

'Offshore' salmon aquaculture: identifying the needs for regulation

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Offshore aquaculture - regulation

- Conflicts and competition for space in coastal regions
- Move to sites not previously exploitable
 - More dynamic environments
 - Deeper offshore environments
- Fundamentally different environments
- Above and below.....



Offshore aquaculture - regulation

- Conflicts and competition for space in coastal regions
- Move to sites not previously exploitable
 - More dynamic environments
 - Deeper offshore environments
- Fundamentally different environments
- **But what is offshore?**
- **Why is this important?**



Offshore aquaculture - regulation

Dictionary	Definitions for the term “offshore”
Collins Dictionary	From, away from, or at some distance from the shore
Oxford English Dictionary	In a direction away from the shore At some distance from the shore; at sea
Cambridge Dictionary	Away from or at a distance from the coast
Merriam-Webster	At a distance from the shore
Dictionary.com	Off or away from the shore At a distance from the shore
The Free Dictionary	Moving or directed away from the shore Located at a distance from the shore
Lexico	Situated at sea some distance from the shore
Google Dictionary	Situated at sea some distance from the shore

- FAO expert workshop defined three categories of marine aquaculture site:
 - Coastal aquaculture
 - Off the coast aquaculture
 - Offshore aquaculture



“offshore when it is located > 2 km or out of sight from the coast, in water depths > 50 m, with waves heights of 5 m or more, ocean swells, variable winds and strong ocean currents, in locations that are exposed (open sea, e.g., ≥ 180° open) and where there is a requirement for remote operations, automated feeding, and where remote monitoring of operating system may be required”

Offshore aquaculture - regulation

- Most countries have a formal planning and licensing process for establishing fish farms
- Fish farms must be compliant with pre-set environmental limits, based on scientific evidence.
- The scientific evidence is based on knowledge of existing sites and impacts
- Problem:
 - Little is known for new areas 'offshore'
 - May require revised regulations and/or new monitoring protocols relevant for those conditions
 - What is "offshore"?

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'Offshore' salmon aquaculture and identifying the needs for environmental regulation

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ABSTRACT

'Offshore' aquaculture has gained increased attention as a potential route of expanding production of commercially important finfish species such as Atlantic salmon (*Salmo salar*). However, there is a lack of clarity about the term 'offshore' and how different 'offshore' environments are, compared to more traditional coastal or inshore locations. This uncertainty is an issue for effective governance and regulation and is a bottleneck for development that must be addressed. This study used a mixed method approach to evaluate what is meant by 'offshore' production and determine if existing approaches are suitable for licensing and regulating 'offshore' salmon aquaculture in Scotland, as a case study. First, a systematic literature review was used to assess academic studies and then an online questionnaire was used to gather views from salmon aquaculture stakeholders in Scotland and other countries. The results show there is inconsistency in what is perceived by the term 'offshore' aquaculture, making it challenging to determine a global definition. Literature, which was not limited to salmon production, tended to focus on distance from the coast but salmon aquaculture stakeholders had very mixed views, though a slight majority considered wave exposure was the key characteristic. The stakeholders indicated there may be a number of benefits of 'offshore' salmon aquaculture, but also suggested that existing regulations are not appropriate for 'offshore' salmon production and could be enhanced. The study results suggest that regulators and stakeholders need to agree on consistent terminology that characterises the production environment. Depending on local or regional complexities, several classifications that reflect key features, may be required. Additionally, new or adapted approaches to aquaculture licensing, regulation and site suitability may also be needed to account for physical and ecological differences from more traditional farming locations. Ultimately, environmental regulation will only be fit-for-purpose if it is evidence-based and relevant to the environmental conditions, surrounding ecosystem, and species being produced. Ironically, the biggest constraint to 'offshore' aquaculture regulation seems to be understanding what 'offshore' is and means, and until this is addressed there will continue to be uncertainty and confusion that hinders development of the sector.

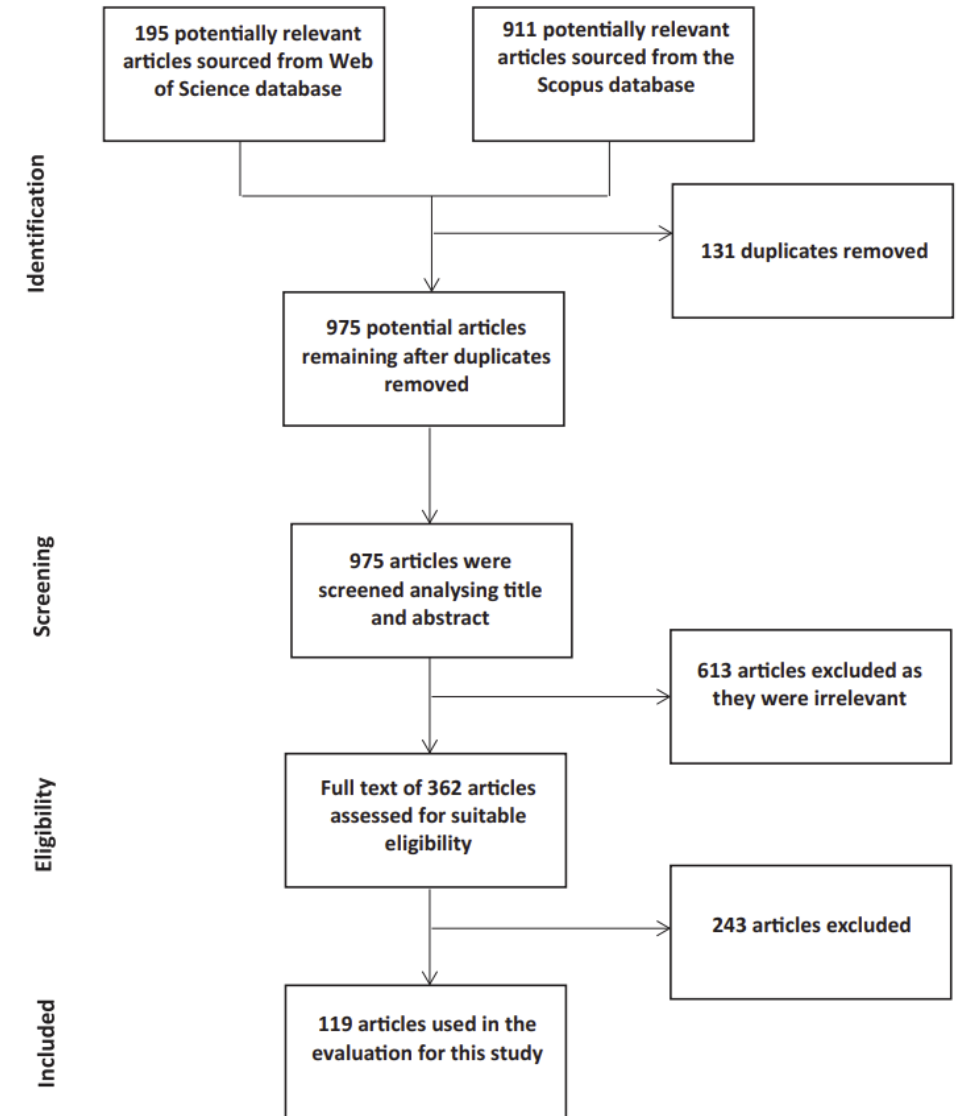
1. Introduction

Coastal regions are highly productive and an important resource for

consequently 'offshore' aquaculture has gained increased attention in recent years for both fish and shellfish (Jansen et al., 2016; Gentry et al., 2016; Barillé et al., 2020).

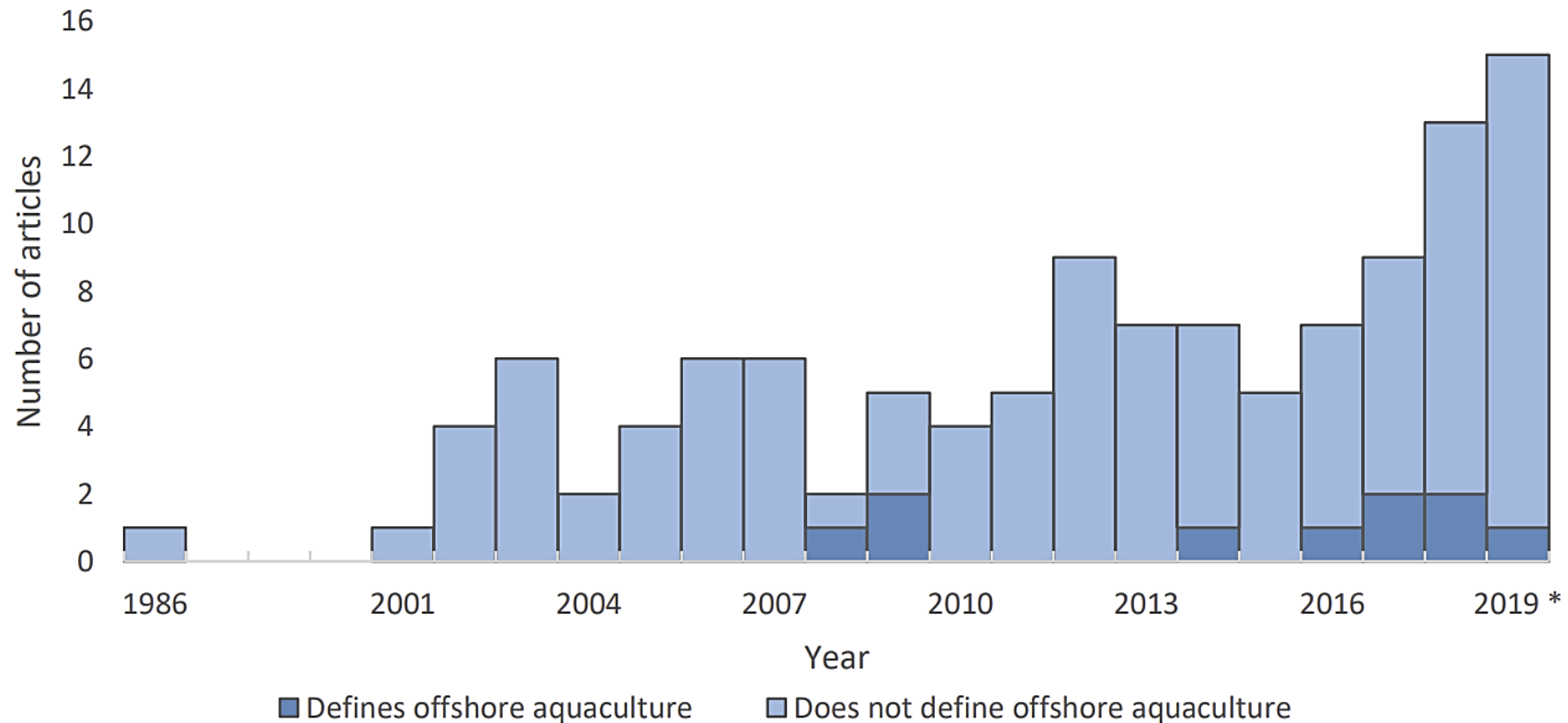
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- What is known in relation to offshore aquaculture, regulation and licensing considerations?
- Is there any disparity between scientific research and stakeholder views on offshore aquaculture?
- Mixed methods approach:
 - PRISMA systematic literature review
 - Online stakeholder questionnaire



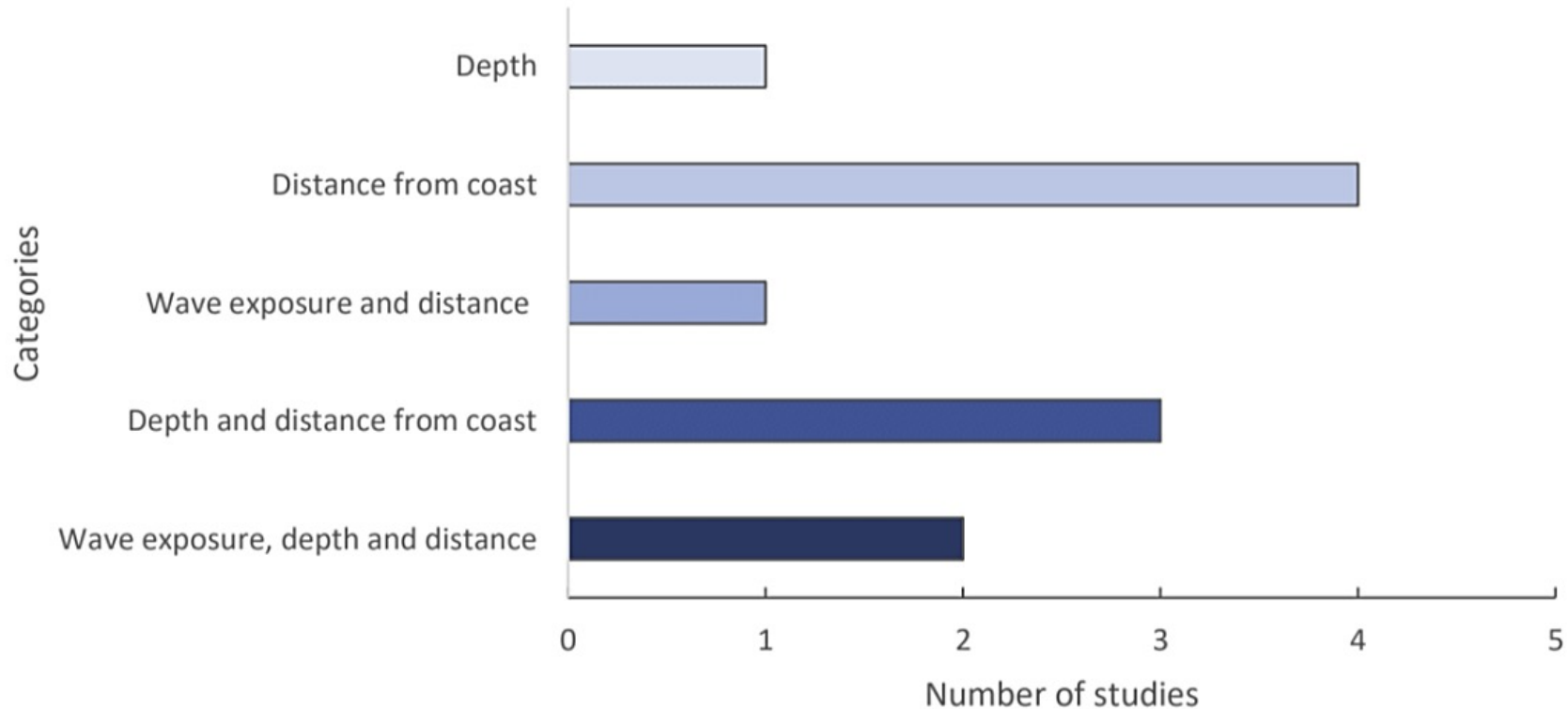
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Articles published annually displaying whether they define offshore aquaculture or not.



Offshore aquaculture - regulation

Number of articles defining offshore, and category of definition.

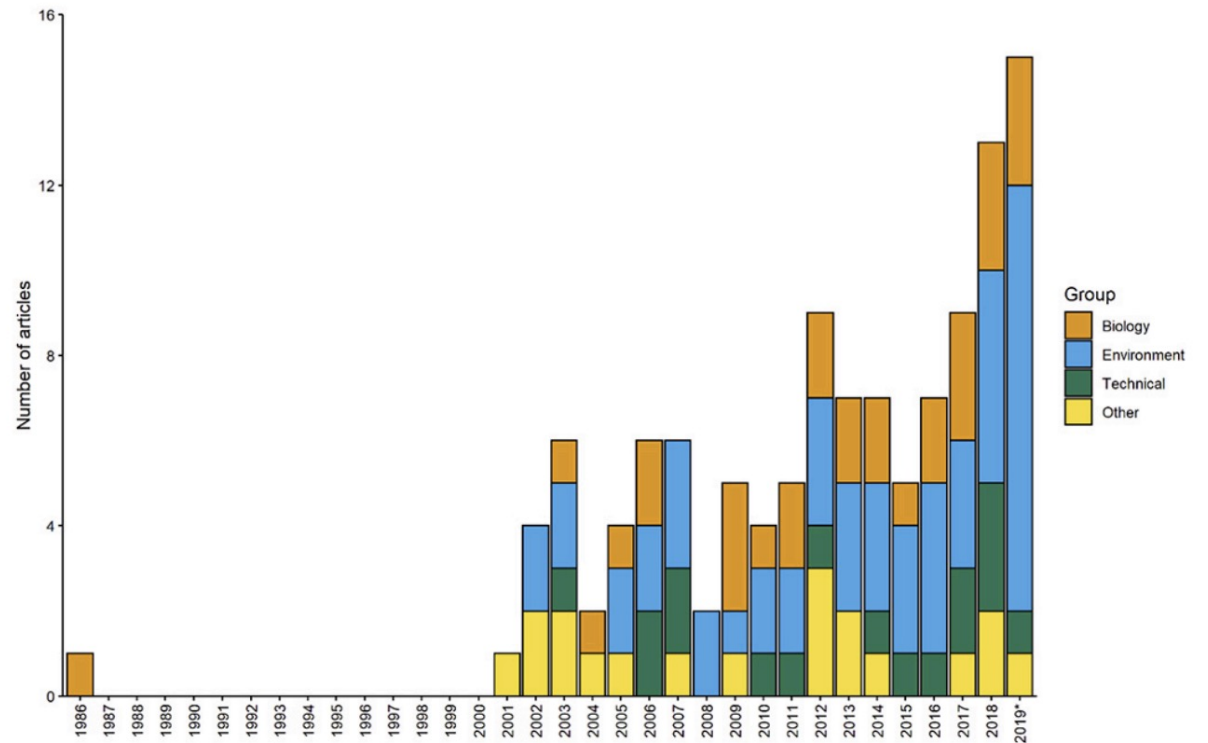


Remember this!

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Breakdown of academic literature and research

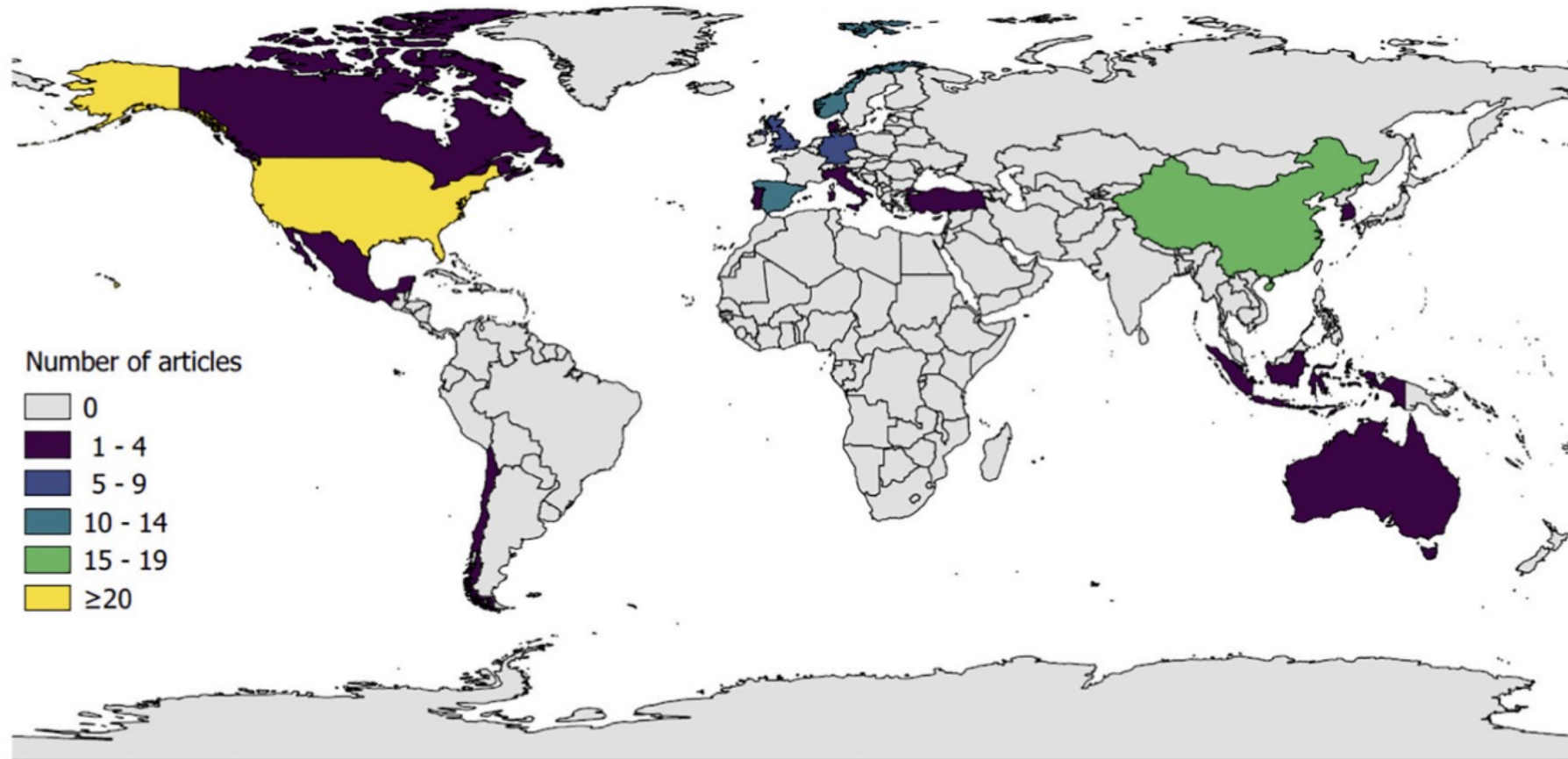
Theme	Description	% Articles
Technical feasibility	Engineering requirements of the environment	15%
Biology	Physical, chemical, physiological, and development processes	25%
Environmental impact	consequences (positive and negative) of a development, and/or regulations and governance associated	44%
Other	Not fit above	16%



Importance of environmental regulation?

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Countries where studies on 'offshore' aquaculture are taking place



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- Good start, background information
- Used this as the basis to ask stakeholder related to especially salmon aquaculture questions online and through interview-based questions.
- Respondents from:
 - Scotland
 - Norway
 - USA
 - Canada
 - Chile
 - China

Environmental regulation of offshore aquaculture: Questionnaire

Page 1: Page 1

What country is your company / organisation based in?

Scotland
 Norway
 Other

If you selected Other, please specify:

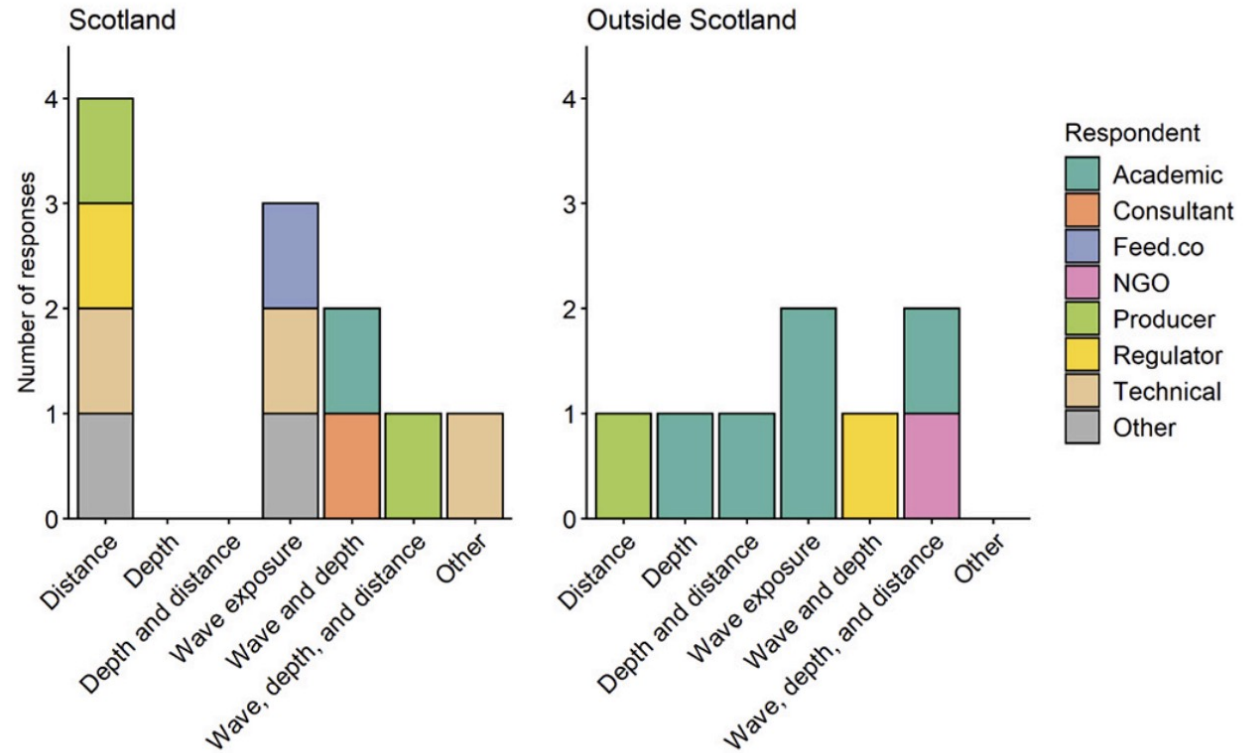
What best describes your organisation?

Feed company
 Producers
 NGO
 Regulator
 Academic
 Consultant
 Industry representative body
 Other

If you selected Other, please specify:

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- How would you define 'offshore' aquaculture?



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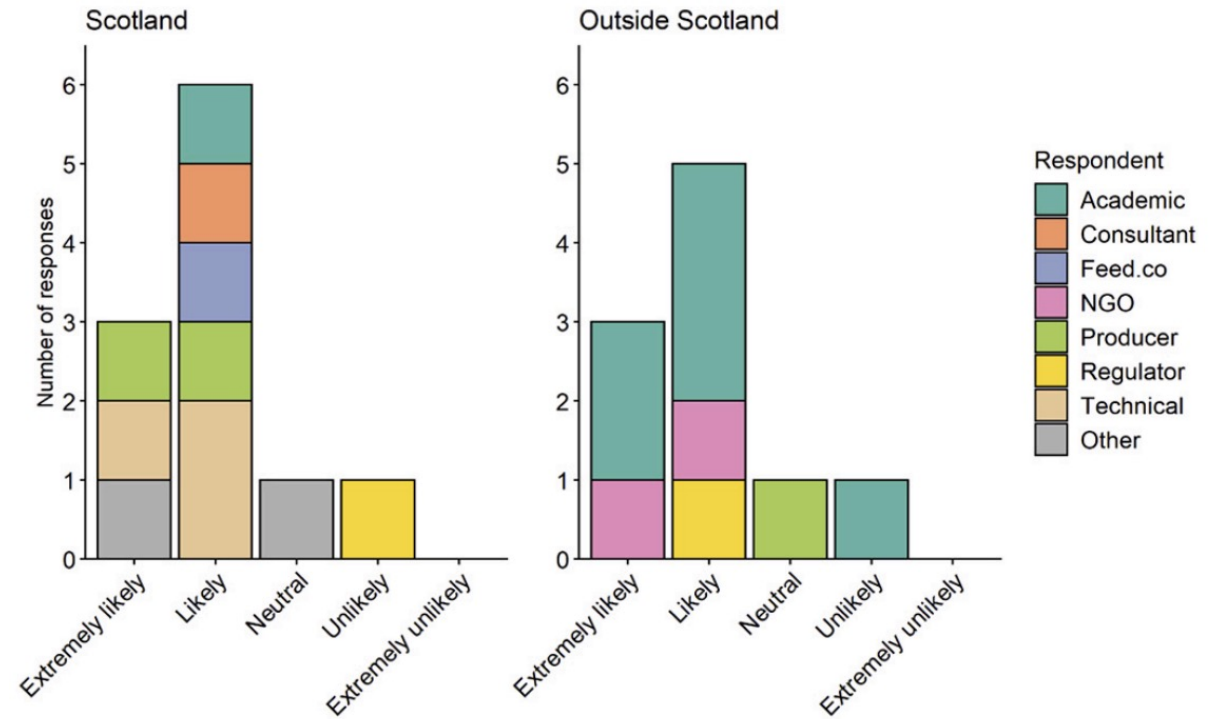
- What do you think the greatest environmental issues are with the salmon industry in inshore locations at present?

Environmental Issues	Issues in rank order of importance*	Relative weighting of respondents (%)
Sea lice spread	1	60
Disease transfer	2	45
Discharge of organic waste	3	35
Feed sustainability	4	35
Escapees	5	30
Predators	6	30
Visual impacts	7	25

* (1 = most important, 7 = least important).

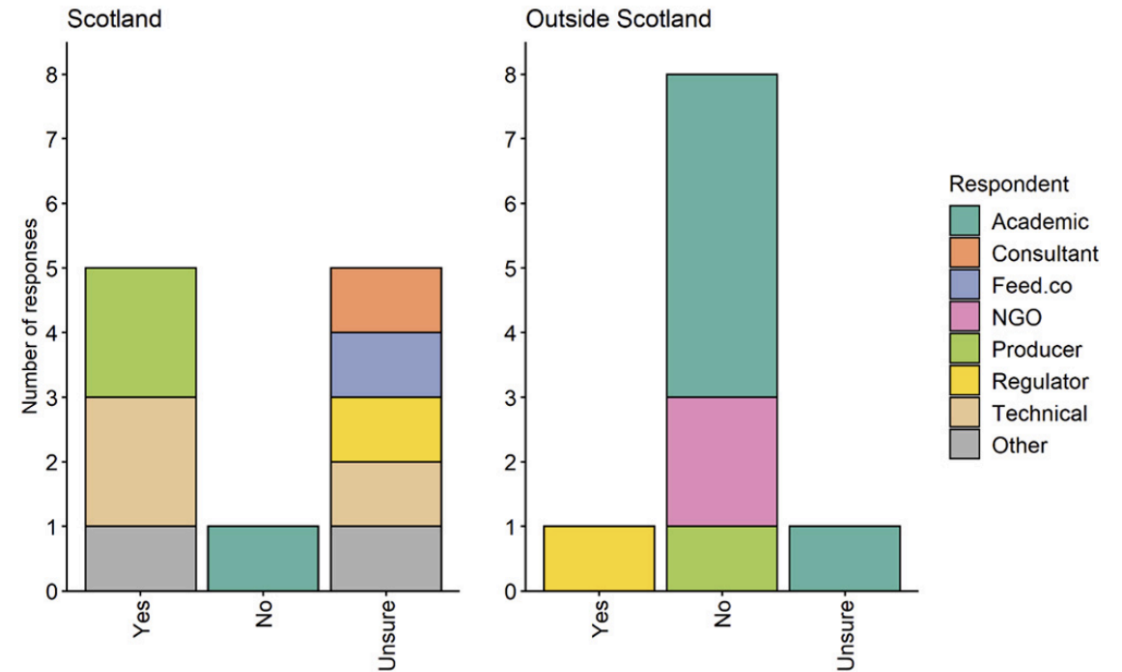
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- How likely do you think aquaculture will move to offshore in the next 10 years?



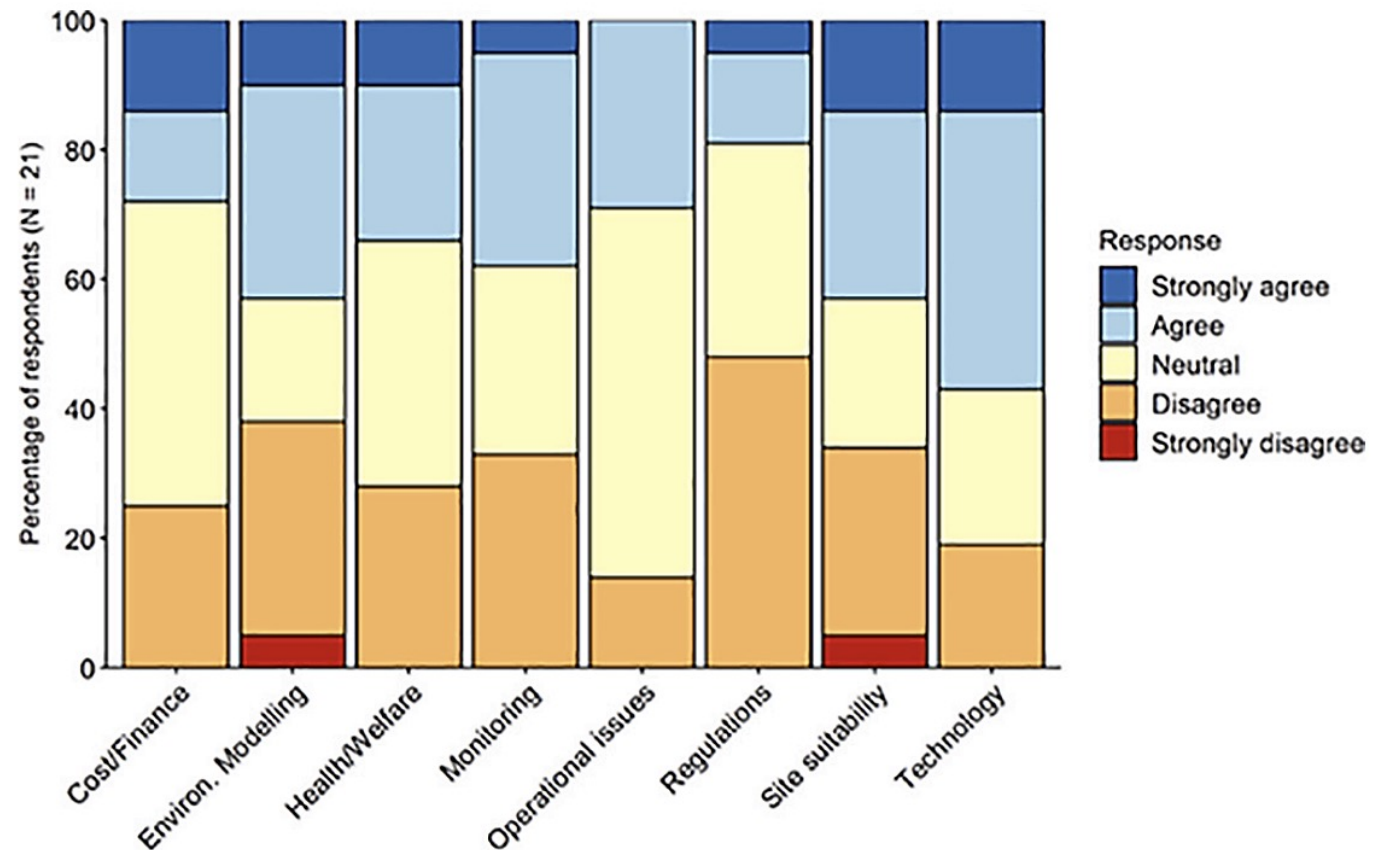
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- Are there suitable techniques available for offshore salmon farmers to measure and monitor impacts of salmon production in an offshore environment in your country?



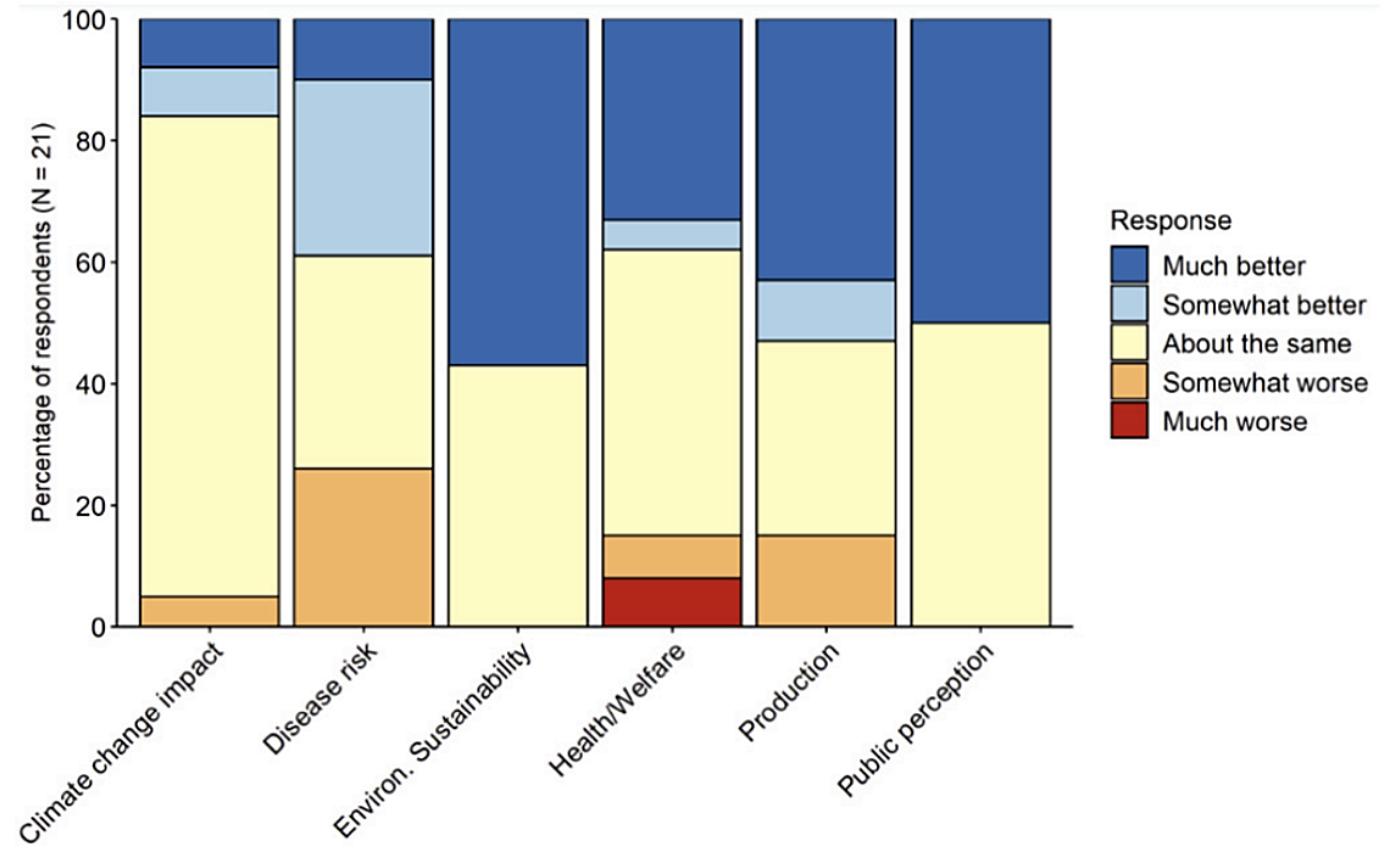
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- Do you think there is enough knowledge and research available to ensure the success of salmon aquaculture in these offshore environments?



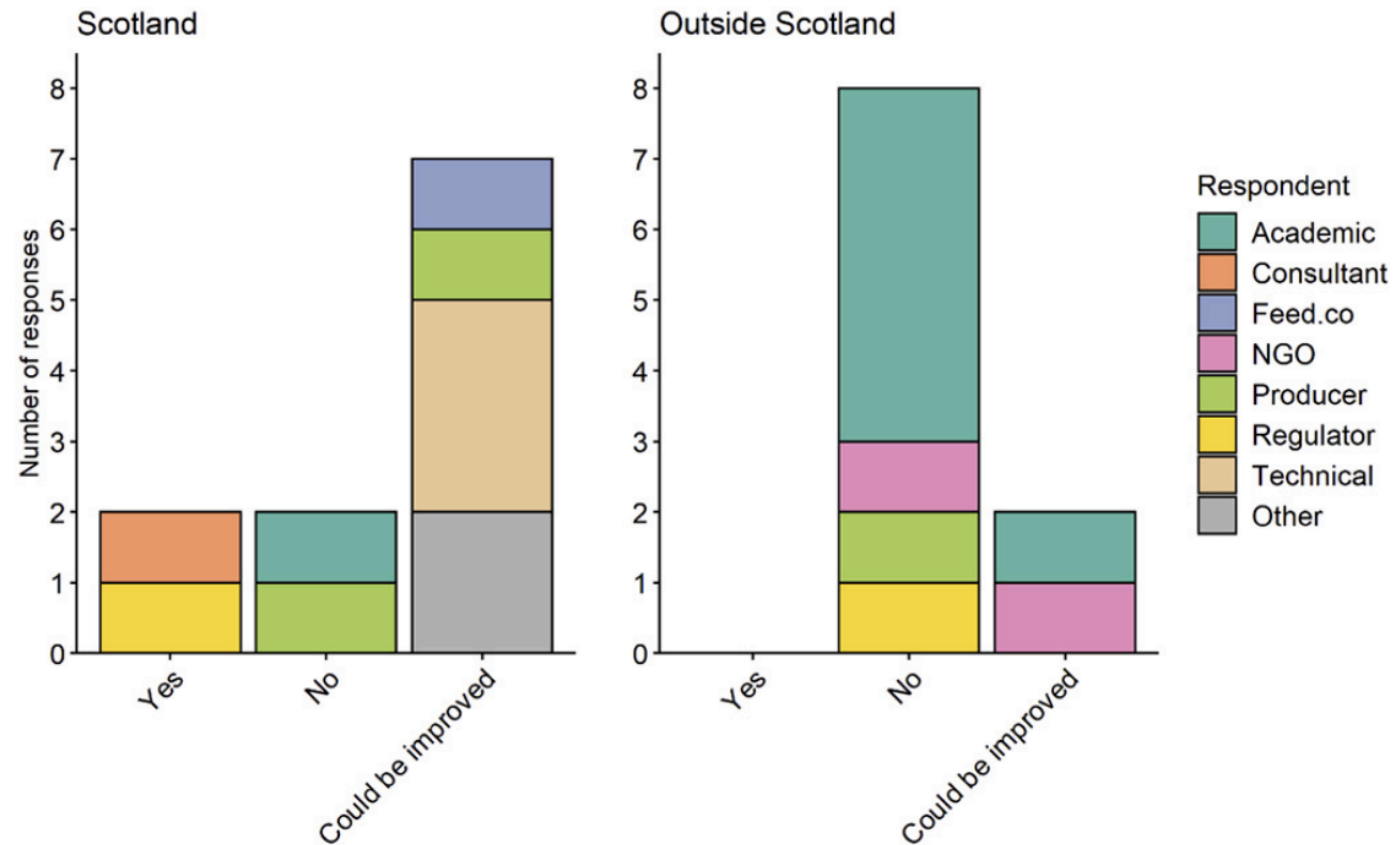
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- Do you think that offshore aquaculture will offer any of the following advantages in comparison with inshore?



Offshore aquaculture - regulation

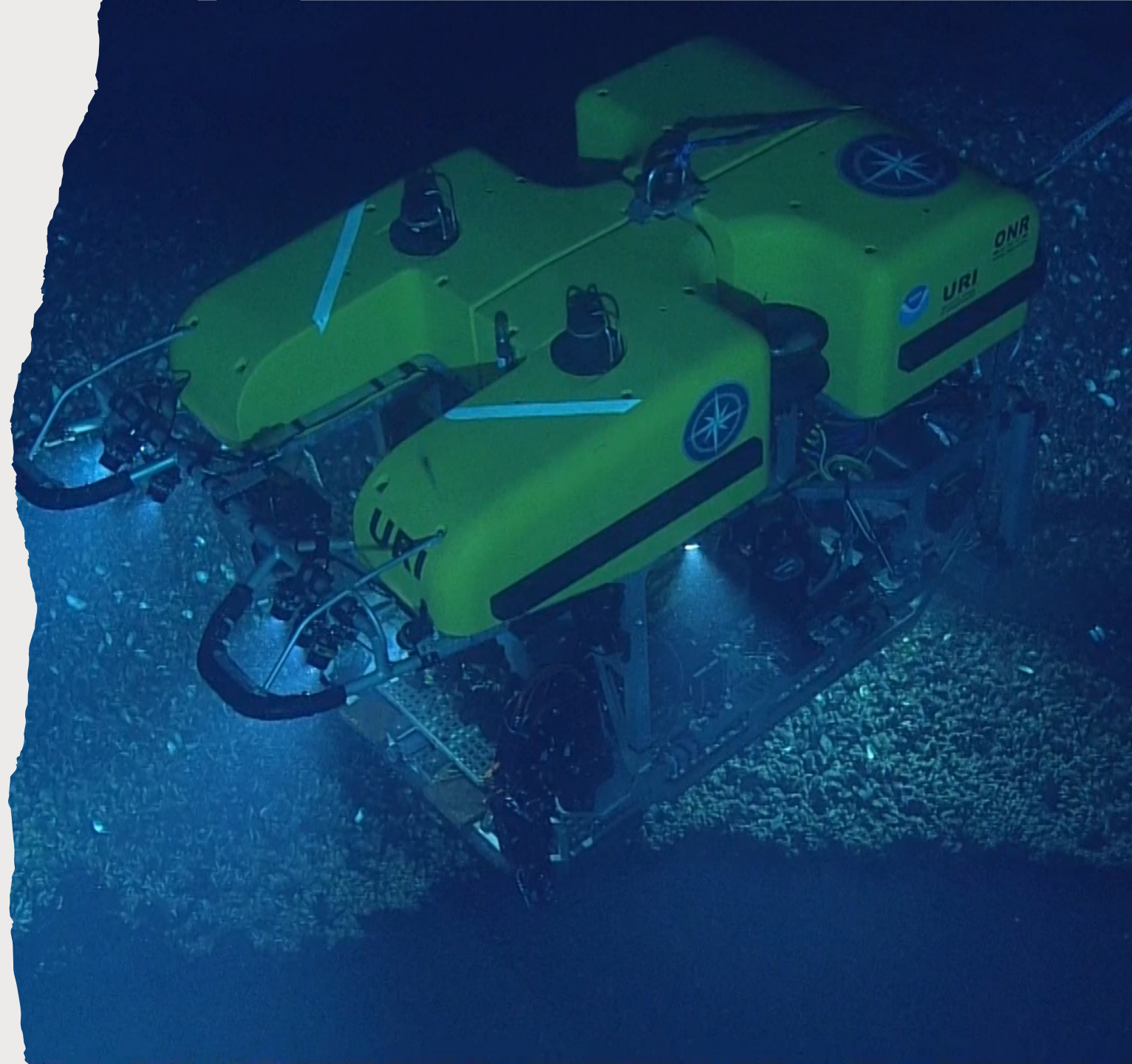
Is existing regulation in your country effective for regulating offshore aquaculture?



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Issues:

- Establish clear and consistent definitions when referring to 'offshore' systems
- Existing regulation could be improved for offshore salmon aquaculture.
- Lack of suitable regulation is a constraint to 'offshore' aquaculture
- Need for different environmental standards for the different seabed habitats, but they are not available for all habitats at present.
- Lack of sufficient monitoring techniques to assess the offshore environment at present
- Agreement that there is technology available to exploit offshore environments for salmon production.



Offshore aquaculture - regulation

Conclusions:

- Regulatory bottlenecks are one of the main factors limiting expansion of 'offshore' aquaculture.
- Must be a clear understanding of what 'offshore' means, and what the offshore environment is.
- Regulation must be relevant to the environmental characteristics of the area and the production methods used. More investigation needed.
- **If the issues are addressed and regulation is in place, it's likely that salmon aquaculture will move into offshore environments in the next decade**

