# Response to the Scottish Government's consultation on extending marine planning zones to 12 nm from the coastal baseline.

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## Introduction

Marine planning zones set out the spatial limits for local authorities' planning controls on marine fish and shellfish farms in Scottish waters. The current marine planning zones extend out to 3 nautical miles from the coastal baseline. The "Scottish Ministers" (i.e., the Scottish Government) are consulting on a proposal to extend these to 12 nautical miles.

The Scottish Association for Marine Science (SAMS) is an independent research organisation, established in 1884 and housed near Oban since 1969, that provides impartial advice based on scientific evidence. This document supports a response by SAMS to the Scottish Government consultation.

Our arguments relate mainly to the waters on the west coast of Scotland. In summary, we think that, on its own, the proposed extension to existing local authority powers is insufficient for good planning and licencing of aquacultural developments in offshore waters. We identify the need for an adequately funded, and democratically controlled, regional marine planning partnership to identify offshore zones for aquaculture, in what is in essence a single water body extending from the Mull of Kintyre to Cape Wrath. Realising the potential for aquaculture's co-location and port sharing with other industries, such as offshore renewable energy generation, requires an integrated strategic planning system. Better monitoring and scientific knowledge of these waters is also needed.

## Acronyms

ASA: Area Suitable for Aquaculture

CAR: Controlled Activities Regulations (operated by SEPA under the Water Environment (Controlled Activities) (Scotland) Regulations 2011)

EEZ: Exclusive Economic Zone

FAO: Food and Agriculture Organisation (of the United Nations)

HTA: High-Trophic Aquaculture (in the present case, salmon and trout)

LTA: Low-Tropic Aquaculture (in the present case, bivalve molluscs and seaweeds)

MDSG: Marine Directorate of the Scottish Government

MPZ: Marine Planning Zone (the marine area assigned to a local authority)

MSS: Marine Science Scotland (name discontinued, part of MDSG)

MTA: Multi-Trophic Aquaculture (e.g. the joint cultivation of salmon and seaweeds)

nm: nautical mile

NMP: (Scotland's) National Marine Plan

ORE: Offshore Renewable Energy (i.e. electricity generation from wind, waves or tidal flows)

RMMP: Regional Marine Planning Partnership

SEPA: Scottish Environment Protection Agency

SLO: Social Licence to Operate

*See also Table 1*

## Background from consultation document

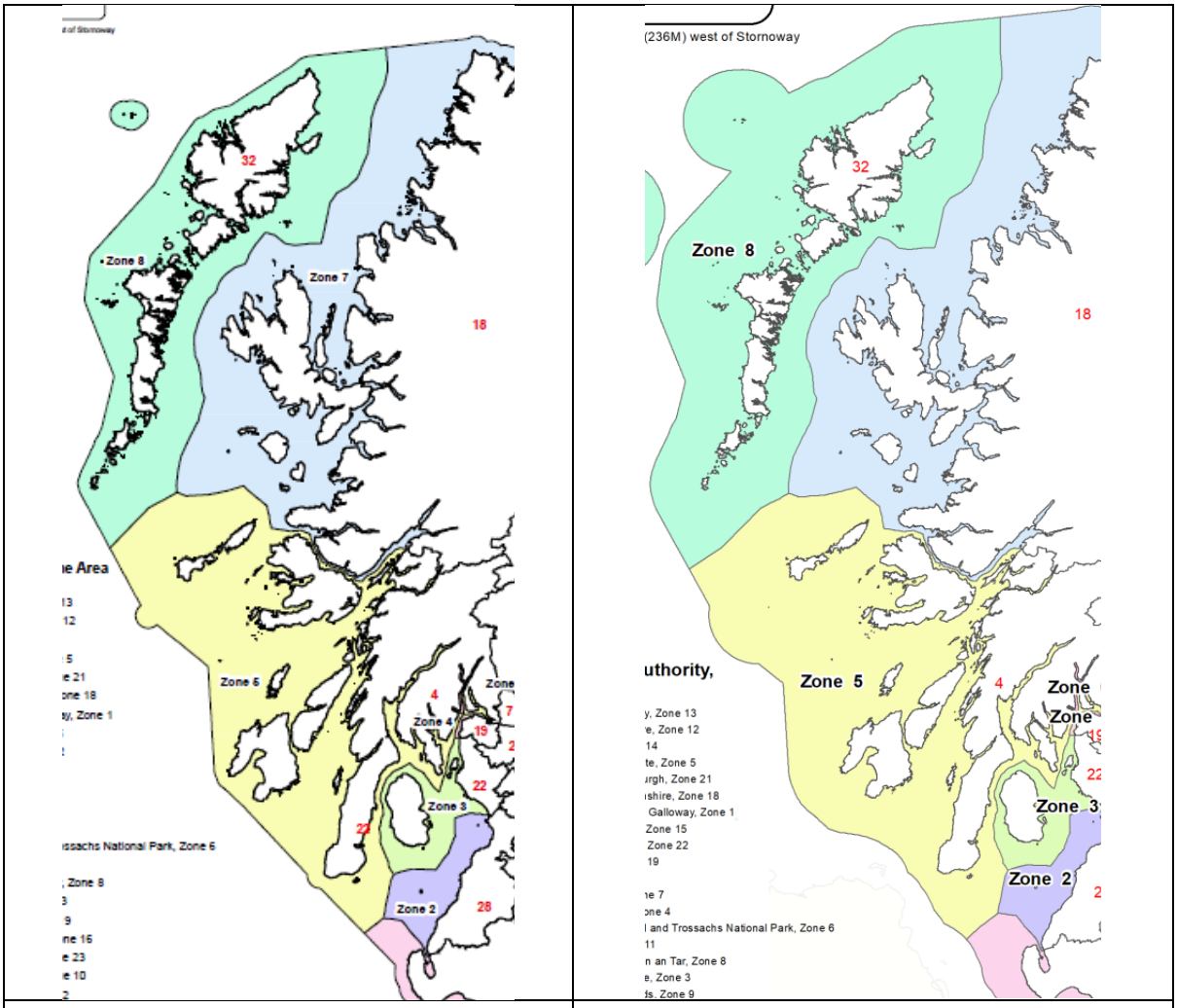
These quotes from the consultation document (Scottish Government 2024) sets out the reasons for proposing the spatial extension of the planning powers given to Scottish local authorities.

*"In 2007 the definition of "development" in the Town and Country Planning (Scotland) Act 1997 ("the 1997 Act") was amended to include fish and shellfish farming out to 12 nautical miles. This means that any proposed marine fish or shellfish farm located between 0-12 nautical miles requires planning permission from the relevant planning authority. However, the Town and Country Planning (Marine Fish Farming) (Scotland) Order 2007 ("the 2007 Order") only designated Scotland's marine planning zones out to 3 nautical miles. … In practice, this means that there is no designated planning authority to which a developer may submit an application for a farm located between 3-12 nautical miles."*

*"There is now growing interest within the fish and shellfish farming sector to develop farms beyond 3 nautical miles from the coast, with developments in technology making farms in this region feasible. This type of innovative development has the potential to reduce environmental interactions and to support fish health and welfare in line with the aims of our Vision for Sustainable Aquaculture. There is also increasing interest in the potential for shellfish farms located beyond 3 nautical miles, including through co-location opportunities with other structures.*

*"It is therefore proposed that the marine planning zones should be extended to 12 nautical miles as originally intended (excluding those marine planning zones that are enclosed by other marine planning zones), to enable businesses to explore opportunities to develop fish and shellfish farms in this zone. It is considered that the proposed approach to extend all zones out to 12 nautical miles will mean there would be consistency in planning requirements for fish farm developments within the 0-12 nautical mile zone across Scotland. The existing planning process is already well understood by businesses, regulators and other stakeholders."*

Figure 1 is taken from maps in the consultation document (Scottish Government 2024). It shows the existing and proposed marine planning zones on the west coast of Scotland. The zones extend from the coastal baseline, which is drawn from headland to (island) headland. It is apparent that some local authorities, such as Argyll & Bute, are already responsible for a large area of sea, and are being given additional responsibilities in environments that may be unfamiliar to their planning departments.




| Existing Marine Planning Zones | Proposed extended Marine Planning Zones |
|---|---|
| In the Firth of Clyde, zone: *2, South Ayrshire* and *3, North Ayrshire*, are unchanged by the proposal; on the west coast, zones *5, Argyll & Bute* and *8, Eilean Siar,* are substantially extended, whereas *zone 7, Highland*, is unchanged except at its north-western corner. | |
| From Scottish Government (2024), copied under Open Government Licence v3 | |

*Figure 1: Existing and proposed new Marine Planning Zones in western Scotland.*

## Q1: Do you agree with the proposal to extend marine planning zones out to 12 nautical miles?

Answer: **no.**

As presently constituted and funded, some local authorities lack sufficient resources adequately to deal either with operational planning (i.e. considering applications for planning permission at single sites) or strategic planning (e.g. allocating zones for aquaculture) in offshore waters. On the west coast of Scotland, in particular, the area of sea within the 3 nm limit is already very large. Extending planning zones to 12 nm will intensify the difficulties. Furthermore, there is no mechanism attached to this extension to enable potential synergies between aquaculture and offshore renewable energy generation. Finally, it's also unclear if the statutory consultees for licensing have the resources necessary to support offshore site licensing or to properly police the consents that must accompany planning permission. Whereas problems close to shore are often detected and reported by local people, this is less likely in the case of offshore sites.

## Q2: Do you agree with the proposed marine planning zones, extended out to 12 nautical miles (as mapped)?

Answer: **no**

Existing, and proposed extended, marine planning zones are purely administrative divisions, unrelated to processes in the marine environment that can carry water, wastes and organisms between zones. Knowledge of currents on the west coast of Scotland suggests that the waters between the Mull of Kintyre and Cape Wrath should be treated as a single unit for strategic planning, operational licensing, and management, and not divided amongst Argyll & Bute, Highlands, and Eilean Siar. Similarly, the Firth of Clyde behaves as a single water-body, and should not be subdivided. Strategic planning - allocation of areas prioritised for aquaculture - should bring together all relevant authorities and take account of cumulative effects from multiple farms and other sea-uses.

## Q3: Do you have any other points you wish to raise regarding the proposal to extend marine planning zones out to 12 nautical miles?

Given the importance of salmon-farming to Scotland's economy, and the potential contribution of the farming of seaweeds and bivalve shellfish to reducing food-related carbon emissions, it is vital to create an effective framework for strategic planning, site permitting, and environmental monitoring, of these activities in offshore waters. However, it seems to us that the proposed offshore extension to marine planning zones solves only one problem, avoids others, could add to the burden on local authorities, and may make it more difficult for local communities to engage with developments.

We are especially concerned with the waters of the west coast and western isles of Scotland, from the Mull of Kintyre to Cape Wrath, which comprise a well-defined eco-hydrodynamically interconnected system. The present status of the Regional Marine Planning Partnerships (RMPP) envisaged under Scotland's Marine Plan is unclear: we suggest that a joint RMPP be set up for these western waters, to draw up a zoning plan for the several sorts of aquaculture, taking account of possibilities for multi-species aquaculture and synergies with offshore renewable energy generation. In the light of experience with existing RMPP, careful attention should be given to the composition and operating rules of the joint board: in the interests of democracy and local engagement it should have a strong role for local authorities, whilst also including representatives of key stakeholders and the statutory consultees. There is also a case for including local academic researchers.

Once zoning and information on carrying capacity are available, local authorities could, as at present, provide planning permission in consultation with the statutory bodies. Mechanisms for funding the extra work for the local authorities, and the new RMPP, will be needed: options might include drawing on Crown Estate Scotland's income from leasing the sea-bed, or an analogue of the Norwegian scheme whereby local authorities levy a production tax on farms. Broad-scale environmental monitoring could be directly funded by industry, with findings made public, as in Tasmania.

## Q4: Do you agree with our approach to the impact assessments for the proposed extension to marine planning zones?

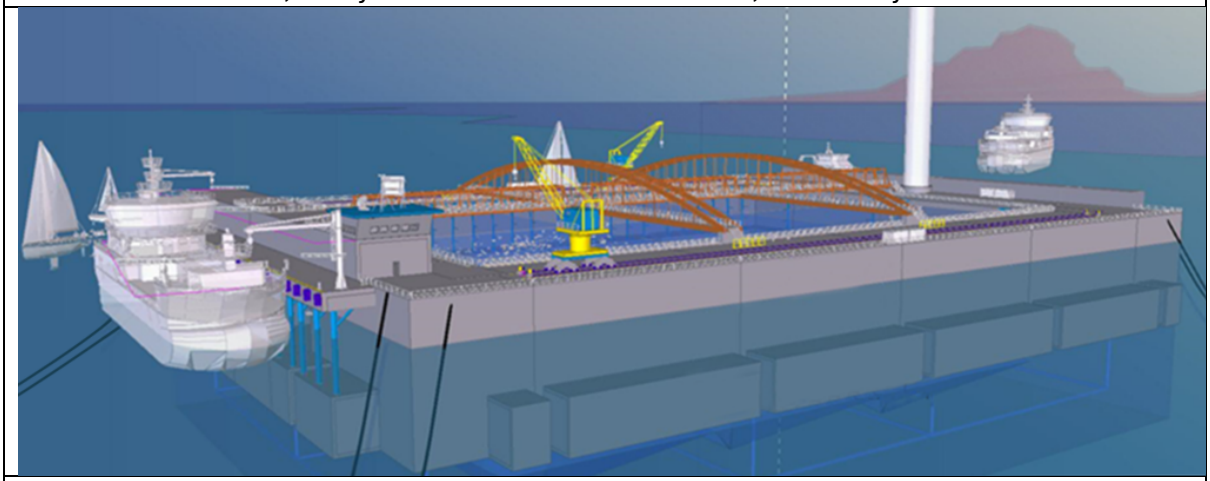
Answer: no

In relation to the **Island Communities Impact Assessment**, the largest expansions of marine planning zones are those allocated to the three islands authorities and to Argyll & Bute, the latter responsible for many island communities. Whereas the Northern Isles have benefitted from the special financial powers of their local authorities, the budgets of Eilean Siar and Argyll & Bute are more constrained. We question whether they have the financial or personnel resources to deal adequately with offshore planning even within the existing 3 nm limit, let alone the extension to 12 nm. In addition, if the Hebridean island communities are to benefit from the servicing of large offshore aquaculture structures, they will need new or upgraded port facilities. It appears therefore that these island communities could be disadvantaged by the planning zone extension, unless there is more support for marine planning and port development.

## Introduction to the rest of this document

The remainder of this document presents the evidence on which our responses are based. It begins by summarising relevant knowledge of the natural environment for, and the governance of, aquaculture, focussing particularly on the west coast of Scotland. Figure 2 compares a typical structure for an inshore salmon farm with a design for a multi-use offshore platform. Other offshore designs are in development (Chu et al, 2020; Morro et al. 2022); most are large.

Inshore: typical net-pen salmon farm in the Firth of Lorne near Oban: somewhat sheltered from wind and waves, easily accessed from local harbours, and clearly visible from the shore.



Offshore: a design from the EU Blue Growth Farm project for a multi-use structure combining a fish farm with wind and wave energy generation (Ruzzo et al., 2021; Billing et al., 2022)

*Figure 2: Inshore and offshore fish-farms*

## Environmental science

**Several types of marine animals and seaweeds** are cultivated in Scotland. *Finfish*, especially salmon (*Salmo salar*), are typically on-grown in large floating net-pens after initial rearing in freshwater hatcheries. *Shellfish*, meaning especially mussels (*Mytilus* spp.), are grown mainly on ropes suspended from long-lines, while oysters (*Ostrea*/*Crassostrea* spp.) are mainly raised on trestles attached the sea-bed. Cultivation of *seaweeds*, especially certain kelps (*Laminaria*/*Saccharina* spp.), is still at the nascent stage and mainly uses long-lines. Salmon farming is referred to as *high-trophic aquaculture (HTA)*, because in nature salmon are carnivores feeding near the top of food webs; although vegetable proteins now provide a large part of feed, there remains a requirement for fish oils and meal. Salmon farming is an intensive mode of production, generating much particulate and dissolved waste per unit area, and relying on water-body *assimilative capacity* to dispose of those wastes. In contrast, the cultivation of mussels, oysters and kelps is referred to as *low-trophic aquaculture (LTA)*, because kelps are primary producers of organic material and the shellfish feed mainly on phytoplankton. Although it is not without environmental impact, LTA is much less intense than HTA, using a larger area of sea, at the point of production, for the same output. *Multi-trophic Aquaculture* (MTA) refers to the planned co-growth of several species, either in one farm or in the same water-body, for example using seaweeds to absorb some fish-produced mineral nutrients.

**Distance from the coast** determines the cultivation, engineering and regulatory requirements for farms and the environmental and social conditions under which they operate. A simple distinction is between *inshore* and *offshore* sites. Although there are no exact definitions, *inshore* unambiguously refers to sites within the sea-lochs of the Scottish west coast and islands and the voes of the northern islands. Sites in these water-bodies are sheltered from wind and waves, easily accessed from facilities ashore, but often highly visible from land. *Offshore* sites are more exposed to wind and waves, more difficult to access, and require more robust (and hence costly) farm structures. As defined by Chu et al. (2020) offshore sites are unsheltered and at least 3 km from land. However, the distinction between inshore and offshore is often imprecise and involves public visibility as well as physical exposure. Offshore waters tend to be more energetic, and dispersive of wastes, than inshore waters (Morro et al, 2021). This helps reduce environmental impact and/or allows farms to be larger for a given impact. Figure 2 compares a common type of inshore fish-farm with a proposed multi-use offshore structure.

**Carrying capacity** is, in the present case, the amount of aquaculture that a water-body or defined region of sea can support without undesirable impact on ecosystems or society. For present purposes it is useful to distinguish between *ecological carrying capacity* and *social carrying capacity* (McKindsey et al., 2006; Tett et al., 2016). In the

case of finfish farming the ecological carrying capacity is set by the local environment's capacity to provide a steady supply of oxygenated water and safely assimilate waste from the fish, whereas in the case of shellfish and kelp farming it also depends on the environment's capacity to supply phytoplankton for shellfish or dissolved nutrients for kelp. Social carrying capacity is set by competition for space and resources from other users of the sea and by the amount of visual, environmental, and/or socio-economic disturbance that local communities find acceptable. Some communities prioritise the employment provided by aquaculture, while others argue against it on the grounds of environmental impact. Balancing these priorities is a crucial part of planning.

**Environmental impacts of salmon farming** (Taranger et al., 2015; Tett et al., 2018) include the effects of particulate organic waste and dissolved nutrients (compounds of nitrogen and phosphorus) excreted by the fish, the potential infection of wild salmon with the parasitic copepods called sea-lice (*Lepeophtheirus salmonis*) that grow on farmed salmon unless treated, and the effects of the medicines used in these treatments. Nutrients and sea-lice are carried away from farms by water mixing, tidal excursions, and persistent currents. In low-energy environments, particulate wastes settle to the seabed and locally overwhelm the assimilative capacities of the benthic communities of organisms. Dispersion of sinking particles in high-energy environments may spread their loading over larger areas, with lower impacts per unit area. Mobile species (wild fish, marine mammals and sea-birds) can be attracted to farms and may need deterrence.

The main **environmental impact of mussel farming** (Wilding & Nickell, 2013) is that of mussels' solid wastes including 'pseudofaeces' and shell materials, whilst an abundance of mussels may consume phytoplankton needed by other marine animals. In the case of **kelp farming**, environmental impact is likely to include the input to the seabed of parts of the seaweeds lost in storms or during harvesting, causing localised hypoxia (Wilding, 2014), shading by dense growth of suspended kelps, and excessive removal of nutrients (needed by phytoplankton) by large farms. However, shellfish and kelp farming can provide benefits, by creating habitats for some animals and by removing some of the nutrients added by salmon-farming or agricultural or urban discharges (Timmerman et al., 2018; Hughes et al., 2022).

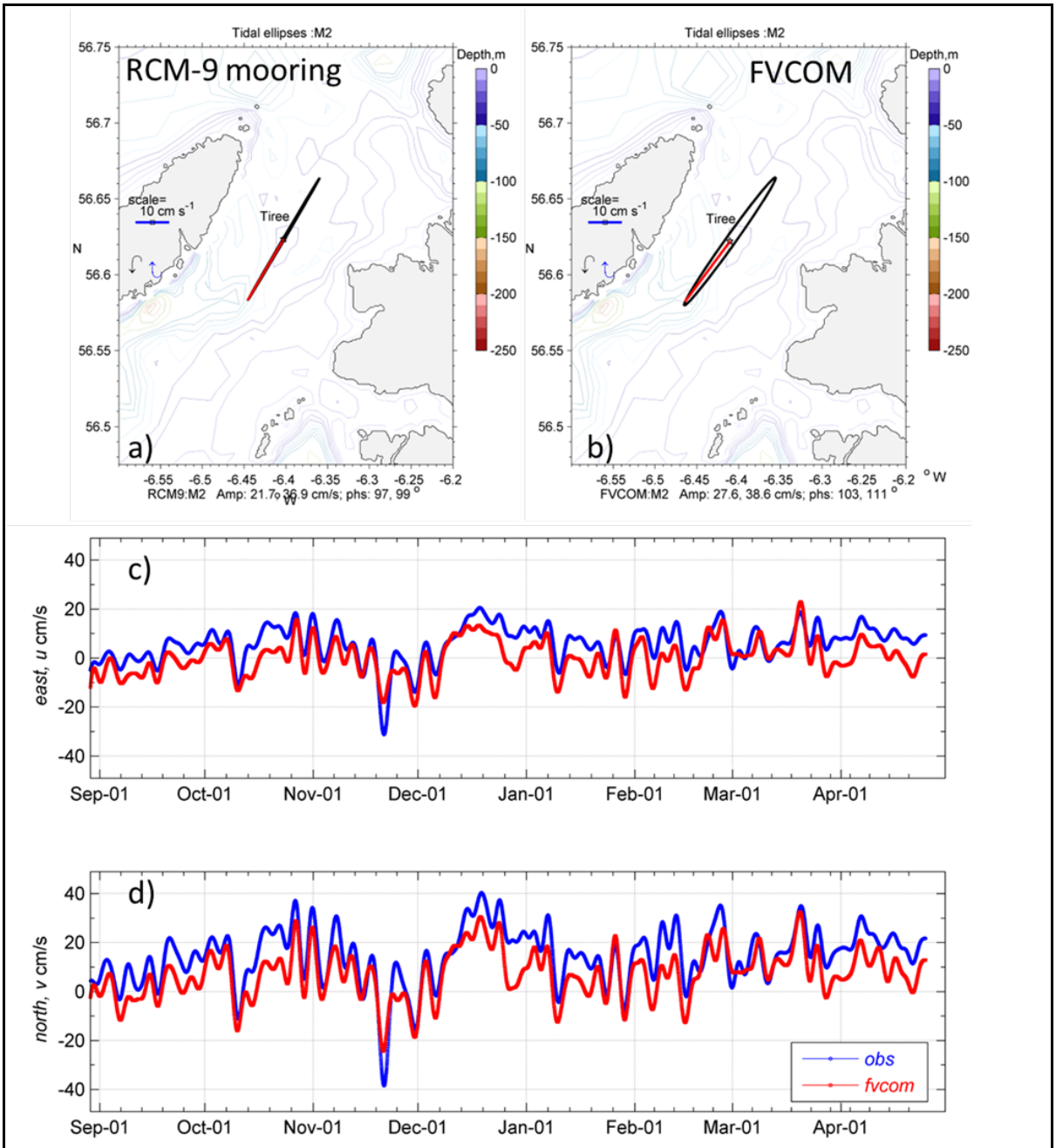
The seas to the west of Scotland form a single, **connected ecohydrodynamic system,** defined as a physically interconnected body of water that provides in all parts roughly similar conditions for plankton (and consequently for the fish, marine mammals and sea-birds that frequent these *pelagic habitats*). There is on average a northwards movement of water, starting from the Irish Sea and flowing up the Minch, although this can sometimes stall or reverse. Evidence for the flow comes from observations of radio-isotopes discharged from Sellafield in Cumbria (McKay et al., 1986), oceanographic studies during the last part of the 20th Century (Simpson, & Hill, 1986; Hill & Simpson,

1988), more recent tracking of drifters (Aleynik et al., 2016), measurements of currents at a mooring formerly maintained by SAMS in the Tiree passage (Figure 3) and high resolution 3D numerical modelling (Davidson et al., 2021). The flow carries wastes, parasites and plankton, and crosses the existing and proposed administrative boundaries between the MPZ of Argyll & Bute, Highland, and Eilean Siar.

**Suitable conditions for aquaculture**: in addition to carrying capacities for the several sorts of aquaculture, estimated from requirements for provisioning and regulating ecosystem services (in the form of waste assimilative capacities and the provision of food for bivalves or nutrients for seaweeds), there are other conditions that may constrain the successful operation of a farm. These include water depth (neither too shallow for farm structures nor too deep to moor them), water temperatures, and the prevalence of harmful organisms. The latter include toxic alga, which can render filter-feeding bivalves unfit for human consumption (Bresnan et al., 2021) as well as damaging the gills of farmed fish (Turner et al., 1987), and small jellyfish which damage farmed fish when swarming (Haberlin et al, 2021). There is little information on the occurrence offshore of these harmful planktonic phenomena, which adds uncertainty to investment decisions.

**Pelagic habitats** are the water column and plankton components of marine ecosystems, which provide the environment for all types of suspended aquaculture; **benthic habitats** are the seabed and associated micro-organisms, seaweeds and animals, which can be impacted locally by particulate waste from aquaculture. Mobile species (fish, marine mammals, seabirds) make use of these habitats. Whereas certain benthic habitats and mobile animals are protected by the UK Habitats Regulations (and their devolved implementations), anthropogenic impacts on pelagic habitats are regulated mainly in relation to *eutrophication*.[1] Circa 2000, there was concern about the cumulative effects of fish-farming on the balance of organisms in the plankton in western Scottish waters; these effects were not thought significant by Tett & Edwards (2002) and Rydberg et al. (2003), but may need to be re-examined if fin-fish aquaculture develops offshore. Whereas the pelagic habitat is regularly sampled in Loch Ewe (Bresnan et al. 2015) and Loch Creran/inner Firth of Lorn (Whyte et al. 2017) there is currently scant monitoring of these habitats in offshore waters.

[1] According to the Urban Waste Water Treatment Directive(91/271/EEC) **eutrophication** is "*the enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned*"; see also Ferreira et al. (2011).




Major M2 tidal ellipse derived (a) from current meter records, 2013.08.29 – 2014.04.24, and (b) from FVCOM model predictions; (c) zonal, and (d) meridional, de-tided residual currents components in the Tiree passage derived from the same observations (blue) and model (red).

*Figure 3: Observed and modelled currents at the SAMS Tiree passage mooring*

## Social science

**Polycentric governance** describes systems for making public decisions that involve a hierarchy of levels and overlapping centres of authority or influence (Ostrom, 2010, McGinnis, 2011). In the case of Scottish aquaculture, *operational* decisions, such as the granting of planning permission to a farm, are made by local authorities in consultation with national bodies and in exercise of powers under laws made in Holyrood or Westminster (Figure 4). Also relevant are *strategic* decisions about policy, such as that involved in Marine Plans, which might include zoning of the sea for particular activities. Whereas the requirement to involve several bodies in the making of planning decisions can be seen as inefficient, polycentric governance is thought to create societal resilience and avoid unhealthy concentrations of power. The *principle of subsidiarity* requires matching the level of decision making to the scales of the natural processes and the size of the societal groups impacted by the decisions that are made. The arrangements (SEPA, 2010), for co-ordinating the different agencies involved in licencing inshore fish-farms, have provided an example of successful polycentric governance at the operational level, but are not guaranteed to work offshore.

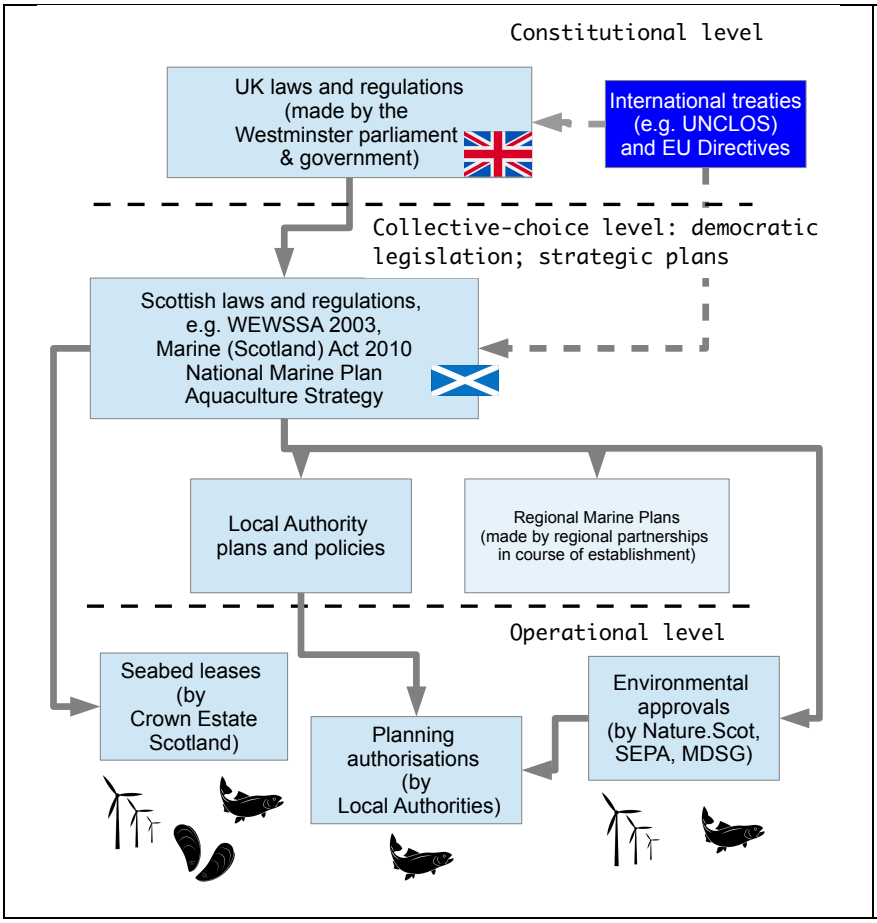



Diagram (modified from Falconer et al, 2023) of some of the *institutions* (referring to norms, policies and laws) and *organisations* (referring to bodies that embody and implement the institutions) of *polycentric governance* relevant to planning and licensing for finfish and shellfish aquaculture and offshore wind-farming in Scotland as part of the United Kingdom. At the operational level, only salmonid farming needs the full range of permissions. MDSG, Marine Directorate of the Scottish Government; UNCLOS, UN Convention on the Law of the Sea; WEWSSA, Water Environment and Water Services (Scotland) Act.

*Figure 4: Polycentric governance of aquaculture and ORE in Scotland*

The **Scottish Ministers**, granted constrained legislative and executive powers by the UK government and parliament ('Westminster') under the Scotland Act, 1998, are commonly referred to as *the Scottish Government*, deemed to include the part of the Civil Service that helps to make and execute policy. The *Scottish Parliament* has legislative powers under the same act. The shorthand 'Holyrood' (the site of the parliament) refers jointly to the Scottish executive and legislature.

The **UN Convention on the Law of the Sea** (UNCLOS, effective from 1994) distinguishes countries' *territorial waters*, extending in Scotland's case to 12 nautical miles (nm) from the *coastal baseline*, from a broader *exclusive economic zone (EEZ),* extending to 200 nm from the baseline or until it reaches the EEZ of another country. Holyrood can make and implement laws, such as the Marine (Scotland) Act of 2010, for the *Scottish Marine Area* (its territorial waters). The UK Marine & Coastal Access Act (2009), made in Westminster, governs the UK EEZ, but identifies 'Scottish Offshore Waters' where the SG has devolved responsibility for fisheries and nature conservation.[2] Scotland's *coastal baseline* is drawn from headland to headland. On much of the east coast, the outer limit of territorial waters is not much above 12 nm from the land, but on the west coast, where the coastal baseline links the Hebridean islands, the Scottish Marine Area extends much further from the mainland shore, as illustrated in Figure 1.

**Marine Spatial Planning** is the *"public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, social and economic objectives"* (Ehler, 2014). Scotland has a National Marine Plan (NMP), first published in 2015, which proposed that detailed planning be carried out by Regional Marine Planning Partnerships. Only a few partnerships are currently in existence (Greenhill et al., 2020). The UN Food & Agriculture Organisation (FAO: Aguilar-Manjarrez et al., 2017) has designed a method for planning for marine aquaculture, involving the designation of suitable zones for each type of farmed organism, but Scotland has no explicit zoning for aquaculture. The NMP has been reviewed twice, in 2018 and 2021, with the 2021 review advising the *"urgent need to tackle the twin crises of climate change and biodiversity loss… core drivers for a new plan"* (Scottish Government, 2022). New policy drivers for NMP2 include the Blue Economy Approach and Scotland's Vision for Sustainable Aquaculture, both including the requirement for improving spatial planning tools at local, regional, and national levels (Scottish Government, 2023; Scottish Government 2022). '**Co-use',** the sharing of sea-areas amongst different user groups,[3] and '**multi-use'**, the sharing of platforms, has been

[2] The 2009 UK Act uses the terms 'inshore' and 'offshore' to mean within, or beyond, territorial waters, which is different from the definition used in this document.

[3] For a proposed example of co-use, see introducing-the-worlds-first-commercial-scale-seaweed-farm-located-between-offshore-wind-turbines

recommended especially in the case of ORE and aquaculture (Holm et al., 2017, Abhinav et al., 2020), but requires a common planning system.

**Social licence to operate (SLO)** is defined (Billing et al., 2022) as "*an on-going active relationship between a host community and a development organisation, wherein the development organisation is held to certain standards set by the community, in exchange for community acceptance or support of the organisation and its local activity*." As thus described, SLO is *bridging social capital* (Leonard 2004) in contrast to *bonding social capital* within communities of place or communities of interest. Fish-farming organisations have begun to recognise that they need SLO for inshore sites, both to expedite planning permission and to operate successfully. Local employment is a key part of the relationship. A possible danger of a shift by the industry to offshore sites is a consequential reduction of interest in community engagement, and a loss of local employment, especially if offshore farms are serviced from ports outside the local area. Trust in regulating authorities is also seen as important in creating and maintaining SLO. LTA currently involves smaller, mostly local, firms, embedded in communities and hence benefitting from bonding social capital as well as contributing to local jobs. These benefits might be lost if expansion takes place offshore.

**Stakeholders** are people or organisations that have an interest in the outcome of a process, in this case that relating to operational or strategic planning. Such interest often gives a right to be engaged in or consulted during that process. The *statutory consultees* (including the Marine Directorate of the Scottish Government, NatureScot and SEPA) are sometimes called stakeholders but their interests clearly differ from the sectoral economic interests of the fishing, aquaculture, or ORE generation industries, or from those of environmental Non-Governmental Organisations. Running a planning process involving stakeholders is a resource-intensive challenge for public authorities, but not as expensive as contesting legal challenges to outcomes.[4]

**Monitoring** of the environment can provide vital information for industry and contribute to SLO as well as steer action needed to maintain the health of ecosystems. It's useful to distinguish *compliance monitoring*, mainly in the immediate vicinity of farms, and aimed to ensure that licence conditions are being met at these farms, from *broad-scale monitoring,* which amongst other things can track changes in the state of marine ecosystems resulting from aggregate effects of industry on water-body scales. Also relevant to industry is monitoring of environmental conditions, including water temperatures and the occurrence of harmful components of the plankton, that can impact on farmed fish or bivalves.

[4] As an example of such a challenge, see Scotland Court of Session, Outer House: [2016] CSOH 103. Petition of The Royal Society for the Protection of Birds for Judicial review. The court case concerned the Scottish Government's licensing of an offshore wind farm. It is discussed in Martino et al. (2019).

## The existing administrative procedures for licensing an aquaculture enterprise in Scotland

Planning permission is only one of the licences required by an aquacultural enterprise. Table 1 summarises public management of different sorts of aquaculture at different distances from the coast. Offshore Renewable Energy (ORE) is included because of potential synergies with aquaculture. The table distinguishes between *inshore waters* and *offshore waters* (as defined above), and divides the offshore waters into those within the Scottish Marine Area and those outside this but in the UK EEZ. The *Scottish Marine Area* comprises Scotland's territorial waters, those out to 12 nautical miles (nm) from the coastal baseline.

An application for development of a fin-fish farm in Scottish coastal waters out to 3 nm from the coastal baseline is currently considered by the appropriate Local Authority (LA) under The Town and Country Planning (Marine Fish Farming) (Scotland) Order 2007. According to a 'Working Agreement' (SEPA 2010), the application must be accompanied by an Environmental Impact Assessment and the local authority must "seek the expert advice of statutory consultees", which included SEPA, Marine Scotland Science (MSS, now rebadged as the Marine Directorate of the Scottish Government: MDSG), NatureScot (formerly Scottish Natural Heritage) and District Salmon Fishery Boards.

SEPA regulates environmental quality issues, especially "discharges of organic matter, medicine residues and other chemicals and interactions between sea lice from farmed fish on wild salmon", considers if "farm sizes and medicine usages [are] appropriately matched to the sea's capacity to disperse and assimilate wastes" (SEPA2019), and if satisfied issues a permit under the Water Environment (Controlled Activities) (Scotland) Regulations 2011. While impacts of organic loading on soft sediments (Pearson and Rosenberg, 1976), and regulatory requirements (SEPA, 2015), are well understood, regulatory models are lacking for impacts on the benthic communities of rocky sea-floors (Dunlop et al., 2021), habitats that are more common in high-energy offshore environments. SEPA is also responsible for ensuring compliance with CAR licence conditions, if necessary by monitoring at farm sites, and for monitoring of water and ecological quality in water bodies originally defined for the European Water Framework Directive (2000/60/EC).

MDSG considers the application in terms of its Locational Guidelines, assessing whether the development will exceed the capacity of the water body to assimilate wastes, taking into account inputs from other farms and sources. NatureScot assesses potential impact on Marine Protected Areas and Priority Marine Features, including species and habitats of conservation concern. The LA will grant planning permission only if the statutory consultees are satisfied. In addition, public views on the planning application are solicited; whilst even large-scale opposition is usually insufficient to

stop an otherwise satisfactory application, there have been numerous cases when such opposition has deterred a developer.

Developers of shellfish farms require planning permission only for shore-based facilities; the main constraint is the requirement for an Aquaculture Production Business Licence from MDSG. This can only be issued if the development takes place within areas that are managed for water quality and monitored for toxic algae, and such areas are currently confined to certain inshore water bodies (Coates et al., 2023). There is no current legislation explicitly controlling seaweed farming, which MDSG oversees as if it were shellfish farming (Marine Scotland, 2017).

Although zones have been designated for ORE, there are no offshore zones adequately identified for aquaculture, as recommended by FAO (Anguillar-Manjarrez et al., 2017). The FAO refers to "aquaculture zones" or "areas suitable for aquaculture" (ASA). Identification of SWPA could be seen as such identification for shellfish. The application of the MSS (now MDSG) Locational Guidelines implies that all sea-lochs and voes on the west coast and islands are suitable for fin-fish aquaculture within the limits of their assimilative capacity, while the moratorium on finfish farm development on the east coast and much of the north coast provides a sort of negative zoning. Local authority Local Development Plans could designate ASA, but in the case of Argyll and Bute, such zoning was not included in the policy to support aquaculture and coastal development.[5]

As previously mentioned, the working arrangements (SEPA, 2010), agreed between local authorities and statutory consultees, appear to have worked well for licensing inshore fish farms. However, licensing offshore sites poses new challenges to both groups, even without considering the need for strategic planning, and, in recent discussions related to ORE and aquaculture, councillors and officials indicated that Argyll and Bute had limited capacity in marine planning.

[5] Policy 28 in Argyll & Bute's 2024 LDP: www.argyll-bute.gov.uk/planning-and-building/planning-policy/local-development-plan-2.

*Table 1: Topics related to controlling developments for aquaculture in seas around Scotland*

This table was originally drafted in December 2019 in relation to co-use of Scottish waters for aquaculture and renewable energy generation. It illustrates the complexities of polycentric governance. We have tried to update it to September 2024, but it should not be viewed as definitive.

FF refers to finfish farms, SF to shellfish (i.e. bivalve mollusc) farms (and by default, kelp/seaweed farms). ORE = Offshore Renewable Energy. LA = local authority (e.g. Argyll & Bute). RMPP = Regional Marine Planning Partnership.

MSS-LG is the Locational Guidelines published by Marine Scotland Science (MSS), and MS-FHI refers to the Fish Health Inspectorate of Marine Scotland, both now badged as the Marine Directorate of the Scottish Government (MDSG). MSS-LOT, the Licensing Operations Team, is now MD-LOT. NMP = (Scotland) National Marine Plan (maintained by MDSG).

JNCC = (UK) Joint Nature Conservation Committee. SNH = Scottish Natural Heritage, now NatureScot. SEPA = Scottish Environment Protection Agency.

FSS = Food Standards Scotland. SWPA = Shellfish Water Protected Area, designated by SG (mostly) under The Water Environment (Shellfish Water Protected Areas: Designation) (Scotland) Order 2013, and overseen by SEPA

WFD = Water Framework Directive, implemented in Scotland by the Water Environment and Water Services (Scotland) Act of 2003.

| Topic | Inshore (Loch, voes and land-adjacent) | Offshore (In Scottish Marine Area) | Offshore (In UK EEZ ) |
|---|---|---|---|
| Seabed Lease Authority | Crown Estate Scotland, or local land-owner | Crown Estate Scotland | UK Government's Secretary of State for the Environment (i.e. Defra) |
| Operational (i.e. site development) consenting Authority | FF & SF: Local Authority; ORE: Not Investigated | FF & SF: Local Authority (out to 3 nm); ORE: MDSG | FF & SF: Unclear; ORE: MDSG |
| Strategic Zoning (and Authority) | FF: LA, potentially LDP, informed by MSS-LG;<br><br>SF: LA, potentially LDP, informed by SWPA;<br><br>ORE: Not relevant | FF, SF: LA, potentially LDP; or RMPP as argued;<br><br>ORE: In NMP (MDSG) | FF & SF: No Zoning; ORE: In NMP (MDSG) |

| Topic | Inshore (Loch, voes and land-adjacent) | Offshore (In Scottish Marine Area) | Offshore (In UK EEZ ) |
|---|---|---|---|
| Marine Licence Authority: ORE, all aspects; FF & SF: only navigational hazards | All: MS-LOT, now MD-LOT | All: MS-LOT, now MD-LOT | All: MS-LOT, now MD-LOT |
| EIA Required? (Evaluator) | FF: Yes (SEPA and MDSG) | FF: Yes (SEPA and MDSG);<br>ORE: Yes (MDSG) | FF &SF: Unclear;<br>ORE: Yes (MDSG) |
| Habitats Regulations Assessment Required? | All: If NatureScot determines | All: If NatureScot determines | All: If JNCC determines |
| Licensing Authority for Predator Deterrence | FF: NatureScot | FF: NatureScot | FF: Unclear |
| Water Quality Management | All: SEPA (WFD transitional and coastal water bodies) | All: SEPA (WFD coastal water bodies), but only to 3 nm from Coastal Baseline | All: (UK) Defra supported by MS, originally from MSFD transposition, now UK Marine Strategy |
| SWPA and Shellfish Harvesting Areas (SHA): *shellfish can be sold only from these areas* | SF: SWPA defined by MS, monitored by SEPA; SHA defined by FSS | SF: Within Scottish jurisdiction but none yet defined. | SF: None defined and authority unclear. |
| Disease Management Areas | FF: Established by joint industry/MDSG group | FF: Some defined in 'near offshore' | FF: None defined |
| Aquaculture Production Business License | FF &SF: MS-FHI | FF & SF: MS-FHI | FF & SF: Unclear |

## Challenges to marine aquaculture

Since 1979 SAMS (and its predecessor, SMBA) has carried out much aquaculture related research. We have used the resulting understanding to provide impartial advice (Black et al., 2002; Tett et al. 2018) for government on the environmental impact of fish-farming. In conjunction with European colleagues, we have explored the diverse challenges to expansion of both HTA and LTA. Recent findings are documented in papers by Galparsoro et al. (2020), Billing et al. (2021, 2022), Falconer et al. (2023) and Tett et al., 2025, which provide the basis for much of what is written in this section.

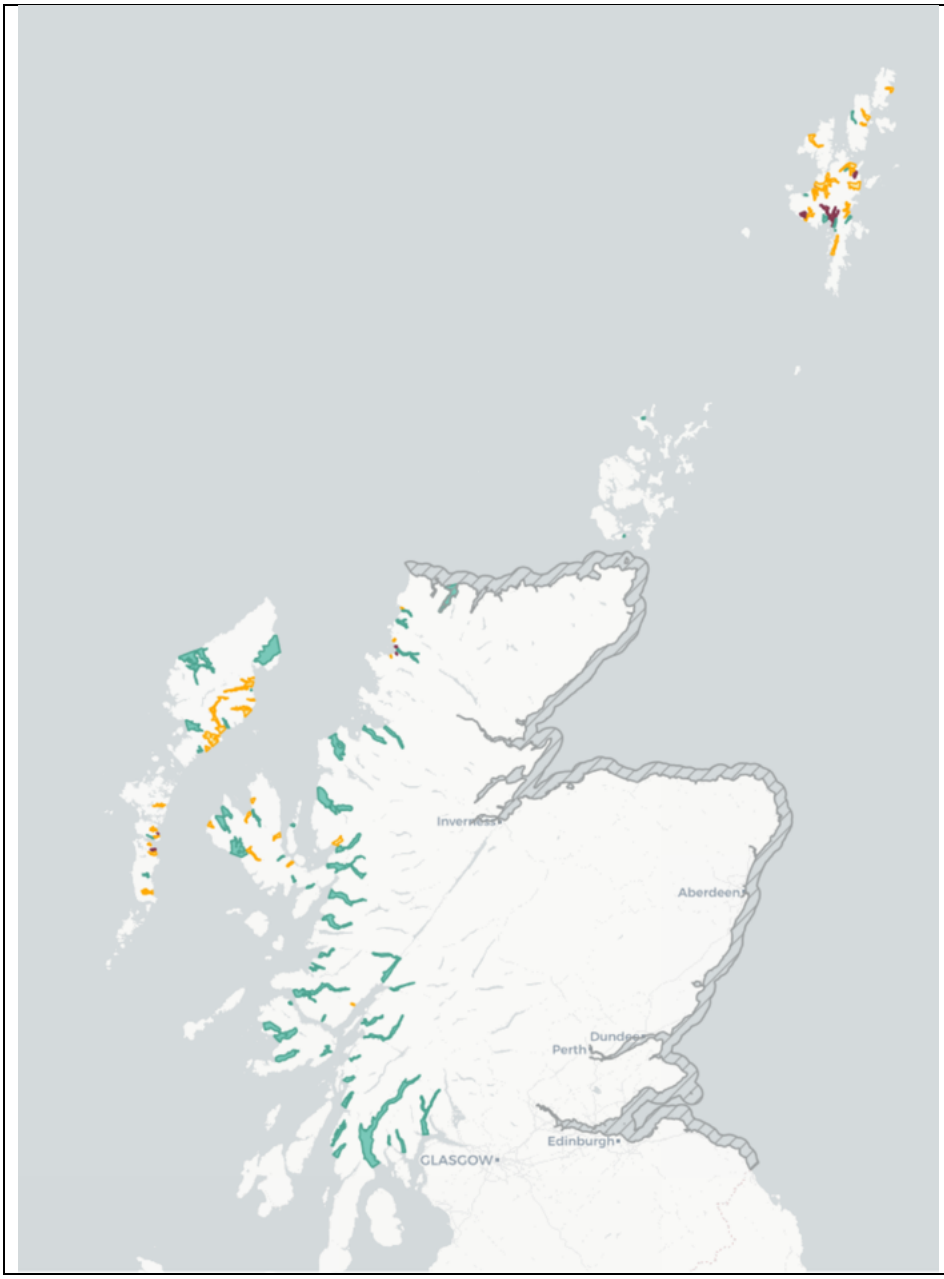
Commercial aquaculture began in Scotland in the 1970s. When in 2003 the Scottish Ministerial Working Group for Aquaculture published policy for the sustainable development of the industry, it cited production in 2001 of 139,000 tonnes of salmon, almost 5,500 tonnes of rainbow trout (*Salmo trutta*), and 3,000 tonnes of cultivated shellfish (Scottish Executive, 2003). The policy of expanding aquaculture has been continued by all subsequent governments, on the grounds of the contribution of the industry, a major exporter, to the Scottish economy and to employment in the Highlands and Islands. Throughout this period, there have been concerns about environmental impact and, until Brexit, acknowledgement of EU environmental protection directives. The recent 'Vision for Sustainable Aquaculture' (Scottish Government, 2023) continues the policy of sustainable expansion, now in the context of Scotland's National Performance Framework and the United Nations Sustainable Development Goals.

However, the policy has been only moderately successful. Scottish production of farmed salmon in 2020 was 192,129 tonnes, with 7,576 tonnes of rainbow trout and 5,661 tonnes of (blue) mussels. Salmon production fell to 150,949 tonnes in 2023, only a little more than that in 2001.[6] It can be plausibly argued that further expansion is constrained by the environmental and social carrying capacities of inshore waters. Figure 5 is taken from the SG's 'Locational Guidelines' for fish-farming, and maps constraints based on the potential impact of fish wastes on sea-lochs and voes. Although it appears to show spare capacity in, especially, mainland lochs, other environmental factors render some of these water bodies unsuitable. In addition, there are often numerous public objections to licencing (Billing, 2018) and a general perception that salmon-farming is harming wild salmon populations (Morton et al., 2016). Many sea-lochs and coastal waters on the west coast and the Hebridean islands have recently been designated by SEPA as *Wild Salmonid Protection Zones*, with operators required to improve sea-lice control.[7] Increased use of offshore waters is

[6] Figures from https://aquaculture.scotland.gov.uk/our_aquaculture/our_aquaculture.aspx. The recent fall in salmon output has been explained by the industry as caused by higher water temperatures, disease and jellyfish blooms.

[7] sepa-confirms-new-regulatory-framework-to-help-protect-scotlands-king-of-fish. A map of the wild salmonid protection zones can be found at scottishepa.maps.arcgis.com

seen (Morro et al., 2021) as providing increased carrying capacities whilst reducing impact on wild salmon and with less competition with recreational use of the sea.




Map from marine.gov.scot/maps/530 based on the *Locational Guidelines for the authorisation of marine fish farms* (Scottish Government, 2024). Crown copyright acknowledged. A presumption against new farms on the north and east coasts is shown by grey hatching. Water bodies coloured orange and dark red are estimated to be at their limit on the basis of existing nutrient loading and benthic impact. Further development is supposed possible in blue-green water bodies. Some of these water-bodies are otherwise unsuitable for net-pen farming (in ways not captured by the locational guidelines), some have been identified as *wild salmon protection* zones, and local objection may be a deterrent in areas where tourism is important.

*Figure 5: Map from the Locational Guidelines showing constraints on new fish farms.*

In addition, aquaculture producers have identified obstacles in governance. Complexities of regulation, planning, and licencing, apply to all sectors, and could be reduced by effective aquacultural zoning and a 'one-stop' shop for licensing (as is currently the case for ORE). Fin-fish farming is (Opstad et al., 2022) currently generally highly profitable, albeit like to be risky offshore. It is carried out by large, well-

capitalised, companies which can potentially meet the high cost of offshore structures[8] and can afford to employ specialists in support of licencing applications. In contrast, much LTA is small scale and needs new measured to generate financial capital and relevant legislation (Tett et al., 2025). Although shellfish farming is supported by relevant legislation in Scotland, it may only be carried out commercially in officially designated Shellfish Waters Protected Areas, which do not currently exist offshore. There is presently no official scheme for licensing seaweed farming, which is de facto treated as shellfish farming (Marine Scotland, 2017). There is currently no regulatory support either for multi-use of sea-space, for example by growing mussels in sea areas with wind turbines, or for multitrophic aquaculture, for example that involved in growing seaweed near fish-farms in order to reduce nutrient loading. These are issues not addressed by the current planning system for aquaculture.

Finally, in the current state of the public finances, it will be a challenge for the statutory consultees and other public agencies: to provide adequate (physical, chemical and biological) oceanographic information for strategic planning of offshore areas suitable for aquaculture; to carry out broad-scale monitoring of the aggregate impacts of offshore developments; to track and forecast the occurrence of components of the offshore plankton harmful to the farming of fish and shellfish; and to reliably monitor compliance of offshore farms with their licences.

[8] Although the costs of offshore farming are high, prospects for returns look good: Offshore fish farming: Food for thought - Kongsberg Maritime

## Discussion

The SG consultation, on what seems a limited and technical extension to existing local authority powers, in fact raises numerous environmental, social and economic issues. We have commented particularly on planning zones in the waters of western Scotland, a region with which our research has made us familiar. From an environmental perspective, this region is a single ecohydrodynamic unit with (on average) a northwards flow of water transporting wastes, parasites and plankton. From the perspective of governance, we question whether the local authorities with marine planning zones in this region have sufficient staff resources and funding to adequately licence offshore aquaculture in their zones. In the case of fish-farming, the authorities must interact with well-funded developers; in the case of offshore mussel and seaweed farming, the authorities may need to support undercapitalised local owners. It is in the interests of sustainable development and the corporations' marketing and social licence that the consenting authorities can properly evaluate, and the regulatory authorities adequately monitor environmental impact.

The consultation on extending MPZ deals with operational planning – the consideration of applications for a development at a particular site. The task would be easier, and the allocation of marine space more productive in the long term, if there was also strategic planning in the form of identification of 'Areas Suitable for Aquaculture' (ASA) as recommended by FAO (Aguilar-Manjarrez et al., 2017). Local authorities already operate 'Local Development Plans' for land and coast, but the example we consulted did not identify ASA. In contrast, areas for offshore renewable energy in both the Scottish Marine Area and the UK EEZ, have been designated by the Scottish Ministers as described in the *Sectoral Marine Plan for Offshore Wind Energy* (Scottish Government, 2020).

The original Scottish NMP envisaged the formation of about a dozen Regional Marine Planning Partnerships (RMPP). These might be suitable bodies to identify offshore ASA. However, only a few of these RMPP have been set up, with none on the west coast of Scotland. The Scottish Marine Regions Order 2015 shows separate RMPP for Argyll, West Highlands and Outer Hebrides, a delineation that is incompatible with the argument that these waters form a single ecohydrodynamic region. We propose instead that a joint RMPP be formed for these west coast waters, from the Mull of Kintyre to Cape Wrath – i.e. based on characteristics of the marine environment – and that its strategic planning remit should include identification of zones for (specific types of) aquaculture, with options for MTA and co-use with ORE. Noting the problems with an existing RMPP (Greenhill et al., 2020), the body's membership and operational rules need careful consideration. Table 2 provides some suggestions for membership. Interactions with fisheries might be a particular issue, as has become apparent in relation to ORE developments (Scottish Government, 2020; Withouk et al., 2023).

*Table 2: Suggestions for membership of a Hebridean joint RMPP*

| Aim/function | Include in membership |
|---|---|
| Preserving local democracy and community engagement | Elected representatives of local authorities and maritime community councils |
| Providing forum for industries | Representatives of fishing, aquaculture, ORE generation, port owners, etc. |
| Giving a voice to other interests | Relevant NGO (e.g. RSPB, Hebridean Whale & Dolphin Trust), 'the sea itself' |
| Supporting with expertise | Appointed officers of local authorities, statutory consultees (including MDSG, NatureScot, SEPA), academic scientists with knowledge of local environment and communities |
| Ensuring outcomes | Chair, appointed by Scottish Government |

Given zoning for aquaculture, operational planning should be easier. Local authorities and statutory consultees could consider applications for farm developments within an ASA and within their MPZ, with provision to consult neighbouring local authorities where development is close to a MPZ boundary. This is essentially the present operational system, as envisaged in the Scottish Government's proposal to extend local authorities' MPZ. However, there is also a need to take account of economic and staffing considerations for the local authorities, the proposed RMPP, and the statutory consultees. These will need adequate (and sustained) funding to carry out their parts in this and to maintain the expertise needed to properly assess the socio-environmental strategic planning issues, the operational permitting issues, and the subsequent policing of permissions.

Given the present state of the public finances in Scotland and especially in many local authorities, it seems clear that new sources of funding are needed for these purposes. One possible source is the revenue raised by Crown Estates Scotland from sea-bed leases, which could be justified on the grounds that their rentals ought to include an element for ecosystem regulating services used by salmon farming (Martino et al., 2019). In Norway, local authorities levy a production tax on salmon farms (Falconer et al., 2023, Box 2) which could serve as a template. Making use of synergies with ORE both offshore (co-use and multi-use) and onshore (port facilities) points to the need for shared planning and investment; a precedent exists in the funding mechanism legislated for the northern isles by the Zetland County Council Act 1974 and the Orkney County Council Act 1974.

Finally, there is and will be a need for ongoing monitoring and oceanographic study of the offshore waters of the west coast, to monitor and understand the environmental impact of new large farms in this region, and also to provide better information for these farms on potential hazards. The latter include blooms of spiny algae and stinging jellyfish which can harm farmed fish, and toxic algae that might be ingested by farmed

bivalves. Harmful algal blooms are currently routinely monitored inshore in shellfish growing waters (Davidson et al., 2021), but not offshore, and UK programs of monitoring plankton (McQuatters-Gollop et al., 2019) are currently under financial pressure and in any case arguably not adequate for Scotland's west coast offshore waters. Following the example of Tasmania, the fish-farming industry could, as a condition of licencing, be required to maintain a broad-area plankton and nutrient monitoring program under the supervision of MDSG or SEPA.[9]

Table 3 shows how these suggestions align with policies in the Scottish Government's (2023) 'Vision for Sustainable Aquaculture'. **Our conclusion is that achieving the policies in this vision will require more than a simple offshore extension of local authorities' operational planning powers. What is needed is (1) a strategic planning body dealing with all forms of sea-use in a region defined by ecology, and (2) a mechanism for funding this body and the additional tasks falling on local authorities from operational licensing. Also needed is (3) better scientific understanding, and monitoring, of the pelagic and benthic habitats in offshore west coast waters.**

[9] Broadscale Environmental Monitoring Programs (BEMPs) were developed as a requirement in accordance with the Tasmanian Marine Farm Planning Act 1995. Environmental licences issued to finfish growing operations in coastal waters states that monitoring must be undertaken by a consultant acting on behalf of all finfish lease holders within these areas. The cost of monitoring is paid by the industry; results are published via the Tasmanian Salmon Farming Data Portal, and the BEMPs overseen by the Tasmanian Environment Protection Authority.

*Table 3 Relation to policies in 'Vision for Sustainable Aquaculture' (Scottish Government, 2023)*

| Policy | As argued in this document |
|---|---|
| (4) the polluter should pay | A greater share of the funding for strategic and operational planning, and for monitoring, should come from the fish-farming industry |
| (5.1) improving spatial planning tools at national, regional and local level, and improving understanding and effective management of cumulative risk and impacts | There is a need for strategic planning (including identification of areas suitable for aquaculture, and co-use areas) by RMPP, and better understanding of the offshore marine environment |
| (5.1) encouraging collaboration between sub-sectors to investigate opportunities arising from the operation of multi-species farms or farm areas | Merely extending existing MPZ will not achieve this: multispecies farming (multitrophic aquaculture) and co-use with Offshore Renewable Energy needs legal changes and strategic planning |
| (5.1) exploring development beyond coastal waters, between 3 and 12 nautical miles, including potential impacts and the associated regulatory mechanisms | The proposed extension of MPZ to 12 nm is not in itself sufficient to address this policy: we think it needs strategic planning by RMPP, more monitoring, and adequate funding |
| (5.2) working with freshwater and marine stakeholders to deliver Scotland's biodiversity strategy, including working to understand and reduce impacts in the water environment and on sensitive habitats and species | Local authorities and statutory consultees currently likely lack resources for improving understanding of impacts in offshore waters |
| (5.2) further exploring the potential of shellfish and seaweed aquaculture as a means of providing beneficial environmental services, including biodiversity restoration, carbon sequestration and nutrient recycling | Merely extending existing MPZ will not achieve this: needs legal changes, strategic planning, and further scientific investigation of offshore environment |
| (5.3) delivering emissions reductions in line with our climate targets, ensuring resilience plans are in place and the risks of a changing environment are understood, enabling adaptation to challenges such as water scarcity, warming seas, storms and fish health issues | Understanding the risks in the changing environment offshore needs additional monitoring here of ecosystem state and of hazards to aquaculture |
| (5.4) increasing adoption of new and innovative technologies which achieve both positive environmental and health and welfare outcomes, including exploring the potential use of semi and closed containment systems | Rearing salmon offshore is likely to result in lower carbon emissions, and more natural conditions for the fish, than rearing them in recycling aquaculture systems. Technological developments will be needed for farming at offshore sites, for multi-trophic aquaculture, and for co-use with ORE |
| (5.5) protecting and improving the ability of, and opportunity for communities to meaningfully contribute to aquaculture planning and consenting | Should be taken into account in identifying areas suitable for aquaculture, but needs improved funding for local authority and community council roles. |

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