



Transparency and communication in Norwegian and Nova Scotian Atlantic salmon aquaculture industries

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ABSTRACT

The Atlantic salmon aquaculture industry has the potential to make a significant contribution to economic development and seafood production globally – particularly in rural and coastal communities. However, the lack of social licence to operate (SLO) can become a barrier for industry development. Greater transparency and communication have been suggested as two of the potential drivers for the industry to achieve SLO. This study explores the role of transparency and communication in the achievement of SLO in the salmon aquaculture industry by contrasting the perceptions of relevant stakeholders (researchers, managers/regulators, NGOs/community groups, and industry). The comparison was carried out in Norway, having national ocean policies incorporating SLO, and Nova Scotia, Canada, that has adopted new aquaculture regulations in 2015 following a three-year moratorium. Results highlight the need for industry to take on a leadership role in transparency and communication. Results also reinforce the importance of meaningful engagement and reporting of environmental standards, but also the need to monitor and report social standards. Comparison of Norway and Nova Scotia helps to understand the role of transparency and communication in achieving SLO, which may be key to promoting the development and sustainability of the salmon aquaculture industry worldwide.

1. Introduction

Aquaculture, or the cultivation of aquatic plants and animals, is a growing industry that continues to support the increasing demand for food from the ocean [1]. Finfish dominate annual seafood production at ~80 million tonnes worldwide [1,2]. The finfish aquaculture industry has the potential to provide relief to wild fisheries, aid in protein production, and revenue generation [1], including for a number of Indigenous communities [3]; however, drawbacks to the industry include the conflicted use of the marine space such as shipping and other industry [4,5], potential effects on fisheries such as Atlantic lobster trap hauls [6], potential ecological impacts to wild salmon fisheries and other capture fisheries [4,7], and cultural/Indigenous impacts by opposition from certain Indigenous groups [8]. These benefits and drawbacks vary worldwide depending on the farmed species and local context, including the scale of the activity, site selection, and regulations and management practices, among others [9,10]. Local-scale protests against aquaculture developments have gained traction, with concerns of environmental effects, and more recently from a social and community benefits perspective [11,12].

Opposition to the development of the finfish farming is most prevalent in Western countries including Canada and Norway [12,13], despite the majority of finfish aquaculture production occurring in Asia [1]. Development of the finfish aquaculture industry in Nova Scotia (Canada) and Norway is dominated by Atlantic salmon, and public perception of the potential social and environmental impact is becoming increasingly relevant for the expansion and continued operation of the industry [14–17]. The concept of social licence to operate (SLO) emerged with increased expectations on industries to uphold corporate responsibilities and address issues of social acceptability [18], positioning the community affected by operations as a critical stakeholder [11,15]. These expectations hold substantial weight not just socially, but also economically, as SLO directly affects the profitability and operations of a company [19]. Transparency, the principle of freely sharing information, is considered a key component for achieving SLO in the case of salmon aquaculture in Nova Scotia and Norway (Fisheries and Aquaculture, 2015; [20]). However, the power of transparency in helping to secure a SLO of the aquaculture industry depends on the way in which actors respond to transparency [21]. Part of the effectiveness outlined by Fox [21] is linked to the way in which information is released, and the

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context around which information is communicated to minimize confusion and prevent recipients from becoming overwhelmed [22]. Communication, the multidirectional flow of information between parties, allows for perspectives to be exchanged among relevant stakeholders. This multidirectional flow is crucial for meaningful engagement [23,24], in contrast to a unidirectional flow of information that may have been prioritized in the past [25]. Transparent and clear communication could more accurately prepare the industry for future sustainable growth [26].

Social licensing has traditionally involved transparency to generate accountability [21,22,27]. The role of transparency in this context is that operations must consider the consequences of their actions to avoid negative impacts on their public perception. However, the assumption that transparency and accountability are directly linked has been challenged, with few researchers capable of explaining the direct link between the two [21,27]. Fox [21] has suggested that communication could play that role. The importance of distinguishing between varying degrees of transparency arises as information that is communicated in a way that is challenging to interpret or access could undermine the value of releasing that information. As explained by Fox [21], “opaque” transparency is information that is communicated in an unclear way, divulged partially, or that is unreliable. This is contrasted with “clear” transparency practices that explain institutional behaviour, and allow for productive change based on accountability. In this study, transparency and communication are made distinct as a means for developing the accountability and therefore SLO of the Atlantic salmon aquaculture industry. These principles are distinguished; communication is the act of sharing information from one party to others, while transparency is making the information available.

Nova Scotia’s coastal areas have potential for food production and economic development – particularly in rural communities [28]. Nova Scotian stakeholders including public groups, media, NGOs, and First Nations communities scrutinize the industry based on the way that transparency and environmental protection are being regulated in the context of finfish aquaculture [28]. Although regulations in Nova Scotia released in 2015 [29] have begun to promote transparency, this does not seem to be enough for certain stakeholders [16]. In contrast, Norwegian policy makers began incorporating statements supporting social licensing, including communication and transparency requirements, in their National Ocean Policy for some decades [30]. Furthermore, Norway with the floating pen design in operation since the 1960s [31], has seniority over the Nova Scotian context, with Nova Scotia harvesting its first farmed salmon in 1984 [32]. Nonetheless, in both regions, the aquaculture stakeholder network is complex, with industry proponents competing with the fishing industry, recreation, and tourism for use of the marine space [11]. A comparison of Norwegian perspectives of transparency and communication in the industry with Nova Scotian industry, where there is now potential to expand aquaculture into the coastal zone, could increase the understanding of the role of transparency and communication in achieving genuine social licence.

This study investigates how the key stakeholders in the salmon aquaculture industry perceive the role of transparency and communication in the achievement of SLO. To achieve this, a mixed-methods Q-methodology approach was used to quantitatively explain the patterns of subjectivity in human behaviours and opinions based on a comprehensive set of statements provided to each participant. Q methodology was used to identify similarities in perspectives between participants across stakeholder groups through classifying participants based on their responses [33]. This research allows for the identification of overlaps of priorities in stakeholder groups, as well as where there is expected (or existing) areas of conflict. In addition, semi-structured interviews were used to further understand the similarities and differences in perspectives between stakeholders, allowing participants to explain their beliefs. By gaining insight into how a range of stakeholders view the role of transparency and communication as components to SLO, regulations and industry performance may be strengthened to develop

Table 1
Q-sort statements (n = 40) used in the Q methodology interview, organized by corresponding categories.

Category	Statement
<i>Drivers of Social Licence</i>	Reducing the use of pesticides and antibiotics is not important to achieving social licence.
	Meaningful engagement with communities affected by aquaculture operations is important to achieving social licence.
	Communication among stakeholders (e.g. industry, public and government) is not important to achieving social licence.
	Public education is important to achieving social licence.
	Minimizing the effects on benthic species (e.g. lobster) is not important to achieving social licence.
	Preventing effects on wild salmon populations is important to achieving social licence.
	Reduced reliance on fishmeal is not important to achieving social licence.
	Monitoring, reporting, and enforcement of environmental and social standards is important to achieving social licence.
	Transparency is not important to achieving social licence.
	Independent certification of environmental and social standards is important to achieving social licence.
<i>Transparency</i>	Transparent aquaculture operations generate a higher value product.
	Transparent aquaculture operations are a pre-requisite for entry into some markets.
	Regulations that promote transparency can compromise industry development.
	Transparency leads to accountability of the industry.
	Existing regulations sufficiently encourage transparency.
	Current capacity (e.g. infrastructure, personnel, resources) does not prevent farmers from operating in a transparent way.
<i>Communication</i>	Sharing technical information without proper public education does not cause confusion.
	Polarization of views regarding salmon aquaculture is caused by a lack of effective communication.
	Government does not have the capacity to effectively communicate to the public.
	Government communication initiatives do not reach the majority of the public.
	Communication strategies have failed to show changes in aquaculture operations over time.
	Effective record-keeping systems provide the potential for effective communication of aquaculture practices.
	The information that industry is currently communicating is accessible to the public.
	Without communicating information in a way that is easily understood, transparency is not useful to the public.
	Promoting transparency is not a role for NGOs.
	Promoting communication is not a role for NGOs.
<i>Who should take the lead?</i>	Promoting transparency is a role for the government.
	Promoting communication is a role for the government.
	Promoting transparency is not a role for industry.
	Promoting communication is not a role for industry.
	Promoting transparency is a role for an independent ecolabel.
	Promoting communication is a role for an independent ecolabel.
	Promoting transparency is a role for media (e.g. newspapers, television coverage, etc.).
	Promoting communication is a role for media (e.g. newspapers, television coverage, etc.).
	Transparent aquaculture practices do not promote sustainable aquaculture.
	Conflict resolution in the marine space is a process of transparency.
<i>Other Benefits and Challenges</i>	Conflict resolution in the marine space is not a process of communication.
	Current transparency policies set by the government are not effective.
	Current communication policies set by the government are effective.

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Table 1 (continued)

Category	Statement
	There is no reluctance for salmon aquaculture companies to communicate environmental parameters (e.g. disease occurrence, escapees, etc.) to the public.

more socially acceptable aquaculture.

2. Materials and methods

Q methodology (henceforth “Q”) is a combination of qualitative and quantitative methods that can allow researchers to find patterns in the subjectivity of its participants [33]. Originating in psychology, Q has been applied to a range of disciplines, including ecological economics [34], forest management [35], wetlands management [36], program evaluation in nursing [37], and aquaculture [38-41]. Results allow for the identification of thematic perspectives on a topic, grouping participants based on similarities in their answers [42]. Using Q allows researchers to capture perceptions through structured sorting rather than relying on large sample sizes [43]. This provides a major logistical advantage to Q methodology, allowing for smaller sample sizes to produce statistically significant results [33].

2.1. Concourse survey and selecting statements

A Q study begins with the development of the ‘concourse’ survey where a broad, well-represented understanding of the opinions and existing knowledge surrounding the study topic is developed [40,44]. From this survey, all statements are inspired by media, literature, or other existing documents (see Appendix i). In the context of transparency, communication, public trust, and SLO, scientific and grey literature were surveyed. From these documents, statements were compiled, and then tailored to ensure that each statement was stand-alone, with its meaning not repeated in a similar wording, and ensuring that only the most relevant statements were included. Compilation is done to ensure that there is a manageable number of statements for participants to read through, as well as balanced to ensure there is pro, neutral, and con opinions about the topic. These statements were sorted into categories by topic: (1) Drivers of Social Licence, (2) Transparency, (3) Communication, (4) Who Should Take the Lead?, and (5) Other Benefits and Challenges. This final grouping of statements is called the Q-Sort, containing 40 statements in this study (Table 1).

2.2. Study area

Interviews were completed across NS and Norway with the approval of Dalhousie University’s Marine Affairs Program Ethics Review Standing Committee under application #MAP2019-01. Norway has a population of 5.3 million, with a GDP per capita of 72,185 USD [45]. Norway produces around 1.4 million metric tonnes of finfish per year [1], valued at 7.4 billion USD with 94.6% of this being Atlantic salmon [46]. Nova Scotia has a GDP per capita of approximately 30,078 USD, and a population of 950,680 individuals [47-49]. In 2018, Nova Scotia produced 8228 metric tonnes of Atlantic salmon, valued at over 57 million USD. This constituted 83% of the total provincial aquaculture production (finfish, shellfish, and other seafoods combined) in 2018 [47, 48].

2.3. Survey participants

Norwegian interviews were completed between mid-April and the end of June 2019, and Nova Scotian interviews were completed from the start of July to the end of August 2019. 16 interviews were completed in each region (N = 32), with 4 participants in each stakeholder group: (i) managers/regulators, (ii) industry, (iii) ENGO/community groups, (iv) academia/researchers. These stakeholder groups were chosen based on their familiarity with the Atlantic salmon aquaculture and those that possess interest in the issue [50]. In the context of this study, a stakeholder is defined as: (1) a person impacted, (2) with knowledge about, or (3) with interest in the salmon aquaculture industry. One of the strengths of Q methodology is the low number of participants needed to determine statistical significance [34,36,39]. Because of this, 32 stakeholders were interviewed, with even and varied representation within each group (4) representatives per stakeholder group and region. Stakeholders were identified largely through internet searches and invited via email to participate in the interviews. Nobody refused the invitation to participate, although some potential participants did not reply to the request. All stakeholders were generally identifiable and classified prior to interviews based on the field of their group (e.g., an employee of a research institution, having completed work on aquaculture would be classified as academia/researcher), and had varying levels of tenure in their respective stakeholder group to capture breadth, including some late-career participants, and some who had been with their organization for about one year. Interviews were completed in multiple communities, between rural and more urban environments across both regions, contained to the year 2019.

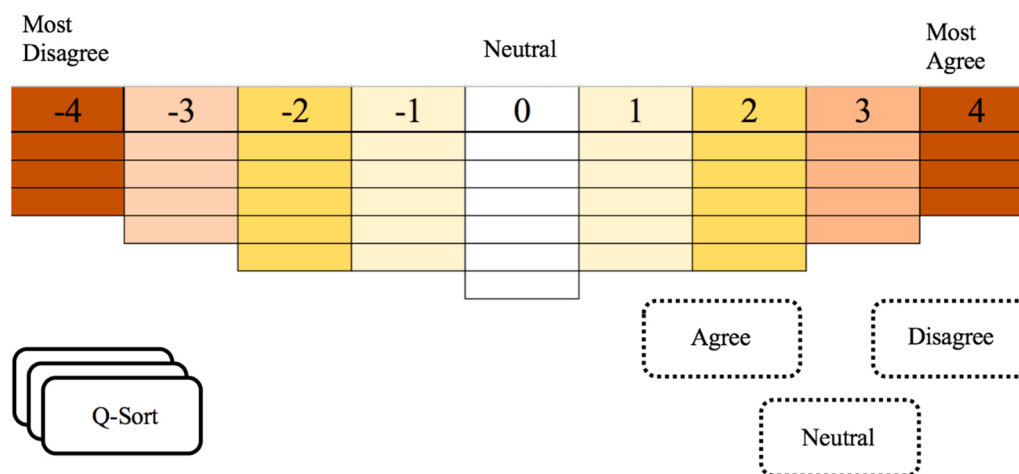


Fig. 1. Q methodology interview setup. Participants read through 40 statements (Q-sort), sorting first based on "agree," "disagree," and "neutral." Piles were then subdivided onto the matrix, based upon subjective rankings perceived by the participant.

2.4. Semi-structured interviews

This study combines the quantitative approach of Q with the qualitative perspectives of semi-structured interviews to address the research purpose. The order of the statements provided to participants during the interviews was randomized to ensure that statements were not clumped by category, as represented in Table 1. Participants would then sort these statements with the help of a grid (Fig. 1) based on how much they agree, disagree, or feel neutrally/do not know about an issue. This was completed either in-person or online using QSortWare software when an in-person interview was not possible. Q is designed to force a quasi-normal distribution, where participants were asked to sort only three statements in the category they felt most strongly about (+4 for most agree and -4 for most disagree), and up to six statements for the neutral/do not know category. The number of statements intended for each rank is illustrated by the number of rectangles below each column. Once participants completed placing all 40 statements on the board, there was the opportunity for them to discuss their choices. This was done in person, through Skype, or over the phone. These interviews allowed for participants to explain how they interpreted the statements and to explain why they may have chosen to sort the statements the way they did rather than an alternative.

2.5. Statistical analyses

Analysis was completed with the use of the PQMethod software version 2.35 [51] to find patterns in the way participants sorted all 40 statements within and between stakeholder groups. Once data was imported to PQMethod software, a factor analysis was performed [51]. For each individual Q-sort, a correlation matrix was created to compare to all other Q-sorts, where a correlation of 1 represents two Q-sorts that are completely identical. Principal component analysis (PCA) was then used to group similar Q-sorts based on the correlation matrix. Because Q requires participants to decide what is meaningful and valuable, these groups, or “perspectives” [52] represent individuals that share similar understanding surrounding transparency and communication in Atlantic salmon aquaculture. Varimax orthogonal rotation provides the explained variability and eigenvalues for each perspective, where perspectives with an explained variance > 10% and eigenvalues > 2 were further analyzed. Eigenvalues exceeding 2 indicate that at least two Q-sorts correlate significantly with each other in the perspective.

Once the perspectives are identified, factor analysis is used by creating an idealized Q-sort for each perspective, meaning an average of all Q-sorts that were loaded significantly for that perspective [52]. This can be thought of as a mock participant generated by the software that would be an idealized sort for the perspective. From this analysis, another correlation matrix is developed between each Q-sort and the perspective with which they correlated most closely. Determining if the factors were loaded significantly relative to its closest perspective, the below equation was used:

$$s = 2.58 \times \left(\frac{1}{\sqrt{N}} \right)$$

Where N is the number of statements [53], producing $s = 0.408$ at $p = 0.10$ [54]. The original level of $s = 0.4$ (rounded to one decimal place) was raised to 0.55 to create more conservative statistics, a step commonly adopted in the literature [40,52,55]. Once completed, perspectives were then labelled qualitatively based on perceived patterns. Confounding sorts were those pertaining to participants who sorted significantly on multiple factors or in none of them.

3. Results

From the analysis of the Q-sorts, two significant perspectives emerged, explaining 63% of the variance (P1 = 33% and P2 = 30%). All

Table 2
Factor loading for each participant across the two perspectives.

Participant	P1	P2
Perspective 1 (P1)		
Norwegian Industry	0.794	0.0779
Norwegian Industry	0.676	0.284
Norwegian Industry	0.728	0.128
Norwegian Manager/Regulator	0.768	0.402
Norwegian Academia/Researcher	0.574	0.355
Norwegian Academia/Researcher	0.742	0.239
Norwegian ENGO/Comm. Group	0.562	0.451
Norwegian ENGO/Comm. Group	0.568	0.522
Nova Scotian Industry	0.655	0.316
Nova Scotian Industry	0.702	0.537
Nova Scotian Industry	0.558	0.502
Nova Scotian Industry	0.872	0.0668
Nova Scotian Academia/Researcher	0.674	0.303
Nova Scotian Academia/Researcher	0.643	0.533
Perspective 2 (P2)		
Norwegian Manager/Regulator	0.470	0.674
Norwegian Manager/Regulator	0.262	0.804
Norwegian Academia/Researcher	0.0689	0.755
Norwegian Academia/Researcher	0.502	0.597
Norwegian ENGO/Comm. Group	0.294	0.705
Nova Scotian ENGO/Comm. Group	0.491	0.698
Nova Scotian ENGO/Comm. Group	0.0660	0.715
Nova Scotian ENGO/Comm. Group	0.144	0.818
Nova Scotian Academia/Researcher	0.453	0.776
Nova Scotian Manager/Regulator	0.519	0.597
Confounded Sorts		
Norwegian Industry	0.620	0.628
Norwegian Manager/Regulator	0.637	0.601
Norwegian ENGO/Comm. Group	0.378	0.149
Nova Scotian Academia/Researcher	0.606	0.591
Nova Scotian Academia/Researcher	0.533	0.503
Nova Scotian Academia/Researcher	0.710	0.555
Nova Scotian Academia/Researcher	0.595	0.679
Nova Scotian ENGO/Comm. Group	0.559	0.552
Explained Variance (%)	33	30
Defining Q-Sorts	14	10
Total Q-Sorts	20	16

Note: Bolded values represent participants who scored significantly for that factor (absolute value of coefficient >0.55).

participants interviewed (except for two) could be grouped into one of these two perspectives as a result of their perceptions about Atlantic salmon aquaculture, transparency, communication, and their role in the social licensing of the industry. 14 participants aligned significantly with *Perspective 1*, 10 participants aligned significantly with *Perspective 2*, 6 participants aligned significantly with both (confounding sorts), and 2 participants aligned significantly with neither (also confounding sorts) (Table 2). Each of the two perspectives is defined by an idealized sort (Table 3) that represents the perception of a participant who fits perfectly into that perspective. The following sections explore areas of consensus among the 32 participants, as well as analyze each perspective based on the idealized sort (Table 3). To ensure the most relevant statements are interpreted, only significantly distinguishing statements ($p < 0.05$), as well as extremely ranked statements (-4, -3, +3, +4) were analyzed. The corresponding number of Q-statements are indicated in brackets in the text (i.e. (#)). Perspectives were labelled based on the statistically significant statements of the idealized sorts as follows: *Perspective 1 – Public Trust Starts with Industry*; *Perspective 2 – Transparency Starts with Government*.

3.1. Areas of consensus

Statements that were not ranked differently between *Perspective 1* and *2* indicate no major disagreement in how participants decided to sort them and are considered consensus statements; 17 statements were non-significant for both perspectives at $p > 0.05$, and could not be used to define either perspective (Table 3). In particular, both perspectives

Table 3

Idealized sort for each perspective described by each category of Q-statements. * indicates significant difference between perspectives at $p < 0.05$ and ** indicates significance at $p < 0.01$. Statements without significant difference are consensus statements.

Category	P1	P2	Consensus Statements
Drivers of Social Licence			
24. Reducing the use of pesticides and antibiotics is not important to achieving social licence.	-4	-3	✓
10. Meaningful engagement with communities affected by aquaculture operations is important to achieving social licence.	4	4	✓
31. Communication among stakeholders (e.g. industry, public and government) is not important to achieving social licence.	-3	-3	✓
* *16. Public education is important to achieving social licence.	4	2	
* *38. Minimizing the effects on benthic species (e.g. lobster) is not important to achieving social licence.	-2	-4	
* *6. Preventing effects on wild salmon populations is important to achieving social licence.	2	4	
* 12. Reduced reliance on fishmeal is not important to achieving social licence.	-2	-1	
* *20. Monitoring, reporting, and enforcement of environmental and social standards is important to achieving social licence.	3	4	
11. Transparency is not important to achieving social licence.	-4	-4	✓
* *13. Independent certification of environmental and social standards is important to achieving social licence.	2	3	
Transparency			
7. Transparent aquaculture operations generate a higher value product.	1	2	✓
* *1. Transparent aquaculture operations are a prerequisite for entry into some markets.	3	2	
26. Regulations that promote transparency can compromise industry development.	-2	-2	✓
* *40. Transparency leads to accountability of the industry.	3	3	
* *34. Existing regulations sufficiently encourage transparency.	0	-3	
37. Current capacity (e.g. infrastructure, personnel, resources) does not prevent farmers from operating in a transparent way.	2	2	✓
Communication			
33. Sharing technical information without proper public education does not cause confusion.	-2	-1	✓
* *4. Polarization of views regarding salmon aquaculture is caused by a lack of effective communication.	3	0	
* *25. Government does not have the capacity to effectively communicate to the public.	-2	0	
* *18. Government communication initiatives do not reach the majority of the public.	-1	1	
* *23. Communication strategies have failed to show changes in aquaculture operations over time.	1	0	
15. Effective record-keeping systems provide the potential for effective communication of aquaculture practices.	2	3	✓
* *3. The information that industry is currently communicating is accessible to the public.	1	-1	
* *14. Without communicating information in a way that is easily understood, transparency is not useful to the public.	4	2	
Who Should Take the Lead?			
30. Promoting transparency is not a role for NGOs.	-1	-2	✓
21. Promoting communication is not a role for NGOs.	-1	-1	✓
* *19. Promoting transparency is a role for the government.	1	3	
5. Promoting communication is a role for the government.	0	1	✓
	-4	-2	

Table 3 (continued)

Category	P1	P2	Consensus Statements
* *27. Promoting transparency is not a role for industry.			
* *36. Promoting communication is not a role for industry.	-3	-2	
39. Promoting transparency is a role for an independent ecolabel.	1	1	✓
35. Promoting communication is a role for an independent ecolabel.	0	0	✓
22. Promoting transparency is a role for media (e.g. newspapers, television coverage, etc.).	0	0	✓
29. Promoting communication is a role for media (e.g. newspapers, television coverage, etc.).	0	1	✓
Other Benefits and Challenges			
* 2. Transparent aquaculture practices do not promote sustainable aquaculture.	-3	-3	
* *9. Conflict resolution in the marine space is a process of transparency.	2	0	
* *28. Conflict resolution in the marine space is not a process of communication.	-3	-2	
* *8. Current transparency policies set by the government are not effective.	0	1	
32. Current communication policies set by the government are effective.	-1	-1	✓
* *17. There is no reluctance for salmon aquaculture companies to communicate environmental parameters (e.g. disease occurrence, escapees, etc.) to the public.	-1	-4	

strongly believed (-4, -3, 3, or 4) that the following were important to achieving social licence: (i) meaningful engagement with communities affected by aquaculture operations (10); (ii) communication among stakeholders (31); (iii) reducing the use of pesticides and antibiotics (24); and (iv) transparency (11). In addition, participants believed that transparency promotes sustainable aquaculture. This was explained by a Nova Scotian academic participant whereby “everyone knows that sustainability is important, environmentally and economically. So, if you have a reason to hide your practices, then perhaps they aren’t environmentally sustainable, maybe at the expense of your own economic sustainability.” One Nova Scotian ENGO/Community group participant suggested that “I definitely think that it’s important for any and all regulations around aquaculture to be transparent... but I don’t think that transparency necessarily leads to social licence.” Both perspectives generated an apathetic or unsure response (-1, 0, or 1) regarding: (i) promoting communication is a role for the government; (ii) promoting transparency is a role for media; (iii) promoting communication is a role for an independent ecolabel; and (iv) promoting communication is a role for media.

3.2. Perspective 1 – Public trust starts with industry

The ‘Public Trust Starts with Industry’ perspective was composed of 14 participants that only sorted significantly with this perspective. These participants were 7 industry representatives (50%), 4 academia/researcher representatives (29%), 2 ENGO/community group representatives (14%), and 1 manager/regulator representative (7%). This perspective included 8 Norwegian (57%) and 6 Nova Scotian participants (43%) (Fig. 2). The participants sorted in this perspective shared the common idea that promoting both transparency (27) and communication (36) must come from industry, acknowledging that entry into some markets requires transparency (1). One Norwegian industry representative stated “transparency is a role for industry, because we do it all of the time... industry is promoting transparency all of the time, every day.”

This perspective believes that the difference of views in the salmon aquaculture industry was largely because of a lack of communication (4), which also compromises conflict resolution in the marine space

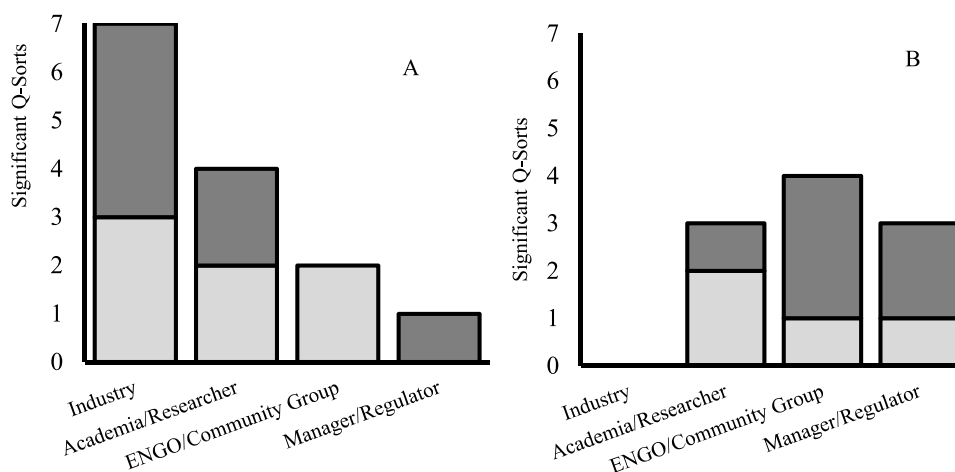


Fig. 2. Number of Q-sorts that were significantly associated with *Perspective 1 – Public Trust Starts with Industry (A)*, and *Perspective 2 – Transparency Starts with Government (B)* divided into their relevant stakeholder groups. Nova Scotian participants are indicated in dark grey and Norwegian participants are indicated in light grey.

(28). Public education is important (16), which is emphasized by the belief that transparency is not useful to the public if the information is not communicated properly (14). Lastly, this group did not hold strong opinions on how effective current transparency policies are, or if existing regulations sufficiently encourage transparency (8, 34). However, one Nova Scotian academic who shared this perspective explained that “I would like to see – and have seen – more growth of aquaculture in Canada... my sorting of these statements [has] to do with my interest in seeing the industry grow and understanding what might be preventing that. And social licence has a huge thing to do with that.” This statement captures the desire among participants sharing this perspective to see the industry grow while recognizing the stumbling block posed by an absence of social licence.

3.3. Perspective 2 – Transparency starts with government

The ‘Transparency Starts with Government’ perspective was composed of 10 participants that sorted significantly with only Perspective 2. Within this perspective, there were 4 ENGO/community group representatives (40%), 3 academia/researcher representatives (30%), 3 manager/regulator representatives (30%), and 0 industry representatives (0%). This perspective had 5 Norwegian participants (50%) and 5 Nova Scotian participants (50%) (Fig. 2). The participants sorted in this perspective shared the belief that transparency should begin with the government (19), and an emphasis on how record-keeping (i.e. having foundational baseline information) is required for information to be communicated (15). One Nova Scotian ENGO/Community group participant explained that “... having access to information and data and transparency around criteria for decision making means that the public and everybody can hold people accountable for what is being done ... existing regulations are not encouraging transparency...” Perspective 2 holds a respect for independent certification of environmental and social standards (13), and emphasized the importance of minimizing the effects on benthic species and wild salmon (38, 6). In the context of conflict resolution, however, participants felt that communication was more important than transparency (9, 28), and that industry held great reluctance to communicate environmental parameters (17). Complementary with this perceived reluctance to communicate the information is a link to the belief that existing regulations must be changed to effectively promote transparency (34), as transparency and communication work together to facilitate SLO. Participants in this perspective tended to be unsure or feel neutrally about communication as the cause for polarization of views regarding Atlantic salmon aquaculture (4), and the capacity for government to communicate to the

public (25).

3.4. Confounding sorts

Some participants were significantly sorted into either both perspectives (n = 6), or neither (n = 2). These sorts are called confounding sorts (Table 2). Stakeholders not sorting significantly with either were a Norwegian ENGO/Community Group member and a Nova Scotian Manager/Regulator representative. In both types of confounding sorts, there were no patterns based on stakeholder group or jurisdiction (Norway or Nova Scotia).

4. Discussion

In the creation of policy and management strategies, stakeholder perspectives are important to understand [56]. Globally, there is a need for increased understanding of how perceptions of the public can influence the management of the aquaculture industry for the benefit of as many stakeholders as possible [10,57]. This research investigated stakeholder perceptions of the role of transparency and communication in acquiring social licence to operate by the Atlantic salmon aquaculture industry in Nova Scotia, Canada, and Norway.

4.1. Nova Scotia-Norway uniformity

This research has revealed an overlap between the perceived role of transparency, communication, and SLO among the Atlantic salmon aquaculture industry stakeholders of Nova Scotia and Norway despite historical, economic, or geographical differences. Stakeholders across regions feel similarly about the statements used in this study, focusing in on how transparency and communication fit together to achieve SLO. However, this conclusion can only be applied to the breadth of the statements used in the study, and other future studies with similar methodology but targeting a single jurisdiction or region should consider the specific local settings when designing the statements (Q-Sort). This could be particularly relevant in the case of redistribution of benefits as a driver of acceptance [58], which is crucial in Norway as municipalities obtain direct income from salmon farm operations, a practice that does not happen in Nova Scotia. The aquaculture industry in Nova Scotia and Norway has very different beginnings. In the 1970 s, the Norwegian industry comprised a large number of small-scale farmers before ownership structures changed to favour centralization towards a select few number of companies. Nova Scotia, in comparison, is a younger industry, following after Norway, and in a context that began

with multi-national companies at the forefront, some of them controlled by Norwegian interests. As pointed out by a Norwegian researcher,

“Here, [in Norway, Atlantic salmon aquaculture] started out innocently. It started out where it had to be local owner-operator, right? And you had to be responsible to your neighbours, and that kind of social traction really made a difference. But as the ownership structure changed, and the regulation around ownership structure went towards big business benefits ... immediate local responsibility changed.”

This exemplifies the relevance of the shift in ownership structure from community members and neighbours to multinationals to obtain SLO [2,57,59]. Although this research identified two distinct perspectives, the fundamental difference was in who should take the lead for transparency or garnering public trust, rather than geographical differences. Norwegians and Nova Scotians both value the potential for the Atlantic salmon aquaculture industry to save coastal communities from outmigration [28,60] and similarly, to provide economic benefits at the local level [57]. In a global industry such as Atlantic salmon aquaculture, there is the common principle of SLO: industry is consistently seeking to maintain or improve its acceptability regardless of location. Although there could be different levels of acceptability in either jurisdiction, it seems clear that transparency and communication are perceived to play the same role in both regions.

4.2. Main drivers of social licence to operate

Reducing the use of pesticides and antibiotics is one major driver of SLO (24). This aligns with the report by Doelle and Lahey [14], reinforcing the notion that the use of antibiotics is one of the significant issues of controversy in finfish aquaculture in Nova Scotia. Antibiotics in finfish aquaculture are easy to apply and cost effective [61], but antibiotic use has been well documented to have unintended impacts, including the potential for antibiotic resistance to develop in microbes, to affect non-target species [62-65], and on human healthcare [66], potentially causing antibiotic resistance in some human pathogens [67]. Since the 1990s, the salmon aquaculture industries have seen a substantial reduction in antibiotic use due to the vaccination for furunculosis and other diseases, combined with better fish care in both Norway and Nova Scotia [14,68,69]. Currently, antibiotics are used only under veterinarian supervision in Nova Scotia and Norway [70,71]. Therefore, although pesticides and antibiotics were used together in the same statement, aiming at representing the use of therapeutants, they could have different weights for obtaining SLO. Pesticides and antibiotics are still a major driver of SLO (24). Better awareness of how stakeholders perceive the trade-offs associated with pesticides and antibiotics is important to understanding SLO, and to improve the management of the Atlantic salmon aquaculture industry. Similarly, salmon escapees have been a source of conflict between various stakeholders [59]. However, there was a substantial difference between how the two perspectives felt about the industry's reluctance for salmon aquaculture companies to communicate environmental parameters, including escapees (17). Also, the two perspectives felt differently about how preventing the effects of escapees would impact SLO (6). This perceived reluctance and importance placed on escapees by perspective 2 could indicate a space for improvement and reprioritization by industry in how it chooses to report escapees.

Generally, participants agreed that monitoring, reporting, and enforcement of environmental and social standards are important to achieving social licence (Table 3). Atlantic salmon aquaculture regulations have focussed broadly on sustainability in both Norway and Nova Scotia [72-74]. However, there is a greater focus on environmental risks than on social and economic impacts [75]. Social standards attempt to address nuanced questions beyond profit maximization and environmental health [76]. Currently, there are ecolabels that do attempt to

differentiate products based on social standards including regulated working hours and a decent wage [77]. Although, social standards are not directly considered in current monitoring and reporting protocols for Nova Scotia [78] or Norway [79], adding social standards into monitoring, reporting, and enforcement practices may promote an empirical understanding of social licencing. This would allow Atlantic salmon aquaculture proponents to respond to claims made regarding their social licencing [80]. The development of these social standards must be done through the engagement with communities affected by aquaculture operations (10), to identify indicators of social performance, as well as enabling multidirectional communication among stakeholders (31). Drawing on the mining industry, companies in New South Wales (NSW) have developed their own ‘Communities Standard’ where socio-economic baseline studies are required in all of their operational areas [81]. Explicitly incorporating monitoring, reporting, and enforcement of social standards into the management regime of the Atlantic salmon aquaculture industry would allow industry to more effectively tackle the issues most compromising to SLO.

Across all perspectives, geographic regions, and stakeholder groups, participants agreed that transparency is critical in achieving social licence for the Atlantic salmon aquaculture industry (11). This reinforces the transparency-based suggestions by the Nova Scotian Doelle-Lahey report (2014), as well as literature-supported research on the importance of transparency in the establishment of trust [21,22,27]. There are still issues with social licencing, but this research reveals the importance of ongoing and improved implementation of regulation to promote transparency. This desire for transparency by salmon aquaculture experts interviewed in this research could be supported by the notion that increasing transparency in the context of industry development is good practice to prevent corruption and promote good governance in sustainable development [82].

In Nova Scotia, the most recently implemented regulations, combined with the lifting of a moratorium in 2015, seem to favour the development of the industry. However, more stringent regulations on transparency including those suggested by the Doelle-Lahey report (2014) have been thought to have a major negative impact on industry expansion. Although, contrary to Drabek and Payne's [83] findings, our Nova Scotian research suggests that transparency does not appear to be an issue of concern for development of the industry. This finding indicates some consistency with Fox [21] who suggested communication may have a critical role to play in complementing transparency. By considering communication in parallel with transparency regulations, the relationship between transparency and accountability may be strengthened and fully realised.

4.3. Identifying leaders

Identifying a champion for the leadership of transparency was the main factor that defined the two key perspectives found in this research, which was consistent across countries. There is overlap in the drivers of social licence, but not consensus on who should operationalize them. *Perspective 1* placed emphasis on the importance of industry being a leader in both transparency and communication. As a perspective made up of 50% industry representation, they understood the importance of having information come directly from the source. This could indicate that the industry feels that they are doing an effective enough job as is. Additionally, industry representatives consider the consequences of not being accountable to their stakeholders a sufficiently strong motivator for taking the lead on transparency and communication, as one has indicated here;

“[w]hat you say has to be founded in reality. If you're in a company and you can't communicate the decision you want to make to your stakeholders in a way that will not decrease the trust of your company for example, you can't make the decision.”

Table A1

(#)	Statement	Source
1	Transparent aquaculture operations are a pre-requisite for entry into some markets.	Asche, F. & Khatun, F. [90]. Aquaculture: issues and opportunities for sustainable production and trade. Geneva: International Centre for Trade and Sustainable Development (ICTSD), 2006. Retrieved November 1, 2019, from http://www.ictsd.org/sites/default/files/research/2008/06/asche_khatun_2006.pdf
2	Transparent aquaculture practices do not promote sustainable aquaculture.	Fisheries and Oceans Canada. (2015). Canada's Sustainable Aquaculture Program. Retrieved August 21, 2019, from http://www.dfo-mpo.gc.ca/aquaculture/programs-programmes/sustainable-durable/index-eng.htm
3	The information that industry is currently communicating is accessible to the public.	Doelle, M., & Lahey, W. [14]. A New Regulatory Framework for low-impact/high-value Aquaculture in Nova Scotia. Retrieved January 1st, 2019 from https://novascotia.ca/fish/documents/Aquaculture_Regulatory_Framework_Final_04Dec14.pdf
4	Polarization of views regarding salmon aquaculture is caused by a lack of effective communication.	Flaherty, M., Reid, G., Chopin, T., & Latham, E. [28]. Public attitudes towards marine aquaculture in Canada: insights from the Pacific and Atlantic coasts. <i>Aquaculture International</i> , 27(1), 9–32. https://doi.org/10.1007/s10499-018-0312-9
5	Promoting communication is a role for the government.	Chu, J., Anderson, J. L., Asche, F., & Tudur, L. [91]. Stakeholders' perceptions of aquaculture and implications for its future: A comparison of the U.S.A. and Norway. <i>Marine Resource Economics</i> , 25(1), 61–76. https://doi.org/10.5950/0738-1360-25.1.61
6	Preventing effects on wild salmon populations is important to achieving social licence.	Mather, C. & Fanning, L. [11]. Social licence and aquaculture: Towards a research agenda. <i>Marine Policy</i> , 99, 275–282. https://doi.org/10.1016/j.marpol.2018.10.049
7	Transparent aquaculture operations generate a higher value product.	Zander, K. & Feucht, Y. [92]. Consumers' willingness to pay for sustainable seafood made in Europe. <i>Journal of International Food & Agribusiness Marketing</i> , 30(3), 251–275. https://doi-org.ezproxy.library.dal.ca/10.1080/08974438.2017.1413611
8	Current transparency policies set by the government are not effective.	Doelle, M., & Lahey, W. [14]. A New Regulatory Framework for low-impact/high-value Aquaculture in Nova Scotia. Retrieved January 1st, 2019 from https://novascotia.ca/fish/documents/Aquaculture_Regulatory_Framework_Final_04Dec14.pdf
9	Conflict resolution in the marine space is a process of transparency.	Jentoft, S. & Chuenpagdee, R. [93]. Fisheries and coastal governance as a wicked problem. <i>Marine Policy</i> , 33(4), 553–560. https://doi.org/10.1016/j.marpol.2008.12.002
10	Meaningful engagement with communities affected by aquaculture operations is important to achieving social licence.	Mercer-Mapstone, L., Rifkin, W., Louis, W., & Moffat, K. [94]. Meaningful dialogue outcomes contribute to laying a foundation for social licence to operate. <i>Resources Policy</i> , 53, 347–355. https://doi.org/10.1016/j.resourpol.2017.07.004
11	Transparency is not important to achieving social licence.	Withers, P. [95]. Aquaculture regulations criticized for a lack of transparency in report. <i>CBC Nova Scotia</i> . Retrieved July, 17, 2019, from https://www.cbc.ca/news/canada/nova-scotia/aquaculture-regs-less-transparent-says-report-1.3316911
12	Reduced reliance on fishmeal is not important to achieving social licence.	T. Buck Suzuki Environmental Foundation. [96]. Fish feed. <i>Salmon Farming Impacts</i> . Retrieved August 12, 2019, from http://www.bucksuzuki.org/current-projects/salmon-farming-campaign/salmon-farming-impacts/fish-feed/
13	Independent certification of environmental and social standards is important to achieving social licence.	Weitzman, J., & Bailey, M. [40]. Perceptions of aquaculture ecolabels: A multi-stakeholder approach in Nova Scotia, Canada. <i>Marine Policy</i> , 87, 12–22. https://doi.org/10.1016/j.marpol.2017.09.037
14	Without communicating information in a way that is easily understood, transparency is not useful to the public.	Fox, J. [21]. The uncertain relationship between transparency and accountability. <i>Development in Practice</i> , 17(4–5), 663–671. https://doi.org/10.1080/09614520701469955
15	Effective record-keeping systems provide the potential for effective communication of aquaculture practices.	Weitzman, J. [97]. Assessing the potential of ecolabels to improve social acceptance within Nova Scotia's finfish aquaculture industry: A stakeholder approach. <i>Master of Marine Management Graduate Project</i> . Marine Affairs Program, Dalhousie University, Halifax, N.S. Retrieved from http://hdl.handle.net/10222/72681
16	Public education is important to achieving social licence.	Fisheries and Oceans Canada. [98]. Overview: Qualitative research exploring Canadians' perceptions, attitudes and concerns towards aquaculture. <i>Reports and Publications</i> . Retrieved July 2, 2019, from http://www.dfo-mpo.gc.ca/por-rop/focus-aquaculture-eng.htm
17	There is no reluctance for salmon aquaculture companies to communicate environmental parameters (e.g. disease occurrence, escapees, etc.) to the public.	Asche, F., Hansen, H., Tveterås, R., & Tveterås, S. [99]. Thalassorama: The salmon disease crisis in Chile. <i>Marine Resource Economics</i> , 24(4), 405–411. https://doi.org/10.5950/0738-1360-24.4.405
18	Government communication initiatives do not reach	Chu, J., Anderson, J. L., Asche, F., & Tudur, L. [91]. Stakeholders' perceptions of aquaculture and implications for its future: A comparison of the U.S.A. and Norway. <i>Marine Resource Economics</i> , 25(1), 61–76. https://doi.org/10.5950/0738-1360-25.1.61

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Table A1 (continued)

(#)	Statement	Source
	the majority of the public.	
19	Promoting transparency is a role for the government.	McLeod, S. [100]. BC's aquaculture, the most transparent food-industry. <i>SeaWestNews</i> . Retrieved August 14, 2019, from https://seawestnews.com/bcs-aquaculture-the-most-transparent-food-industry/
20	Monitoring, reporting, and enforcement of environmental and social standards is important to achieving social licence.	Føre, M., Frank, K., Norton, T., Svendsen, E., Alfreksen, J. A., Dempster, T. ... Berckmans, D. [101]. Precision fish farming: A new framework to improve production in aquaculture. <i>Biosystems Engineering</i> , 173, 176–193. https://doi.org/10.1016/j.biosystemseng.2017.10.014
21	Promoting communication is not a role for NGOs.	Froehlich, H. E., Gentry, R. R., Rust, M. B., Grimm, D., & Halpern, B. S. [10]. Public perceptions of aquaculture: evaluating spatiotemporal patterns of sentiment around the world. <i>PLOS One</i> . 1–18. https://doi.org/10.1371/journal.pone.0169281
22	Promoting transparency is a role for media (e.g. newspapers, television coverage, etc.).	Flaherty, M., Reid, G., Chopin, T., & Latham, E. [28]. Public attitudes towards marine aquaculture in Canada: insights from the Pacific and Atlantic coasts. <i>Aquaculture International</i> , 27(1), 9–32. https://doi.org/10.1007/s10499-018-0312-9
23	Communication strategies have failed to show changes in aquaculture operations over time.	ACFFA. [102]. Media statement: salmon farmers are already transparent about escapes. Retrieved November 20, 2019, from https://www.atlanticfishfarmers.com/media-releases-all/2019/9/13/media-statement-salmon-farmers-are-already-transparent-about-escapes
24	Reducing the use of pesticides and antibiotics is not important to achieving social licence.	WHO. [103]. Vaccinating salmon: How Norway avoids antibiotics in fish farming. Features 2015. Retrieved November 20, 2019, from https://www.who.int/features/2015/antibiotics-norway/en/
25	Government does not have the capacity to effectively communicate to the public.	George Washington University's Elliot School for International Affairs. [104]. The contribution of government communication capacity to achieving good governance outcomes. <i>CommGAP</i> . Retrieved November 20, 2019, from http://documents.worldbank.org/curated/en/511591468331052544/The-contribution-of-government-communication-capacity-to-achieving-good-governance-outcomes
26	Regulations that promote transparency can compromise industry development.	Tang, J. [105]. New environmental assessment process a compromise between industry, activists. <i>National Post</i> . Retrieved November 20, 2019, from https://nationalpost.com/news/politics/government-reveals-far-reaching-new-review-process-for-major-resource-projects
27	Promoting transparency is not a role for industry.	Mowi. [106]. Targets and policies. <i>Corporate Governance</i> . Retrieved November 20, 2019, from https://mowi.com/investors/corporate-governance/targets-and-policies/
28	Conflict resolution in the marine space is not a process of communication.	Jentoft, S. & Chuenpagdee, R. [93]. Fisheries and coastal governance as a wicked problem. <i>Marine Policy</i> , 33(4), 553–560. https://doi.org/10.1016/j.marpol.2008.12.002
29	Promoting communication is a role for media (e.g. newspapers, television coverage, etc.).	Flaherty, M., Reid, G., Chopin, T., & Latham, E. [28]. Public attitudes towards marine aquaculture in Canada: insights from the Pacific and Atlantic coasts. <i>Aquaculture International</i> , 27(1), 9–32. https://doi.org/10.1007/s10499-018-0312-9
30	Promoting transparency is not a role for NGOs.	Ecology Action Centre. [107]. Sustainable fisheries and aquaculture. Our Work. Retrieved November 20, 2019, from https://ecologyaction.ca/marine/sustainable-fisheries-and-aquaculture
31	Communication among stakeholders (e.g. industry, public and government) is not important to achieving social licence.	Thackeray, R. & Neiger, B. L. [24]. A multidirectional communication model: Implications for social marketing practice. <i>Health Promotion Practice</i> , 10(2), 171–175. https://doi.org/10.1177/1524839908330729
32	Current communication policies set by the government are effective.	Doelle, M., & Lahey, W. [14]. A New Regulatory Framework for low-impact/high-value Aquaculture in Nova Scotia. Retrieved January 1st, 2019 from https://novascotia.ca/fish/documents/Aquaculture_Regulatory_Framework_Final_04Dec14.pdf
33	Sharing technical information without proper public education does not cause confusion.	Miljure, B. [108]. Genetically-modified fish could cause 'consumer confusion'. <i>CTV News Vancouver</i> . Retrieved July 2, 2019, from https://bc.ctvnews.ca/genetically-modified-fish-could-cause-consumer-confusion-1.2912422
34	Existing regulations sufficiently encourage transparency.	Doelle, M., & Lahey, W. [14]. A New Regulatory Framework for low-impact/high-value Aquaculture in Nova Scotia. Retrieved January 1st, 2019 from https://novascotia.ca/fish/documents/Aquaculture_Regulatory_Framework_Final_04Dec14.pdf
35	Promoting communication is a role for an independent ecolabel.	van Amstel, M., Driessen, P. P. J., Glasbergen, P. [109]. Eco-labeling and information asymmetry: a comparison of five eco-labels in the Netherlands. <i>Journal of Cleaner Production</i> , 16(3), 263–276. https://doi.org/10.1016/j.jclepro.2006.07.039
36	Promoting communication is not a role for industry.	Terpenning, M. S. [16]. Stakeholder perceptions of the Nova Scotia aquaculture regulations implemented in 2015 – a foundation for social licence? <i>Master of Marine Management Graduate Project</i> . Marine Affairs Program, Dalhousie University, Halifax, N.S. Retrieved from http://hdl.handle.net/10222/75158
37	Current capacity (e.g. infrastructure, personnel, resources) does not prevent farmers from operating in a transparent way.	Terpenning, M. S. [16]. Stakeholder perceptions of the Nova Scotia aquaculture regulations implemented in 2015 – a foundation for social licence? <i>Master of Marine Management Graduate Project</i> . Marine Affairs Program, Dalhousie University, Halifax, N.S. Retrieved from http://hdl.handle.net/10222/75158

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Table A1 (continued)

(#)	Statement	Source
38	Minimizing the effects on benthic species (e.g. lobster) is not important to achieving social licence.	Tomasso, J. R. [110]. Environmental nitrite and aquaculture: a perspective. <i>Aquaculture International</i> , 20(6), 1107–1116. https://doi.org/10.1007/s10499-012-9532-6
39	Promoting transparency is a role for an independent ecolabel.	Weitzman, J., & Bailey, M. [40]. Perceptions of aquaculture ecolabels: A multi-stakeholder approach in Nova Scotia, Canada. <i>Marine Policy</i> , 87, 12–22. https://doi.org/10.1016/j.marpol.2017.09.037
40	Transparency leads to accountability of the industry.	Terpenning, M. S. [16]. Stakeholder perceptions of the Nova Scotia aquaculture regulations implemented in 2015 – a foundation for social licence? <i>Master of Marine Management Graduate Project</i> . Marine Affairs Program, Dalhousie University, Halifax, N.S. Retrieved from http://hdl.handle.net/10222/75158

Other reasons for this perspective favoring industry leadership on transparency may relate to the desire to maintain control over the type of information that is released and how data is used or analysed. Alternatively, the strong representation from industry could also indicate a strong willingness to cooperate with government in relation to promoting transparency and communication in the form of regulation. As a Nova Scotian industry representative noted on regulations pertaining to transparency,

“to say that transparency does not promote public trust, I disagree with that. I think transparency promotes industry support, it promotes – it is tantamount to industry growth, because without transparent operations and transparent regulations, you can’t have industry growth.”

Conversely, Perspective 2 placed government as the leader of transparency initiatives, and uncertainty surrounding a leader for communication. This perspective is led by ENGO/community groups and has no industry participants. This could suggest that Perspective 2 believes more transparency and communication regulation would be beneficial, but that industry requires government intervention. According to a Nova Scotian ENGO/community group representative,

“[i]t’s the government’s job to hold companies accountable for their actions and to make sure they are operating in a transparent way ... although you have to promote the industry for economic reasons, and promote your GDP and that sort of stuff, another aspect of that is that [managers/regulators] are the stewards on behalf of the people for the resource and therefore they have to make sure that resource is being used effectively.”

Values outlined in Perspective 2 suggest there is a strong belief that social licence is rooted in the way that government regulates Atlantic salmon aquaculture. Allowing local communities affected by aquaculture to have input into decisions around benefits and impacts will be one of the key roles of government in ensuring meaningful engagement [11].

In this study, stakeholders are neutral about media’s role in transparency and communication (22, 29; Table 3. While communicating issues around aquaculture via the media is well-known, participants consistently suggest that promoting transparency is not a role for media (22). As suggested by Olsen & Osmundsen ([75]), perhaps because of the perceived potential bias that exists in media outlets, focus should be taken away from media as a potential representative for the transparency of the industry. Conversely, the finding suggesting taking responsibility away from media conflicts with the work of Maxwell & Filgueira [84] based in Newfoundland, Canada, where it was found that media were the second most trusted stakeholder group after academia and researchers. This discrepancy suggests that the perception and trust that participants have may be based on local settings and the reputation that media has relative to other stakeholders. Participants also ranked the role of ecolabels in communication and transparency low (35, 39). This finding is consistent with the explanation provided by Grunert, Hieke, & Wills [85] who noted at the product-related level, the concern for issues diminishes, limiting the efficacy of ecolabels.

5. Conclusions

Generally, the salmon aquaculture industry struggles to obtain Social Licence to Operate (SLO), and governments struggle to regulate the industry to the satisfaction of all stakeholders [57,86]. Stakeholders of Atlantic salmon aquaculture in Nova Scotia and Norway feel similarly about the crucial role of transparency and communication to achieve social licence. Two main perspectives were found that defined most stakeholders: *Perspective 1: Public Trust Starts with Industry* and *Perspective 2: Transparency Starts with Government*. *Perspective 2* had no industry representation, and otherwise, both perspectives had representation from every stakeholder group and both countries. These two perspectives linked the separate roles of transparency and communication in the Social Licence to Operate (SLO) of Norwegian and Nova Scotian Atlantic salmon aquaculture industries and highlighted the need to include both to achieve genuine social licence. Despite difference on who should take the leadership, adopting communication as a tool is essential to realize the full potential of the information provided via transparency. Participants felt that monitoring, reporting, and enforcement of *both* environmental and social standards is important to achieving social licence. Meaningful engagement with communities affected by aquaculture operations and multidirectional communication within the stakeholder network are seen as critical to achieving SLO in both perspectives. In addition, reducing the use of pesticides and antibiotics and increasing their monitoring and reporting is emphasized by participants as being important. This proposed public availability and clarity of information from government and industry may be a way to guide Atlantic salmon aquaculture towards better regulations and a more socially accepted industry.

Although all stakeholders must work together to build a network of communication that allows effective flow of information, this research suggests that industry leadership on transparency (with government support) have the potential to be accepted by stakeholders. Despite the aquaculture industry’s relative youth to other resource-intensive sectors and recent widespread adoption of the principle of SLO within it, an industry such as finfish aquaculture is not immune to the need for social licence for its operation [11,87,88]. We consider transparency and communication to be foundational aspects for trust, which is the crucial step for acceptance. However, transparency and communication are needed but not enough. Trust and procedural fairness, including the redistribution of benefits are key for acceptance [58]. Additionally, as global and local policies are shifting into a higher level of communicative and transparent operations, adopting these as tenets will be tantamount to mitigating social risk in their operations [89]. In addition, consideration of all realms of sustainability (social, environmental, economic) in monitoring reporting, and enforcement will aid in the improvement of SLO in the Atlantic salmon aquaculture industry.

CRedit authorship contribution statement

Justin Trueman: Conceptualization, Methodology, Software, Data Collection, Analysis, Original draft preparation, Writing, **Ramón**

Filgueira: Conceptualization, Supervision, Writing – reviewing and editing, **Lucia Fanning:** Conceptualization, Supervision, Writing – reviewing, and editing.

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Appendix i. – Concourse survey and final statement selections

See Appendix [Table A1](#).

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