out of iVMS in inshore waters will assist local authorities in identifying areas of high small-scale fisheries activity and therefore to assist in the siting of inshore aquaculture sites.

Figure 11: Scotland's proposed boundaries for Scottish Marine Regions

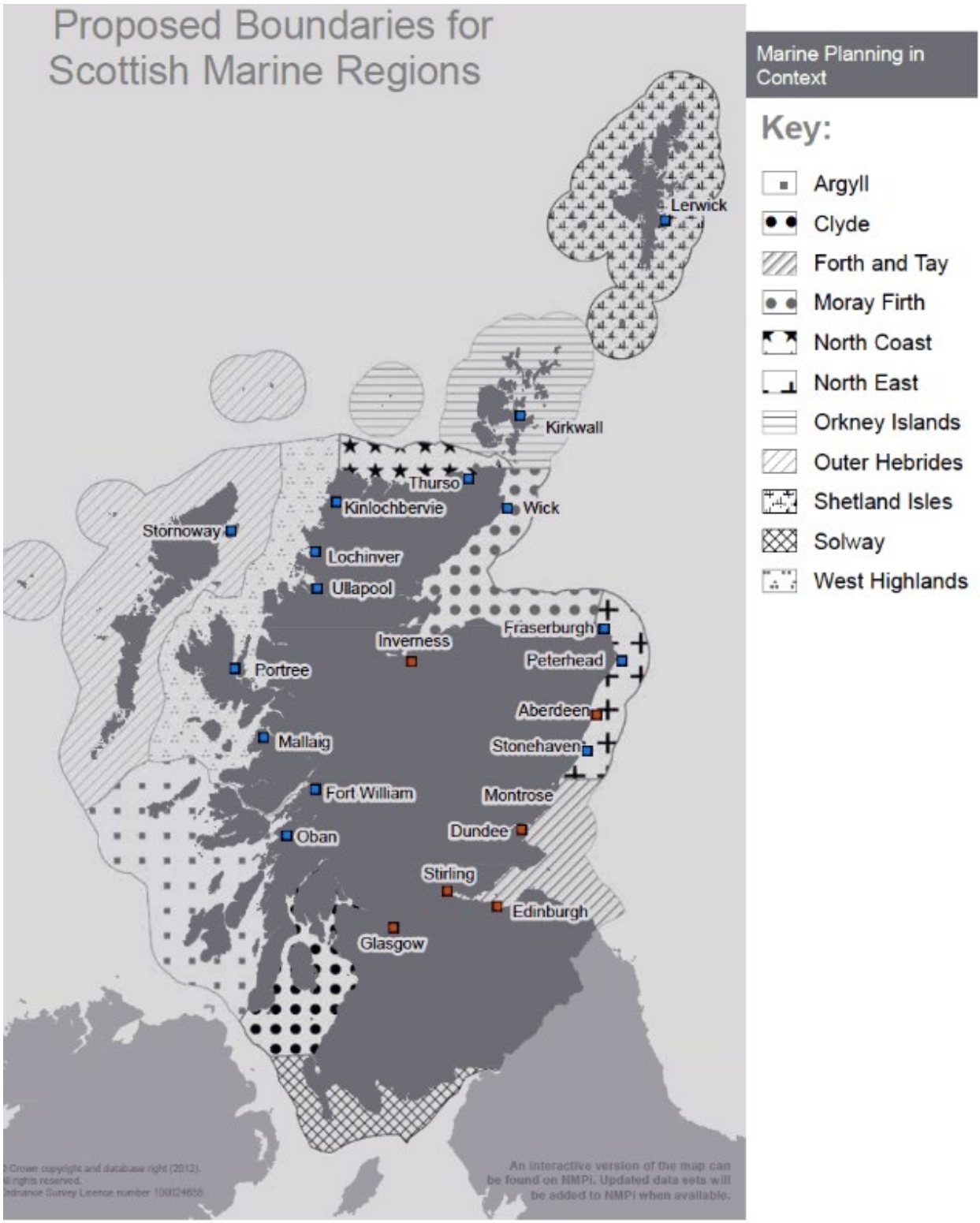
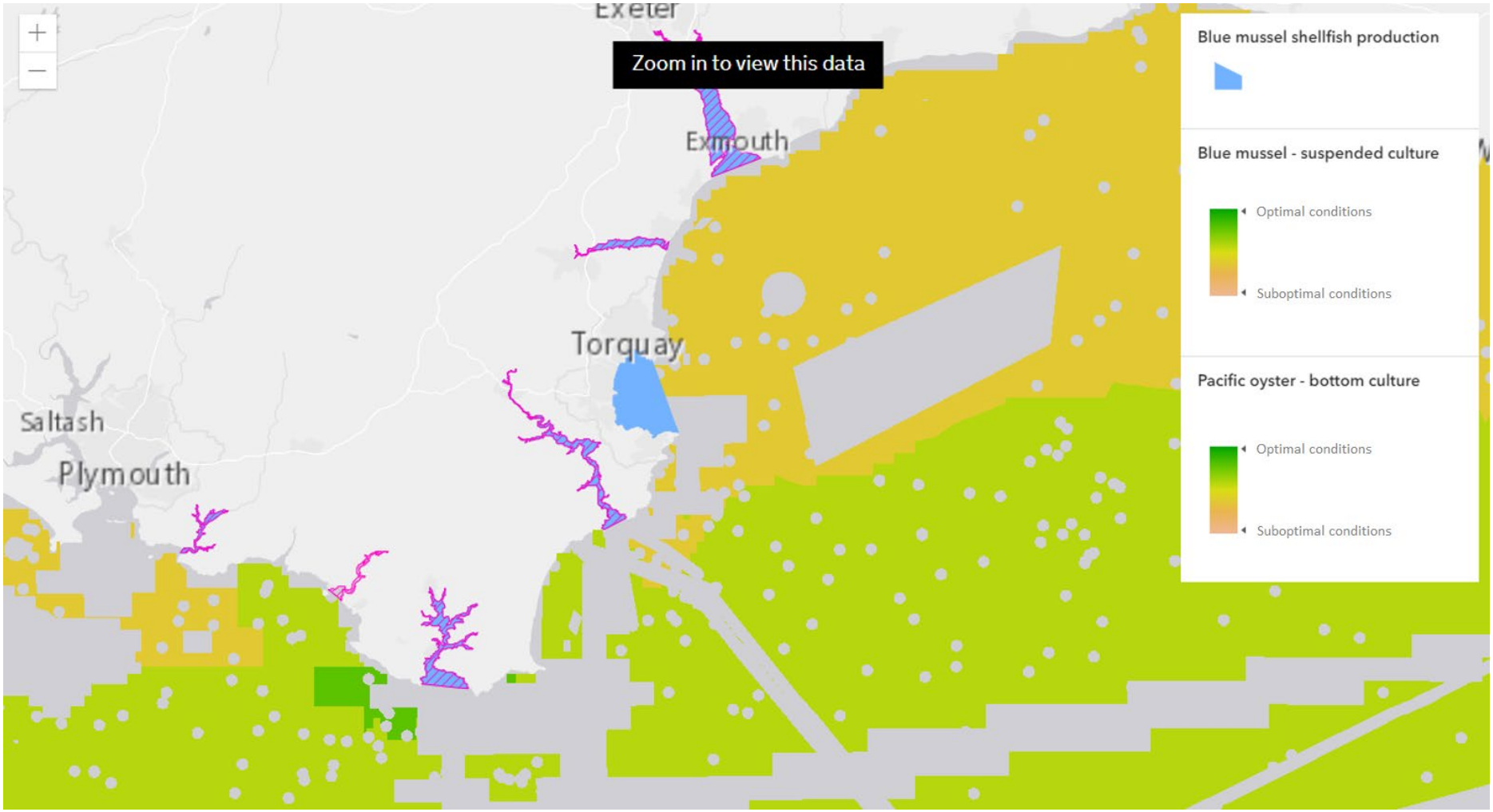


Figure 12: Extract from the English ''Explore Marine Plans GIS, showing existing and planned mussel and oyster aquaculture production areas in South Devon



Source: https://explore-marine-plans.marineservices.org.uk/

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