scottish science advisory council

Annex C

Presentations from Roundtable

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SSAC Multi-stakeholder roundtable

14 February 2023

09.00-12.00 hrs

SSAC – Who are we?

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- SSAC was created in 2002 by Scottish Government
- **Council** – chaired by Maggie Gill since December 2019; and includes 12 members, 2 associate members and 4 *ex officio* - CSA; Chief Scientist Health; CSAENRA; Chief Social Policy Adviser
- **Aquaculture Working Group** – Maggie Gill Lead, Marian Scott and Nick Owens from SSAC and Tonje Osmundsen (Norwegian political scientist) as members
- **Secretariat** – Science Advice and Engagement team within DG Economy (Jo Ward, Alasdair Maclean and Caroline Murray)

Distinctive features of SSAC

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- a remit that cuts across all sectors and policy areas;
- provides independent science advice at “arm’s length” to SG ;
- no disciplinary or sectoral “agenda”;
- operates as a “collective” (i.e. Members have a responsibility to provide checks and balances within the Council);
- our combined knowledge of Scottish science skills and context enables us to ensure that advice commissioned from outside Scotland is appropriate to the Scottish context

Principles of engagement:

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- Our focus is on *science* advice, where science includes social and economic disciplines;
- We consider future needs, highlighting the potential value of science;
- We can be both reactive (responding to requests from within SG) and proactive (identifying topics we think are opportunities or risks for Scotland);
- In developing Terms of Reference for specific pieces of work we take into account the broader landscape of advice available (e.g. Centres of Expertise, other advisory committees and organisations, the RSE etc)
-

SSAC Recent reports

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- SSAC Report - Quantum Technology: Opportunities for Scotland - here
- SSAC Report - Building on the Science Legacy of Covid-19 in Scotland - here
- Future Landscapes: Report on Geospatial Knowledge - here
- SSAC Technical Briefing Note - Sustainable Chemicals - here
- SSAC Report - Environmental Impacts of the Scottish Manufacturing Industry - here

Scope of Aquaculture study

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Title:

USE OF SCIENCE AND EVIDENCE IN AQUACULTURE CONSENTING AND THE SUSTAINABLE DEVELOPMENT OF SCOTTISH AQUACULTURE

About the *process* of using science not the validity of the content

Objective for today

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- To describe the overall policy context in which aquaculture fits in Scotland

- To stimulate ideas from the various stakeholder communities on the specific questions sent round in advance

- To collate multiple perspectives on those ideas from academia, industry, regulators, statutory consultees, communities, e-NGOs and interest groups present

What will happen post Roundtable?

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- Working Group will discuss, analyse and synthesise all the evidence we are collecting
- Further discussions with selected individual stakeholder groups as a check and balance on our interpretations
- High level comparisons with best practice internationally and in other sectors.
- Sense check our recommendations for action with those who will implement
- Sign off by the whole SSAC

Format – part 1

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Scene setting:

- The overall picture of Scottish policy
- The opportunities and limits of science

Breakout groups:

- Participants are pre-allocated to groups
- Chairs are independent of Working Group
- Each group will aim to discus all 4 questions but start from a different question to ensure we get answers to all questions

Format – part 2

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The science of societal engagement:

- What can social science contribute to the sector?
- How to bring natural and social sciences together?

Breakout groups:

- Allocated to the same groups for each session
- Two of the four Chairs change
- Again while each group will aim to discus all 4 questions each starts from a different question to ensure we get answers to all questions

Final Plenary

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- Topics which have raised interesting ideas in individual groups will be discussed (working group members will move between breakout groups but not contribute)

- Given we have > 50 participants, not everyone will be able to speak, so please use the chat function to maximise the number of contributions

What we expect of participants

- Please respect all points of view
- Please keep interventions short to enable everyone to contribute
- The questions have been selected to focus on moving forwards in the context of SG policies and to focus on the *science*
- Please focus on the questions – we have already collected views on what has gone wrong in the past, if you feel you haven't had that opportunity please use email (to Alasdair.maclean@gov.scot) to convey your views to the Working Group

Overview of the wider SG policy environment within which Aquaculture policy sits

SSAC AQUACULTURE ROUNDTABLE

USE OF SCIENCE AND EVIDENCE IN AQUACULTURE CONSENTING AND THE SUSTAINABLE DEVELOPMENT OF SCOTTISH AQUACULTURE

14th February 2023

Eann Munro – Scottish Government, Central Analysis Division

Scotland’s Blue Economy

Blue Economy Vision for Scotland (www.gov.scot)

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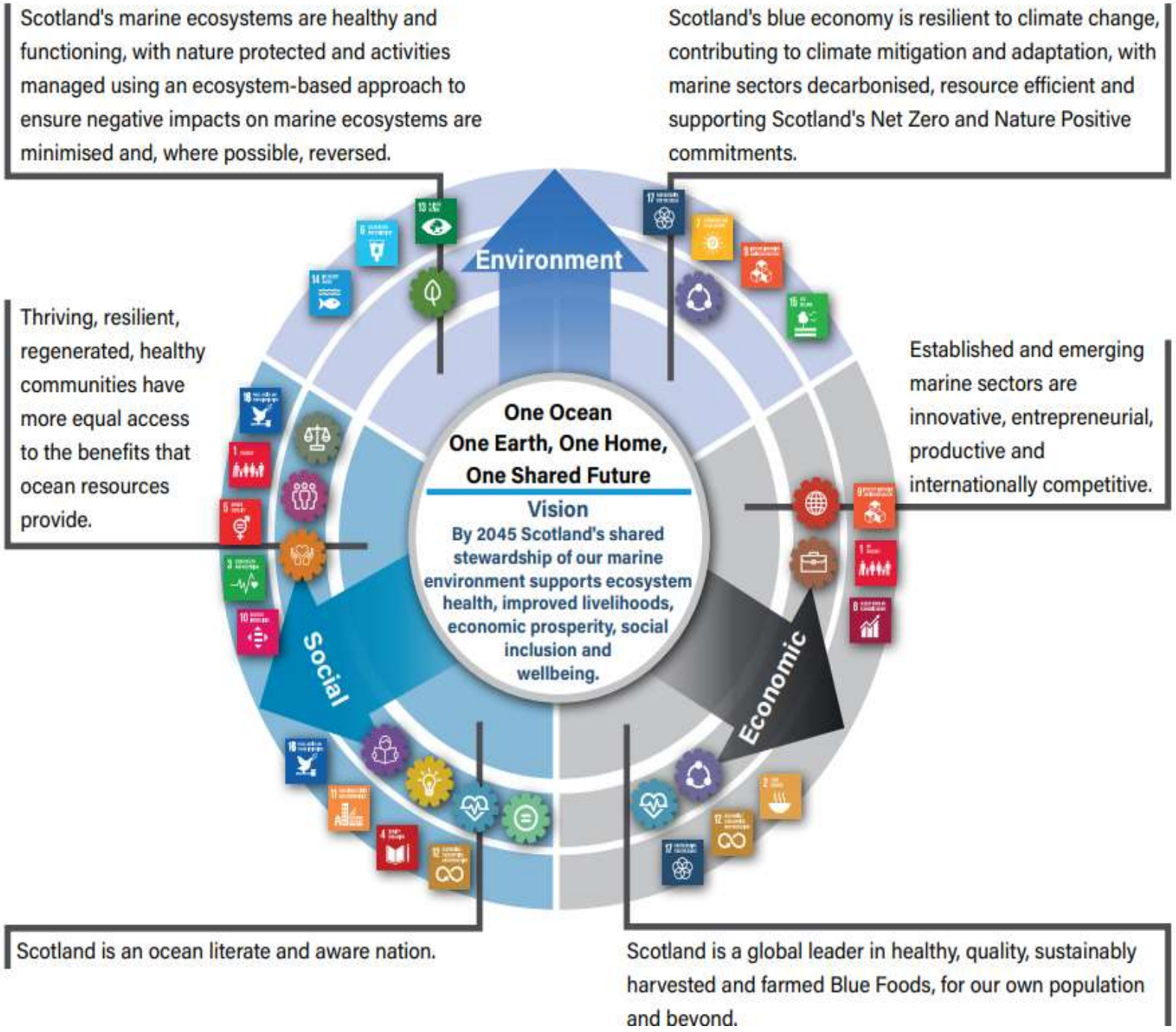
The Blue Economy Vision, published on 31 March 2022, recognises that Scotland's seas and waters have a key role to play in contributing to the nation's future prosperity, especially in remote coastal, rural and island communities – and that a healthy marine environment is essential to supporting this ambition.

Scotland’s Blue Economy includes the marine, coastal and inter-linked freshwater environment of Scotland, the different marine and maritime sectors it supports and the people connected to it.

The legislation, policies and management are all part of this, as well as the scientific research providing data to inform policy development and evaluate success.



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Contribution of the Blue Economy vision and outcomes to National Performance Framework Outcomes and UN sustainable Development Goals.

Centre: Blue Economy Vision
Inner ring: Blue Economy Outcomes
Middle ring: National Outcomes in the National Performance Framework
Outer ring: UN Sustainable Development Goals

Blue Economy Vision for Scotland (www.gov.scot)

The Seafood Strategy

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The seafood industry is a key component of the Blue Economy vision, which sets an ambition for Scotland to be a global leader in providing healthy, high-quality and sustainably produced and harvested "blue foods" for consumption at home and abroad.

Strategy for Seafood

Vision

Scottish seafood is renowned both at home and internationally for its quality and sustainability and is enabled by an innovative and productive sector.

Outcomes

Scotland is recognised for a seafood sector that is:

1. entrepreneurial, domestically and internationally competitive, with a secure supply chain.
2. providing healthy, quality, sustainably harvested and farmed seafood and ensuring a balanced natural capital asset approach.
3. adapting to, and mitigating the impacts of, climate change, lowering greenhouse gas emissions in seafood production and supporting our Net Zero commitments.
4. contributing to thriving, resilient and healthy coastal and island communities.

Seafood strategy - gov.scot (www.gov.scot)

Dietary benefits

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The NHS guidelines state that:
“A healthy, balanced diet should include at least 2 portions of fish a week, including 1 of oily fish.“

Fish and shellfish are good sources of many vitamins and minerals, protein and healthy fats. Oily fish, which includes salmon, is also particularly high in long-chain omega-3 fatty acids, which can help to keep your heart healthy (Fish and shellfish - NHS (www.nhs.uk).

Studies by Bianchi et al., 2022, assess all globally important seafoods, and show that salmonids, both wild-caught and farmed, and small pelagics are the most nutrient dense seafoods (Assessing seafood nutritional diversity together with climate impacts informs more comprehensive dietary advice | Communications Earth & Environment (nature.com)).

Fish and shellfish - NHS (www.nhs.uk)

The value of Scottish aquaculture

- Fish and seafood is Scotland's primary food export.
- In 2021, Scottish exports of fish and seafood were valued at £1.0 billion (204 000 tonnes) and accounted for 60% of total Scottish food exports (£1.7bn), and 63% of total UK fish and seafood exports (£1.6bn) (HMRC Regional Trade Statistics).
- UK exports of Atlantic salmon farmed in Scotland were worth £614 million in 2021 and made up 38% of total UK fish and seafood exports.

Aquaculture Finfish Production - Scotland

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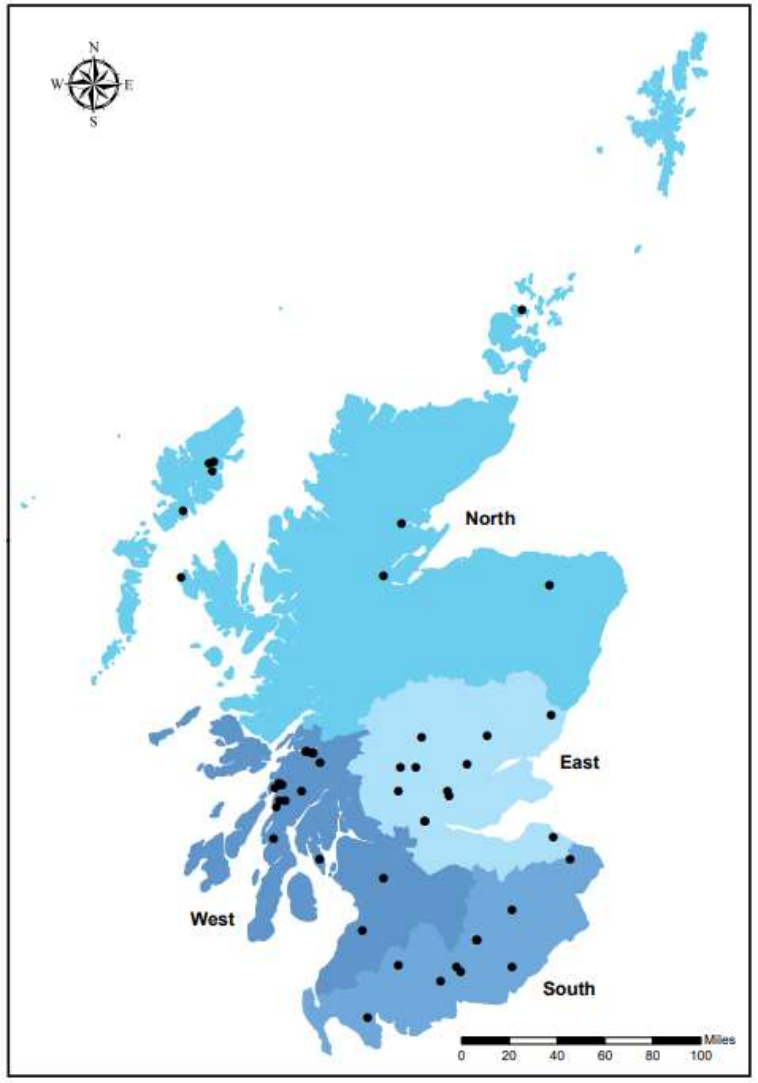
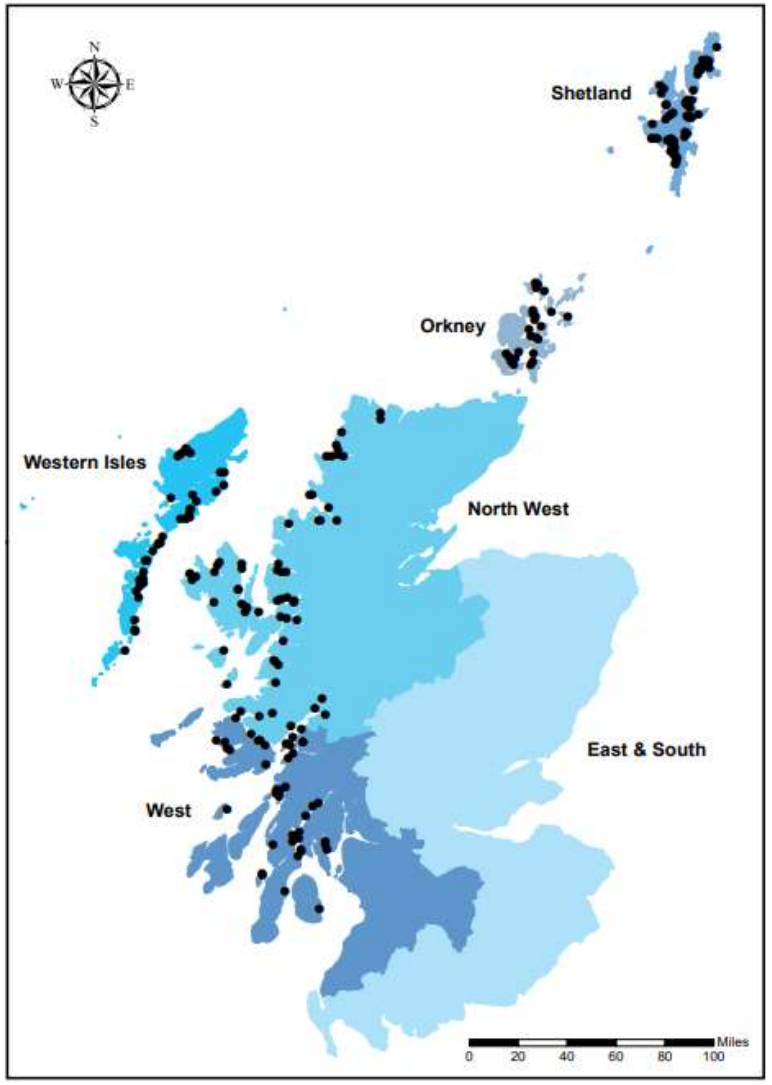
Active rainbow trout sites 2021



Active Atlantic salmon sites 2021



2021	Rainbow trout	Atlantic salmon
No of sites	48	213
Total tonnes	8,156	205,393
Staffing total	146	1,495
Productivity (tonnes/person)	55.9	137.4

scottish-fish-farm-production-survey-2021.pdf (www.gov.scot)

The value of Scottish aquaculture

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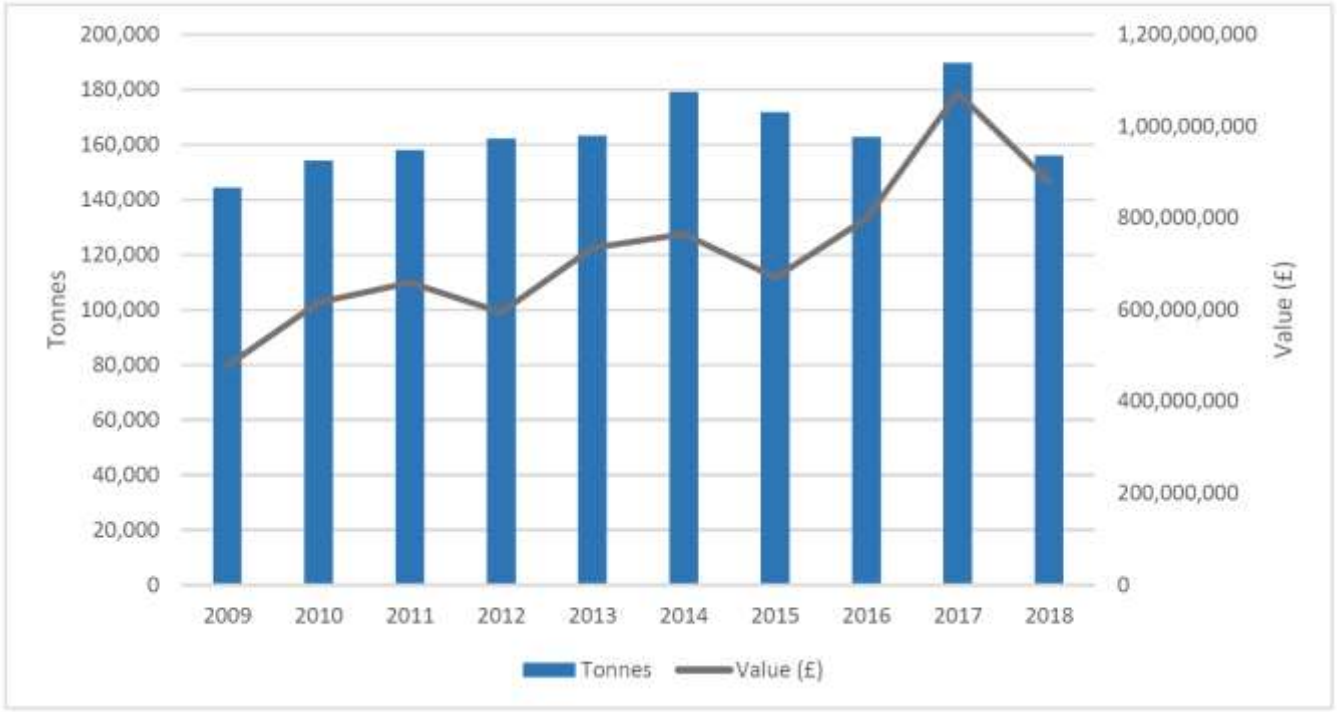
Aquaculture in Scotland provides a range of seafood products:

- Finfish – Atlantic salmon, rainbow trout, brown trout, Atlantic halibut. Wrasse and lumpfish are also farmed to cohabit with Atlantic salmon in seawater as biological controls of sea lice.
- Shellfish – Blue mussels, Pacific oysters, native oysters, queen scallops and king scallops
- Seaweed



Atlantic salmon production and value (2009-2018).
Source: Marine Scotland

Atlantic salmon dominates marine aquaculture, with a production value of £878 million in 2018, 97% of total marine aquaculture value.

Blue mussels are the main shellfish species produced accounting for 6,874 tonnes, 95% of shellfish production in 2018.

Between 2013 and 2017, the aquaculture GVA increased by 58% to £354 million, with employment increasing by 20%.

Aquaculture | Scotland's Marine Assessment 2020

Carbon Footprint

In a report by the Rural Policy Centre it is estimated that in 2019 Scottish salmon farming was responsible for 616 $ktCO_2e$ of GHG emissions.
Salmon has a carbon footprint of 3 $kgCO_2e$ per kg of liveweight, which is similar to chicken meat (produced in a conventional UK broiler unit), and lower than pork, beef or lamb.
[rpc-research-briefing-quantifying-aquaculture-greenhouse-gas-emissions.pdf (sruc.ac.uk)]

In a study by Bianchi et al., 2022, they assessed seafood climate impacts alongside nutritional diversity.
This figure shows the relative nutrient density and production-related GHG emissions (i.e. post-harvest emissions are excluded) per edible weight of globally important seafood groups from fisheries and aquaculture at the point of landing or harvest, along with beef, chicken and pork.
[Assessing seafood nutritional diversity together with climate impacts informs more comprehensive dietary advice | Communications Earth & Environment (nature.com)]

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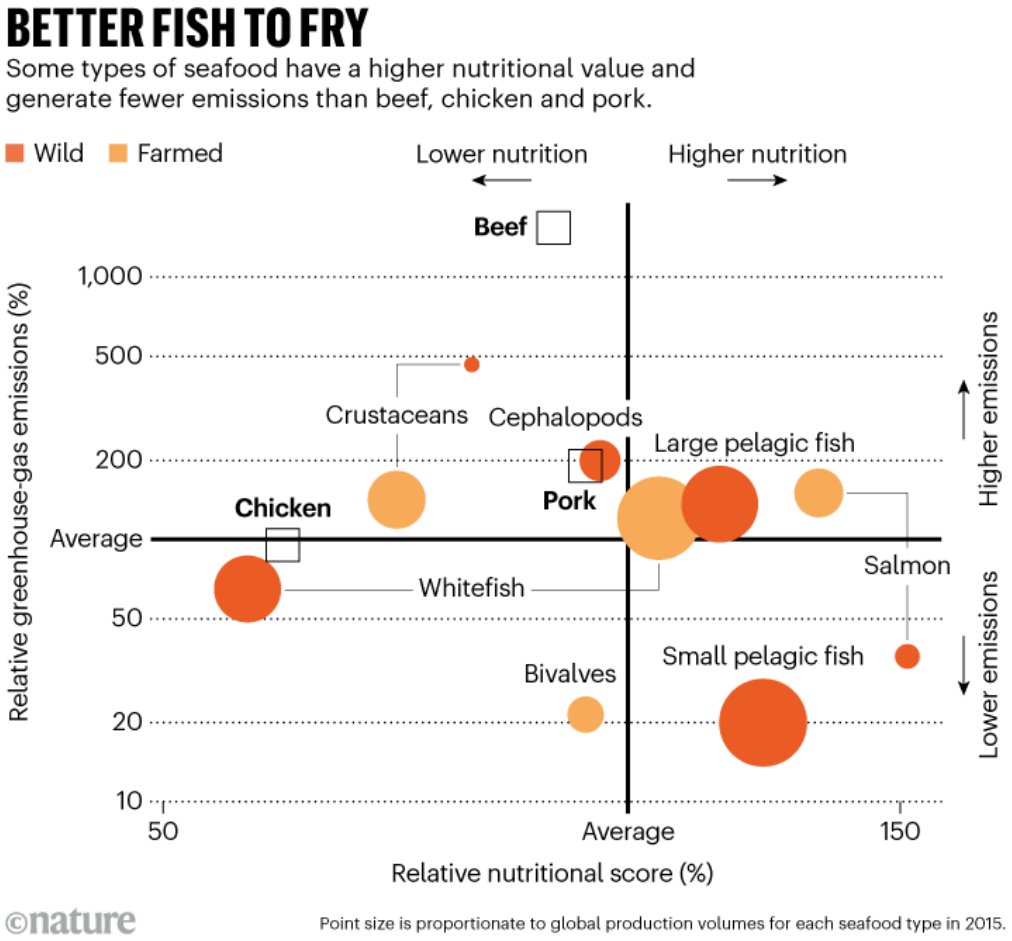
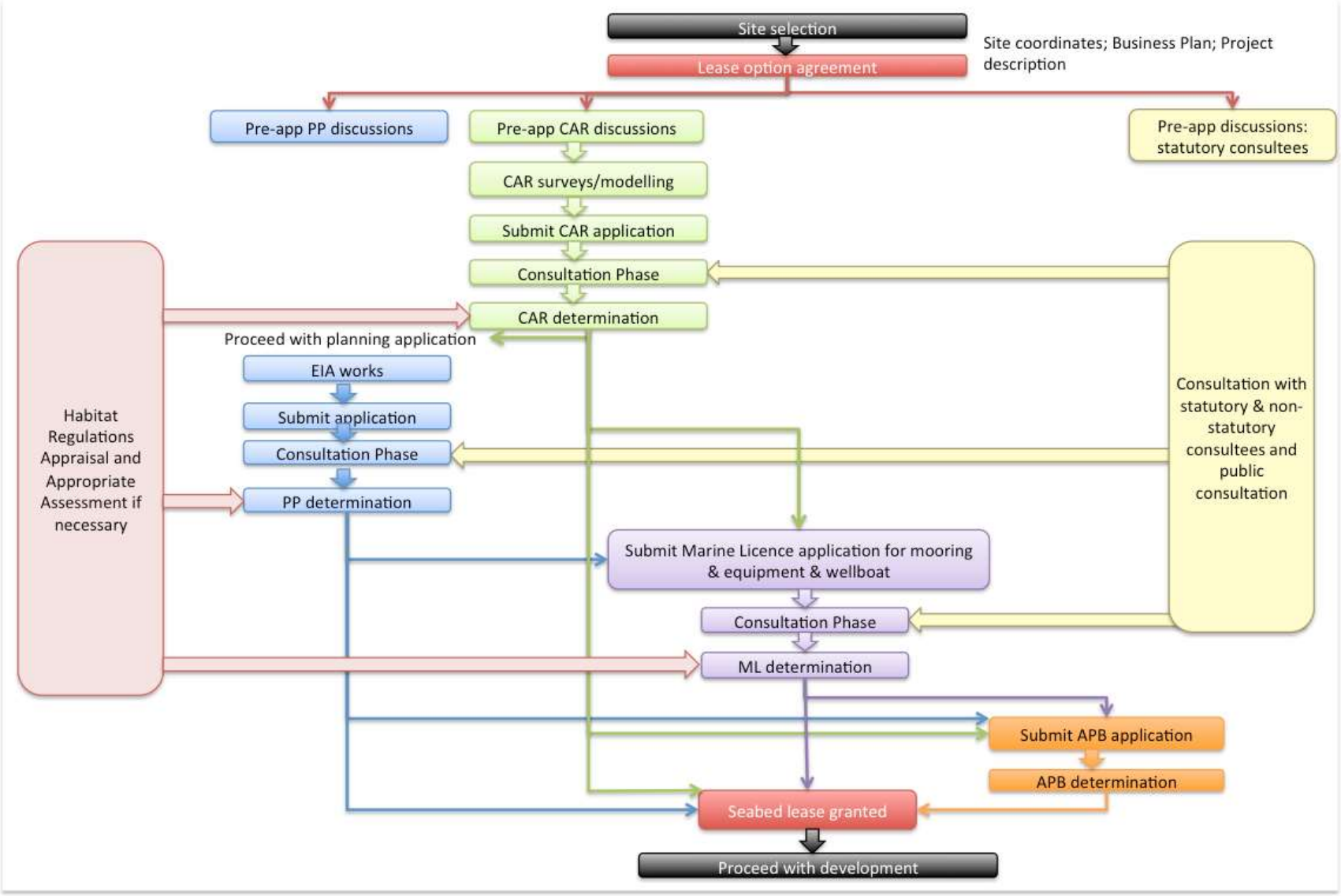


Requirements for Aquaculture Development



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Requirements for planning permission for an aquaculture (marine finfish and shellfish) development.

(Blue = Local Authority, Green= SEPA, Purple = Marine Scotland, Orange = FHI)

From SSAC AQ1 – The aquaculture consenting system in Scotland - DRAFT

Aquaculture Legislation

Application	Authorising Regulator	Legislation	Aquaculture Type		
			FF	SF	SW
Planning Permission	Local Authority (LA)	Town and Country Planning (Scotland) Act 1997	✓	✓	
Environmental Impact Assessment (if necessary, mainly relevant to FF, but can be required for SF)	Local Authority (LA)	The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011	✓	✓	
Marine Licence	Marine Scotland Licensing Operations Team (MS-LOT)	Marine Scotland Act 2010	✓	✓	✓
Seabed Lease	The Crown Estate	The Crown Estate Act 1961	✓	✓	✓
Authorisation to operate an Aquaculture Production Business (APB)	Marine Scotland Science Fish Health Inspectorate (MSS-FHI)	The Aquatic Animal Health (Scotland) Regulations 2009	✓	✓	
Controlled Activity Regulations Licence (CAR)	Scottish Environment Protection Agency (SEPA)	The Water Environment (Controlled Activities) (Scotland) Regulations 2011	✓		
Habitats Regulations Appraisal (if necessary)	All of the above	The Conservation (Natural Habitats, &c.) Regulations 1994 and its amendments	✓	✓	✓
Works Licence	Shetland Islands Council	Zetland County Council Act 1974			✓

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There are three marine aquaculture sectors in Scotland: finfish (FF), shellfish (SF) and seaweed (SW).

Each sector is legally required to obtain the relevant permissions and assessments prior to operating.

The required permissions and assessments are outlined in Table 1.

Table 1: Licences, consents and assessments required for each aquaculture sector, in Scotland.
From Griggs report, 2022 Aquaculture regulatory process: review - gov.scot (www.gov.scot)

Models, data, evidence

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“All models are wrong but some are useful” a quote by George Box.

A rather extreme comment, but reflects the fact that often we are modelling complex systems, and we may not know all the processes that occur in such systems, that models are informed by data (which may be sparse, and itself uncertainty).

So every model is subject to uncertainty, likely to be incomplete, and a simplification of the real world.

Models, data, evidence

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Every model is subject to uncertainty

There are a variety of different uncertainties, inputs and drivers (which could be data), parameters (environmental unknowns), processes that the model cannot capture. There are unknown unknowns.

Models, data, evidence

Every model is subject to uncertainty

As we build the model, we train it to appear similar to what we observe (calibration step), we will observe differences between the model and what we observed, sometimes called an error or discrepancy, we will try and test the model using 'unused' data (validation step).

These steps all depend on data.

Models also evolve and do need to change as our understanding improves

Models, data, evidence

impact occurs over space and time, but we are limited in what we can observe and measure.

Careful design of what, where and when we observe can help in reducing our uncertainty.

What limited data we have requires to be generalisable to a wider population (eg the whole sea bed- and this can be achieved through a model)

Models, data, evidence

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What limited data we have requires to be generalisable to a wider population (eg the whole sea bed- and this can be achieved through a model)

How do we interpret and understand the significance of the model findings? Is what we observe simply due to chance?

(debate concerning statistical significance, practical importance, reproducibility of the findings)

There may be more than one model, and they may show differences in their outputs.

Evidence and proof

“weight-of-evidence analysis as a judgment-based process for evaluating the strength of evidence to infer causation”

“Factors such as the quality of the data, consistency of results, nature and severity of effects, relevance of the information will have an influence on the weight given to the available evidence.”

IPCC created a language of uncertainty and a burden of proof

Evidence and proof- IPCC

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“**The evidence/agreement scale** allows separate assessment the type, amount, and quality of the evidence base supporting a claim and the level of scientific agreement (both on three-point scales).

The five-point **confidence scale** is closely tied to the evidence/agreement scale.

the likelihood scale is used to communicate quantified, probabilistic assessments of uncertainty produced by statistical or modeling analyses, or formal expert elicitation methods.

Precautionary principle (European)

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“The precautionary principle enables decision-makers to adopt precautionary measures when scientific evidence about an environmental or human health hazard is uncertain and the stakes are high.

The precautionary principle divides opinions. To some, it is unscientific and an obstacle to progress. To others, it is an approach that protects human health and the environment.

The precautionary principle is closely linked to governance. This has three aspects: risk governance (risk assessment, management and communication), science-policy interfaces and the link between precaution and innovation.”

Precautionary principle (FAO)

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Key concepts have been the **burden of proof** and the **standard of proof** (i.e., the responsibility for providing the relevant evidence and the criteria to be used to judge that evidence).

This refers again to our data and models discussion.

Precautionary principle (Canadian govt)

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Sound scientific information and its evaluation must be the basis for applying precaution; **the scientific information base and responsibility for producing it may shift as knowledge evolves** ....

Mechanisms should exist for re-evaluating the basis for decisions and for providing a transparent process for further consideration .....

A high degree of transparency, clear accountability and meaningful public involvement are appropriate

Aquaculture challenges

many different sources of evidence- some data, some models, some more qualitative, some strongly held beliefs.

Models are always simplifications, and the systems we are studying are complex.

The data are potentially limited but changing.

What we learn in one place may not be transferable to another.

The effects and impacts and their causes are uncertain (they might be highly likely or unlikely ….)

Our knowledge and understanding improves over time, so our decisions need to reflect this.

The approach and contribution of social science to the Aquaculture sector

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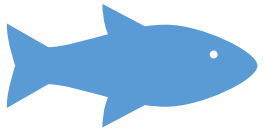
Social science research on aquaculture

Knowledge on aquaculture



Improving aquaculture

Social sciences

- Public regulation: roles, practices, cooperation
- Public perceptions – the social license
- Production practices (fish welfare, environmentally safe and human safety)
- Community significance of aquaculture industry
- Organizing the sector to improve collaboration and learning

Managing and regulating aquaculture

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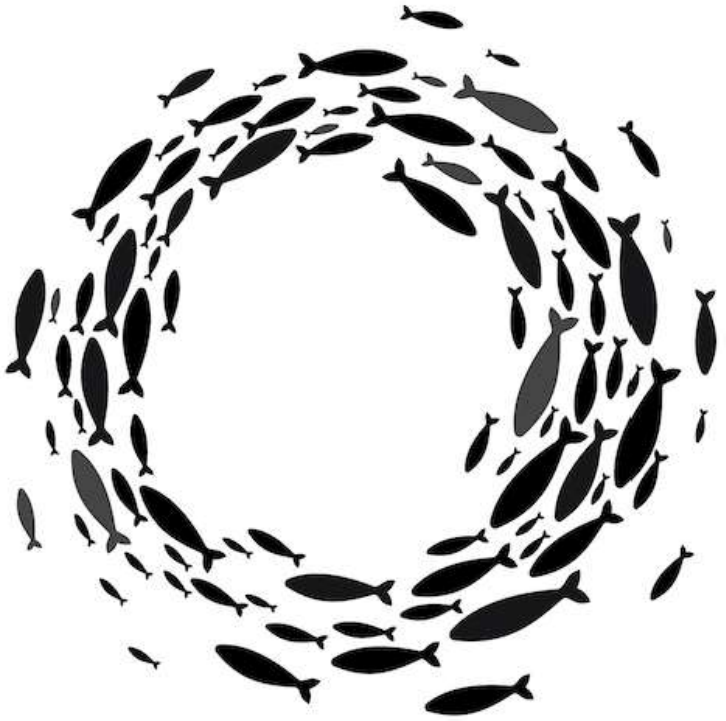
Wicked problems are characterized by uncertainty and lack of knowledge, dynamic challenges, lack of consensus with respect to interpretations and solutions, and problems that persist and rarely have a final solution.

Rittel & Webber, 1973



Aquaculture production

- Farming the ocean involves a multitude of interrelated and interconnected issues, e.g. environmental sustainability, food security, economic viability and social acceptability.

- These issues are complex and dynamic, and have unintended consequences that are difficult to predict and manage.

Implications

The industry is dynamic with frequent innovations. It progresses and evolves, causing established knowledge to be rendered obsolete or irrelevant

Appropriate and up-to-date **regulations** - leads to a complex web of regulations, laws, governmental agencies and levels of jurisdiction

Multidisciplinary **science** with findings that have room for different interpretations – providing support for growth and for contraction

Public lacking access to digestible and transparent information, information gaps causes heightened public sentiments questioning the authenticity of information and suspicions of secrecy

Handling wicked problems

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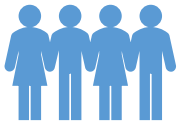
Industry

Regulators

Science



Public

Aquaculture industry

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- A dynamic industry eager to innovate and grow
- An industry «of and in» society
  - Demonstrate transparency and sharing of information
  - Rebuttal misinformation, but open on uncertainties
  - Addressing the relevant audience: «who is the community?»
  - Adapting to concerns

Aquaculture regulators

Ensuring that the benefits of aquaculture are realized while minimizing its negative impacts on the environment and society.

- Access to latest knowledge from science and industry
- Extensive collaboration and knowledge exchange across agencies
- Discretion and flexibility to adapt
- Demonstrate competence and decisions based on valid and relevante knowledge
- Disseminate knowledge and provide access to information

Science

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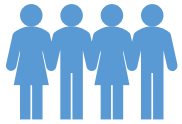
- State-of-the-art knowledge
- Multi-disciplinary collaborations
- Extensive outreach
  - Communicate uncertainties
  - Engage with industry and authorities
  - Address the public and its concerns



The public

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An ocean literate public

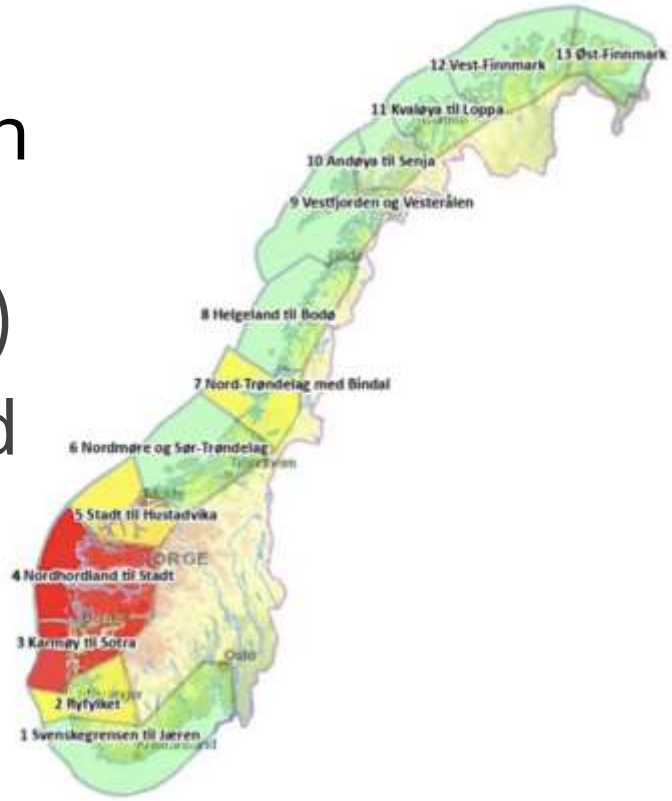
- Have easy access to information
- Opportunities to participate and capable to voice concerns
- Receive responses to their concerns

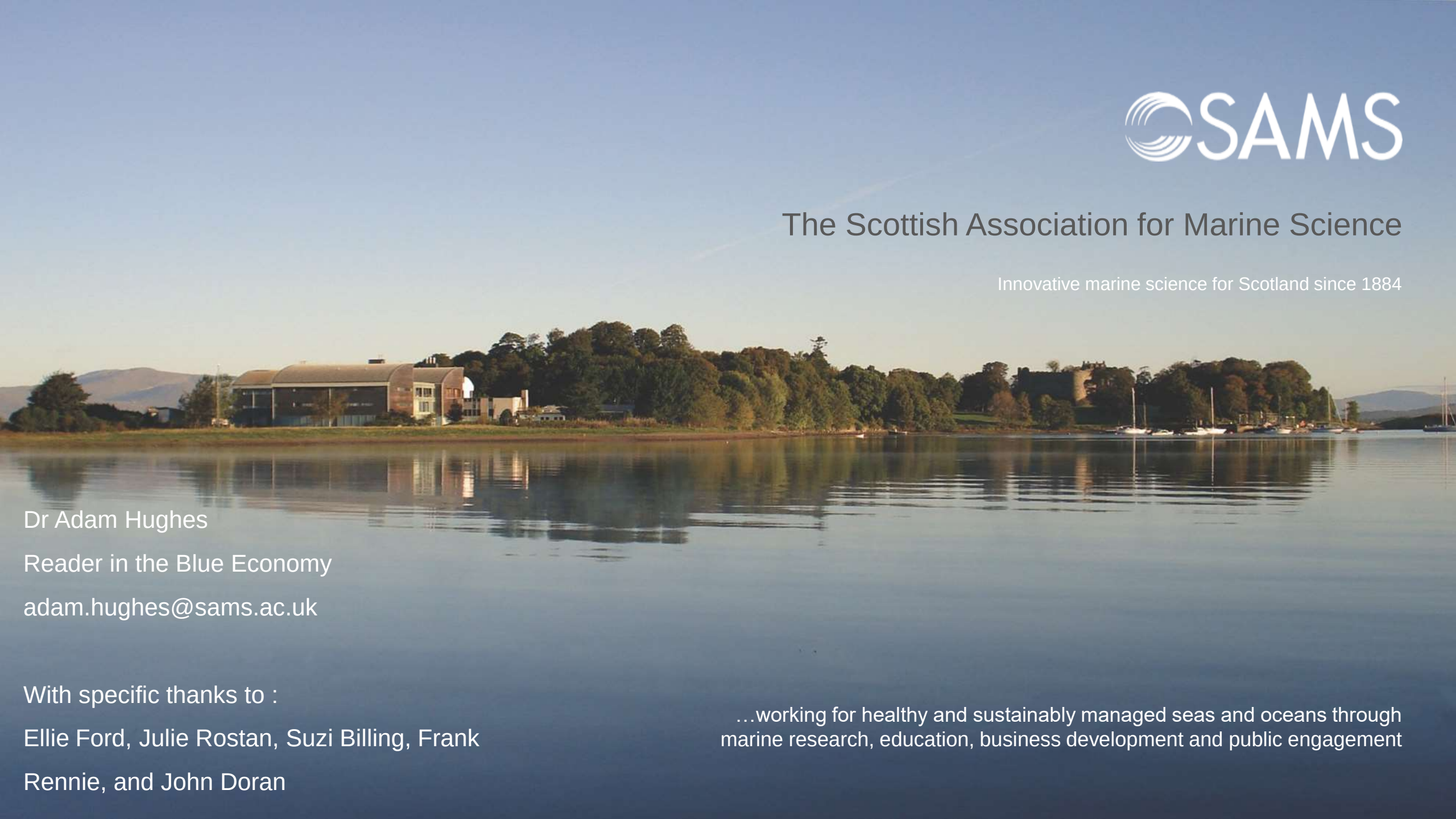
➢Promote informed public discourse

➢Support sustainable and responsible aquaculture practices

Norway

- Production volume 1 562 415 (tons)
- No. companies 163
- 1087 production licenses
- Grow out sites: 1031 (due to fallowing ca. 830 in use)
- Export value: USD 8,3 billion (NOK 81,37 billion)
- Employment approx. 42 000 (in value chain and ripple effect)
- Available information*: www.barentswatch.no*





The Scottish Association for Marine Science

Innovative marine science for Scotland since 1884

Dr Adam Hughes

Reader in the Blue Economy

adam.hughes@sams.ac.uk

With specific thanks to :

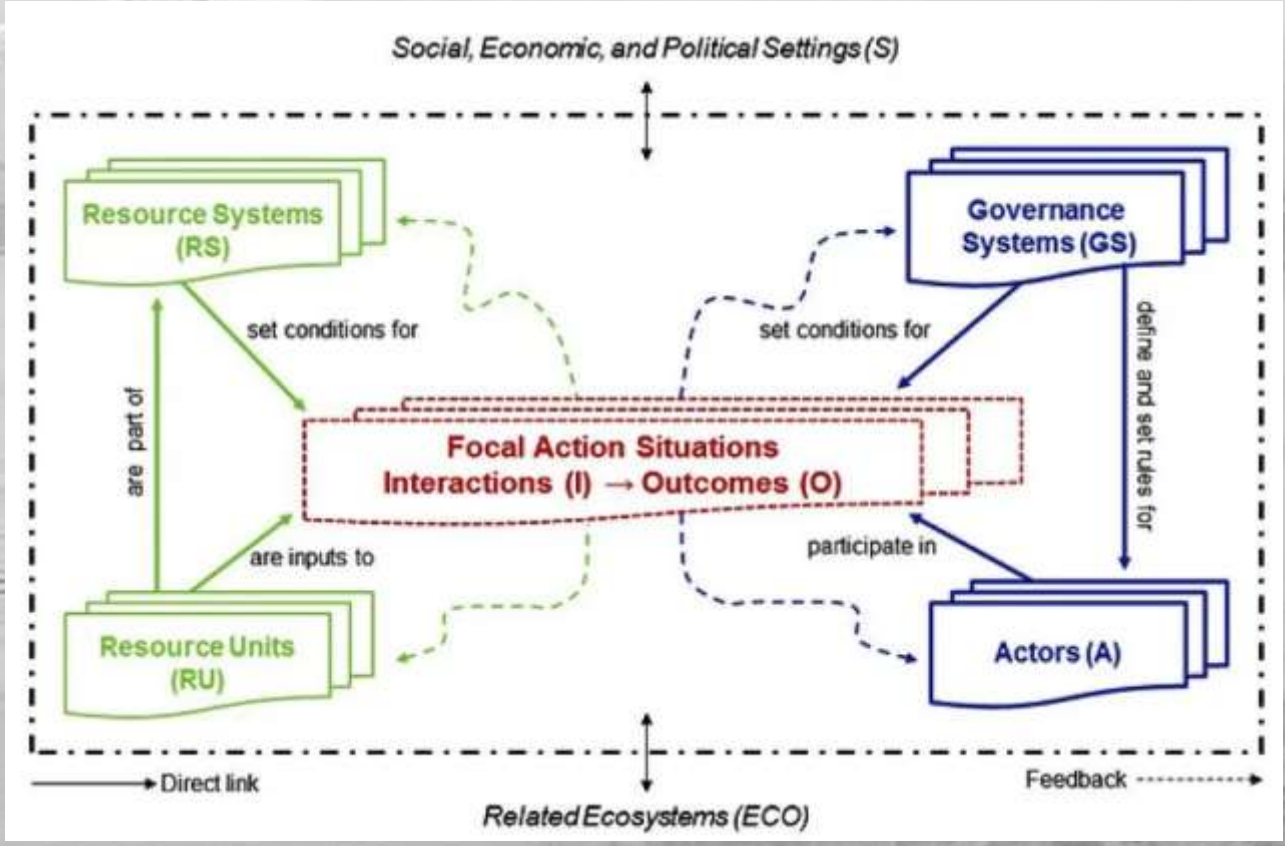
Ellie Ford, Julie Rostan, Suzi Billing, Frank Rennie, and John Doran

…working for healthy and sustainably managed seas and oceans through marine research, education, business development and public engagement

Bringing natural and social science together

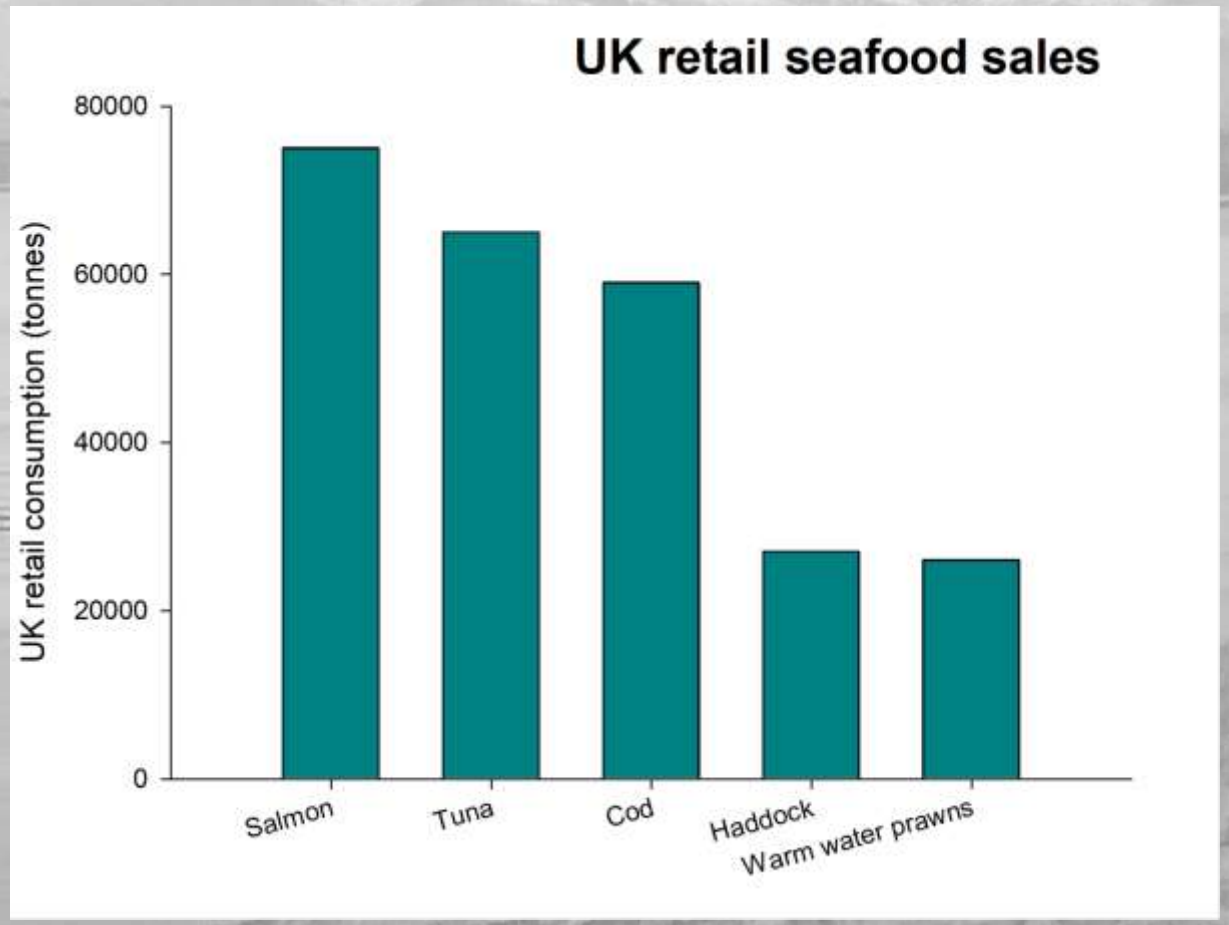
Bringing natural and social science together

- Aquaculture is a highly complex Social –Ecological System
- The ‘sustainability’ of the system is dependant on both ecological and societal dimensions
- Like all complex systems, successful interventions depend on understanding the feedback between the components



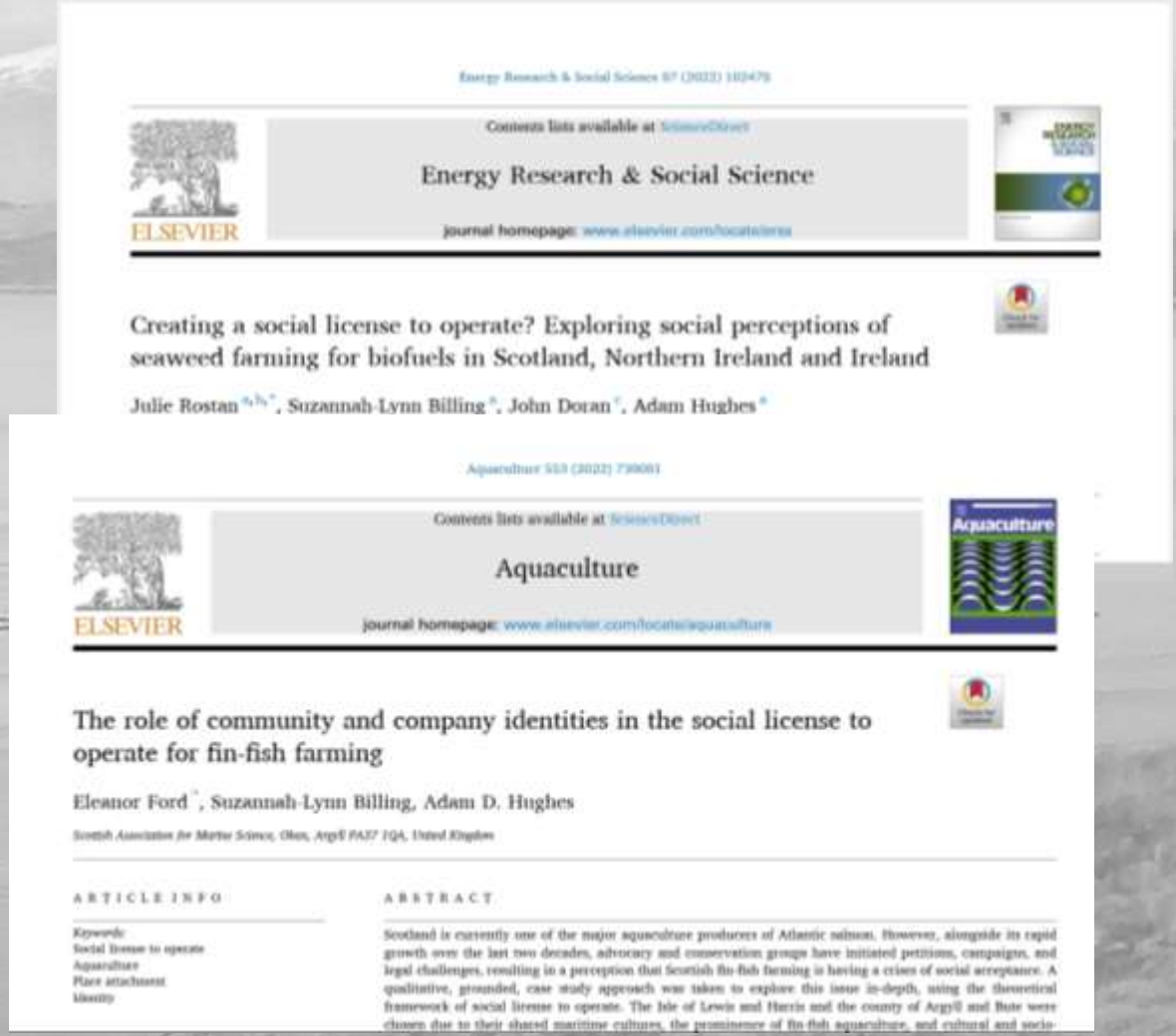
Bringing natural and social science together

- Salmon production in Scotland is growing with the highest production in 2021 (205KT)
- Polarisation on the public opinion of salmon farming is growing
- Without considering both the social and ecological components AND the interconnections we can not manage the complex SES



Bringing natural and social science together

- Two completed PhDs on the concept of social licence to operate in aquaculture (salmon and seaweed)
- Some common themes emerge, around scale, ownership, fairness and identification with the industry emerged
- These studies did not specifically aim to look at SESs or look to identify leverage points



Energy Research & Social Science

Contents lists available at ScienceDirect

journal homepage: www.elsevier.com/locate/erss

Creating a social license to operate? Exploring social perceptions of seaweed farming for biofuels in Scotland, Northern Ireland and Ireland

Julie Rostan, Suzannah-Lynn Billing, John Doran, Adam Hughes

Aquaculture

Contents lists available at ScienceDirect

journal homepage: www.elsevier.com/locate/aquaculture

The role of community and company identities in the social license to operate for fin-fish farming

Eleanor Ford, Suzannah-Lynn Billing, Adam D. Hughes

ARTICLE INFO

Keywords:
Social license to operate
Aquaculture
Place attachment
Identity

ABSTRACT

Scotland is currently one of the major aquaculture producers of Atlantic salmon. However, alongside its rapid growth over the last two decades, advocacy and conservation groups have initiated petitions, campaigns, and legal challenges, resulting in a perception that Scottish fin-fish farming is having a crises of social acceptance. A qualitative, grounded, case study approach was taken to explore this issue in-depth, using the theoretical framework of social license to operate. The Isle of Lewis and Harris and the county of Argyll and Bute were chosen due to their shared maritime cultures, the prominence of fin-fish aquaculture, and cultural and socio-

Bringing natural and social science together

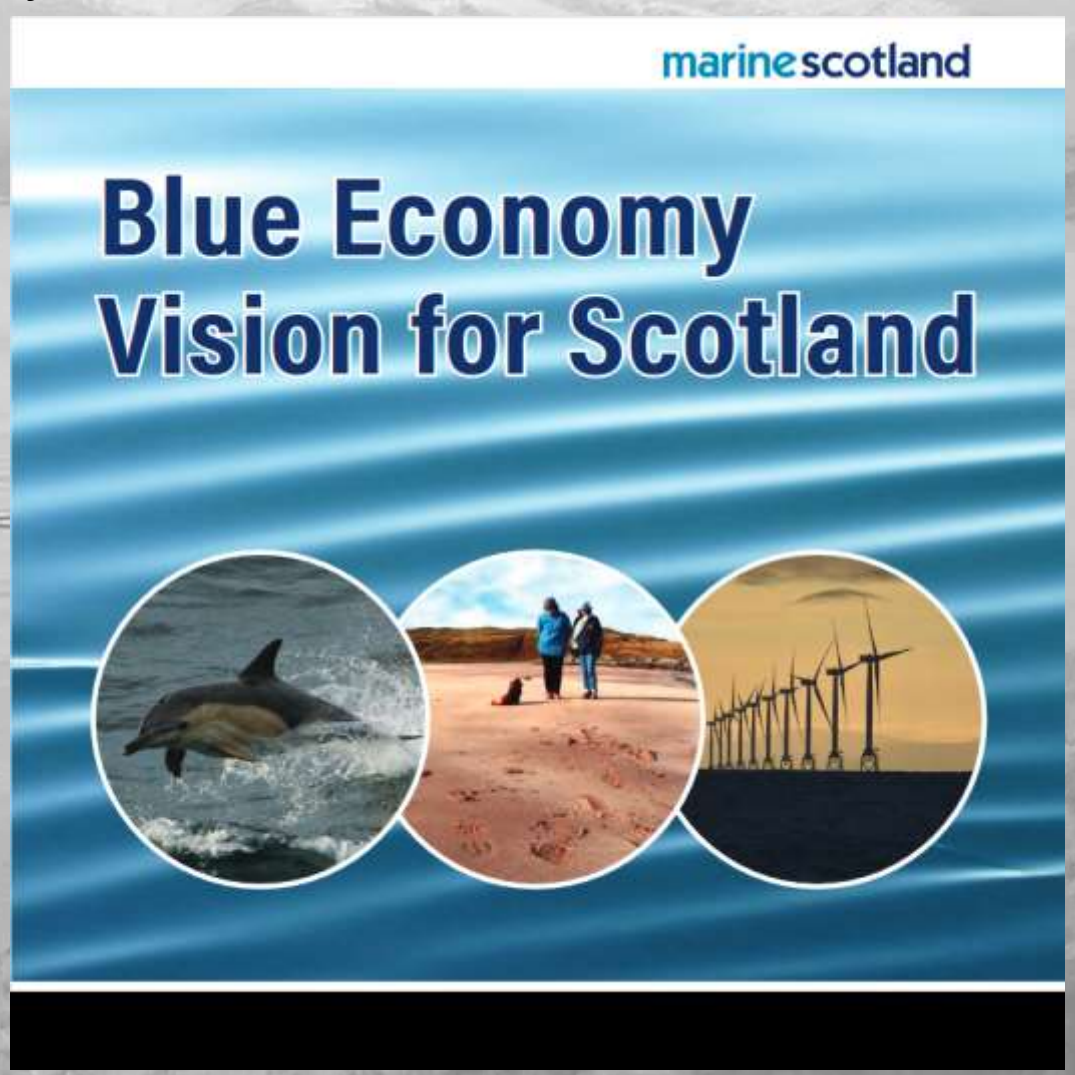
- Scale: There is a wariness of the industrialisation of the marine environment, with a preference for smaller/less intensive developments
- Ownership: A feeling that coastal communities should be participants/partners/owners of aquaculture developments, the perception of the marine environment as a common resource
- Fairness: Open and transparent governance was seen as crucial, but also equitability in the 'power' of different players, and a fairer distribution of costs and benefits
- Identification: Where the aquaculture industry was seen as external to the community or the values of the industry differed to those of the community there was a lack of support,

Bringing natural and social science together

Where is the wisdom we have lost in knowledge?
Where is the knowledge we have lost in information?

The Natural and Social scientific process collects data, information and generates knowledge

- How do we integrate these two disciplines to create leverage in the complex Social Ecological System?
- Understanding and setting goals is a powerful leverage point for complex systems
- Scotland has articulated its goals for the marine environment through its vision for a Blue Economy



Bringing natural and social science together

A common vision for aquaculture?

- Scotland is a global leader in healthy, quality, sustainably harvested
and farmed Blue Foods, for our own population and beyond

- Scotland's marine ecosystems are healthy and functioning, with
nature protected and activities managed using an ecosystem-based
approach to ensure negative impacts on marine ecosystems are
minimised and, where possible, reversed

- **What trade-offs are we willing to accept to meet these two goals?**

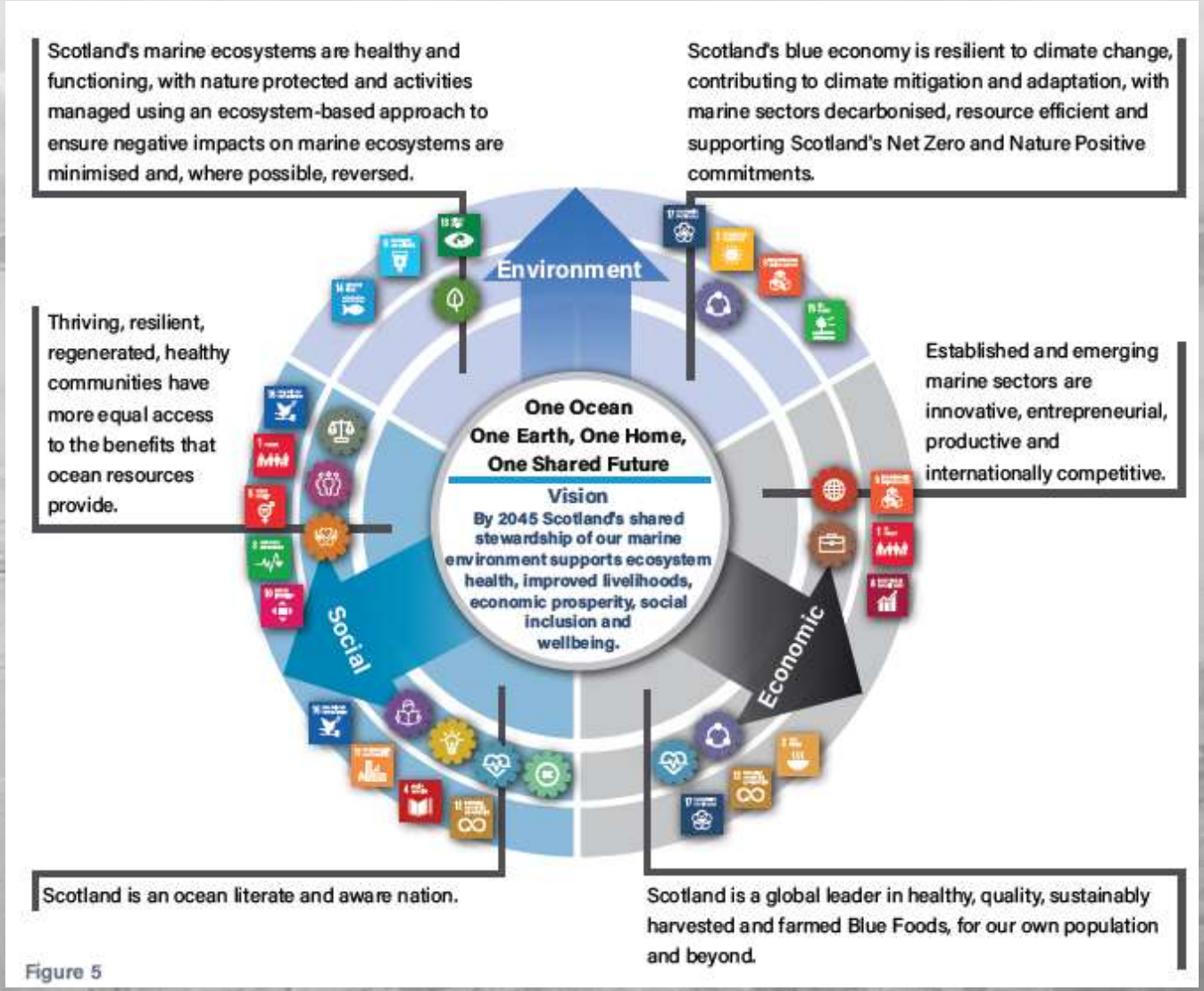
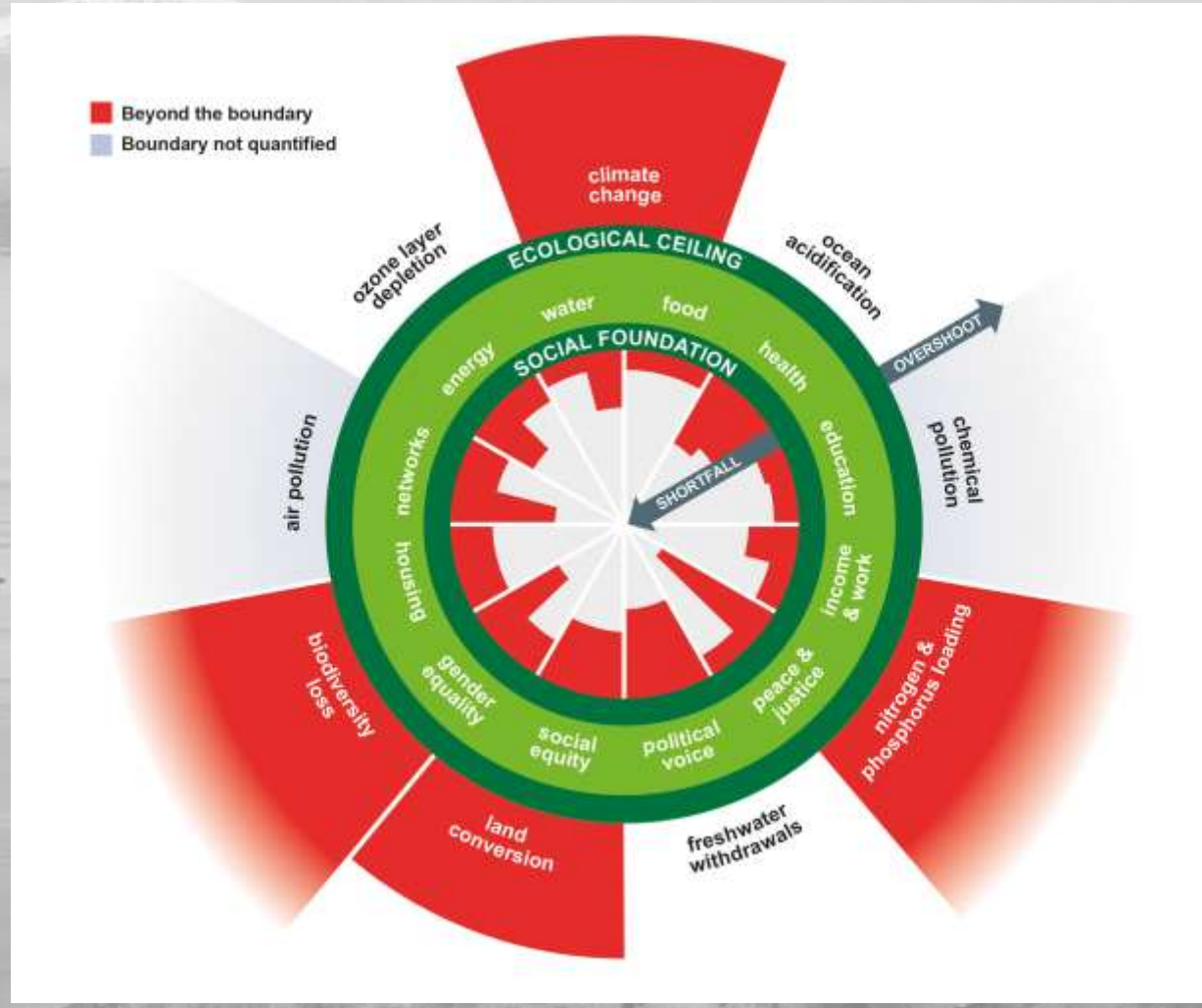


Figure 5

Bringing natural and social science together

What does sustainability mean for Scottish Aquaculture?

- Sustainability is not binary, but multifaceted
- Different people, communities have different ‘models’ of sustainability
- Achieving the sustainability goal will require a combination of social and ecological science



From Donghnut Economic (Kate Raworth)

Bringing natural and social science together

Precautionary principle and adaptive management

The Blue Economy vision states

- ‘development of adaptive management approaches and new decision making tools’

and

- ‘activities managed using an ecosystem-based approach’

What science is required to achieve both these goals?