

Assessing the potential of ecolabels to improve social acceptance within Nova Scotia's finfish aquaculture industry: A stakeholder approach

By

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## Abstract

Weitzman, J., 2016. Assessing the potential of ecolabels to improve social acceptance within Nova Scotia's finfish aquaculture industry: A stakeholder approach [graduate project]. Halifax, NS: Dalhousie University.

While aquaculture has grown exponentially in recent years and has been promoted for its economic benefits and potential to contribute to improved food security, conflicts over public health, land use, and environmental concerns have accompanied its rapid growth. Ecolabelling is widely recognized as a market-based tool for improved sustainability in fisheries and aquaculture, but the ability of ecolabels to address diverse public concerns is not well understood. This research used a stakeholder approach to identify challenges and opportunities for ecolabelling, and discuss its potential to influence social acceptance within a controversial finfish aquaculture industry. This study used mixed-methods (Q-methodology, surveys, and interviews) to explore the perceptions of stakeholders towards ecolabelling finfish aquaculture in Nova Scotia, Canada. Results show that aquaculture producers are highly supportive of ecolabelling, but that other stakeholders have mixed opinions on their benefits, challenges and potential uptake. An analysis of current production methods found that ecolabels could have industry-wide adoption. This study argues that ecolabelling may offer economic benefits, reduce environmental concerns, and represent a shared vision between stakeholders, but is not a panacea for social acceptance. A media analysis found several prominent concerns about aquaculture. The connectedness of diverse environmental, socio-economic, and management concerns challenges the ability of ecolabels to influence social acceptance, since ecolabels only address environmental concerns. Furthermore, the variability between schemes must be acknowledged and better understood to fully assess their potential within Nova Scotia's aquaculture industry. This study provides recommendations to aquaculture producers, governments, NGOs, and other stakeholders interested in pursuing aquaculture ecolabelling.

*Keywords:* aquaculture; ecolabelling; certification; social acceptability; social licence; perceptions; Q-methodology



## **Abbreviations Used**

AANS	Aquaculture Association of Nova Scotia
ACC	Aquaculture Certification Council
ACFFA	Atlantic Canada Fish Farmers Association
ASC	Aquaculture Stewardship Council
BAP	Best Aquaculture Practices
CSR	Corporate Social Responsibility
DFO	Department of Fisheries and Oceans Canada
DFA	Department of Fisheries and Aquaculture
EAC	Ecology Action Centre
ENGO	Environmental Non-Governmental Organization
FAO	Food and Agriculture Organization
GAA	Global Aquaculture Alliance
GMO	Genetically modified organisms
MSC	Marine Stewardship Council
SLO	Social license to operate
SSI	Sustainable Seafood Initiative
WWF	World Wildlife Fund

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## **Chapter 1: Introduction**

### 1.1 Review of major concepts

#### *1.1.1 Aquaculture*

Aquaculture, or the farming of fish, shellfish, and aquatic plants, is a growing and important industry globally and within Canada. Aquaculture has become a promising industry for meeting the food needs of increasing populations and relieving fishing pressures on wild fish stocks. Canada is well suited for potential large-scale growth of aquaculture, and it can be an important contributor to rural economic development. In Nova Scotia, the Ivany report on rural development recommended the aquaculture industry at least double in size to support growth and development in rural communities (Ivany et al., 2014). This is supported by substantial financial investment by the Nova Scotia government for research and expansion (CBC, 2016).

However, the development of finfish aquaculture in Nova Scotia has been accompanied by growing environmental, health and socio-economic concerns (Bacher, 2015). The use of chemicals and pesticides, the spread of disease, impacts of escapes to natural environments and wild populations, and the use of wild fish to feed farmed fish are some of many concerns facing the industry. Conflicting values and views on aquaculture development have resulted in a widespread controversy in Nova Scotia and throughout Canada (Young & Matthews, 2010). Consequently, the Nova Scotian government and aquaculture industry have been working towards developing sustainable industries and addressing stakeholder concerns to promote an industry that is profitable, sustainable and socially accepted (The Province of Nova Scotia, n.d.).

#### *1.1.2 Seafood eco-certifications and ecolabels*

Eco-certification schemes aim to promote sustainable development of resource management through market-based approaches (Ward & Phillips, 2008). Ecolabels can ameliorate a range of public concerns about the environmental sustainability and management practices of products. Ecolabelling for seafood has become popular due to the promise of market benefits, improved sustainability and reduced environmental impacts (Phillips et al., 2003). By informing consumers of the environmental footprint of a certain method of production, ecolabels aim to reduce negative impacts by creating a demand and ‘market-pull’ for sustainably sourced

products. Industries are thus incentivized to adopt sustainable practices with the expectation of earning market premiums for their labeled products.

## 1.2 Management Problem

As global demands for seafood increase, the growth of Nova Scotia's finfish aquaculture industry could offer numerous socio-economic benefits. However, industry growth needs to be supported by sustainable development and addressing the issue of poor social acceptability. Social acceptance is one of many pillars that guide sustainable resource management (Brunson, 1996). However, developing industries that reduce negative impacts and address social concerns has been a challenge for sustainable aquaculture management (Read & Fernandes, 2003), and an ongoing challenge for Nova Scotia (Nguyen & Williams, 2013).

Market-based approaches such as eco-certification and ecolabelling are increasingly used to promote sustainable fisheries and aquaculture. By promoting environmentally friendly practices, ecolabels can help supplement conservation efforts and management frameworks. Not only can eco-certification incentivize the sustainable management of resources, it can act as an effective communication tool between industries and stakeholders to show industry's commitment to sustainable development (Gulbrandsen, 2006). Therefore, ecolabels could be used to promote sustainable aquaculture development in Nova Scotia, while addressing stakeholder concerns and ultimately improving social acceptance. Despite the possible benefits, few finfish farms in Nova Scotia are currently involved in ecolabelling schemes. To reveal the potential role and benefits of aquaculture ecolabels, it is necessary to determine the potential uptake by producers and stakeholders, and understand how ecolabels address public concerns.

## 1.3 Research Aims and Objectives

Eco-certifications and ecolabels could bring numerous benefits to the sustainable and socially-acceptable management of Nova Scotia's finfish aquaculture industry. Since ecolabelling schemes for finfish aquaculture are relatively new in Nova Scotia, this research acts as a preliminary exploration of the potential role for ecolabelling in the industry. This research investigates the perceptions of a range of key finfish aquaculture stakeholders in Nova Scotia to develop a better understanding of the challenges and opportunities for eco-certifications in aquaculture. This was accomplished by answering two primary research questions:

- 1) What is the potential uptake of ecolabelling by industries and buy-in by stakeholders?
- 2) Could ecolabels be an effective tool to address environmental, social and economic concerns of stakeholders within Nova Scotia's aquaculture industry?

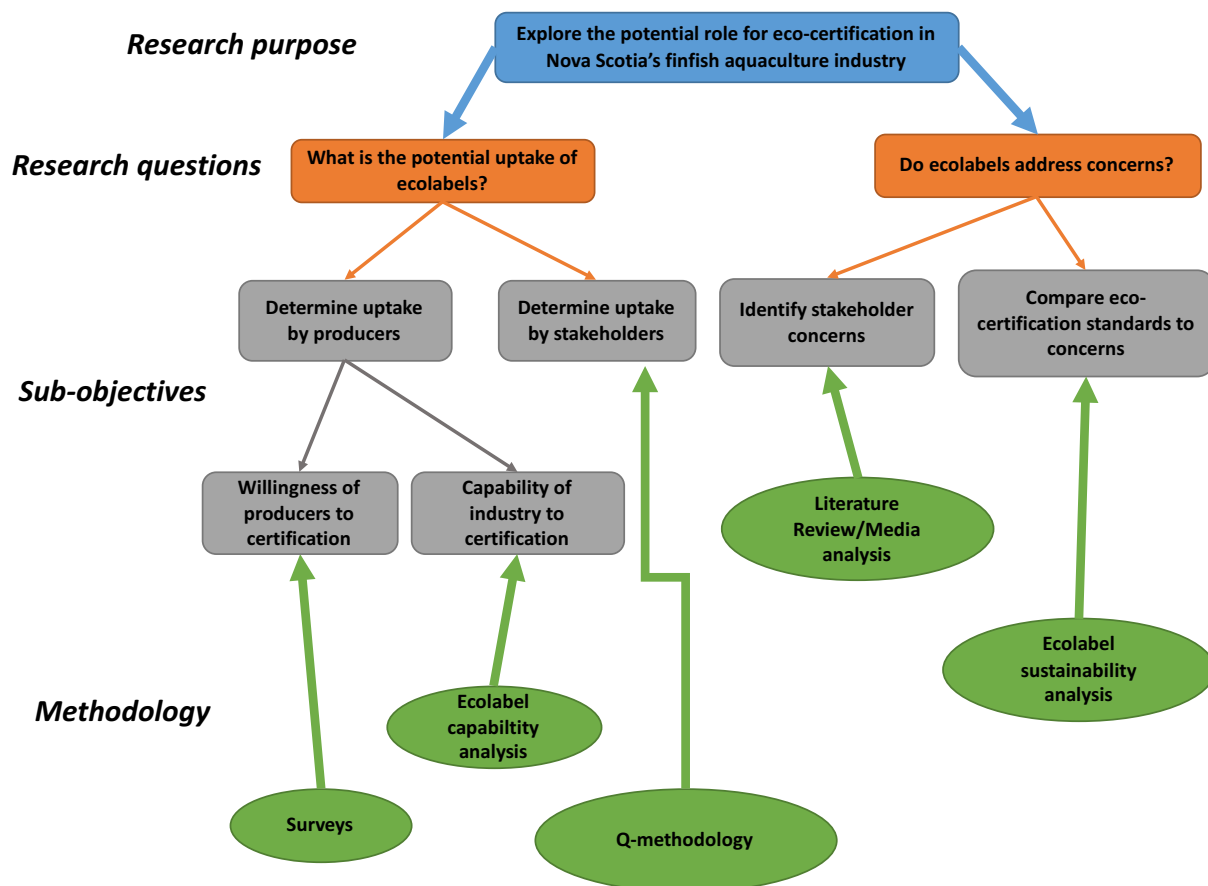
This study aims to answer these questions by exploring the human dimension of coastal resource management. The successful implementation of sustainable management is driven by, and depends on, societal values, opinions and priorities (Weinstein et al., 2007). It is thus necessary to understand the values, opinions and perceptions of the public, communities and important stakeholders. To date, most ecolabel perception studies have focused on consumer demand or public opinion (Bacher et al., 2014) rather than a broader stakeholder approach, which is the approach applied here. While it is often argued that consumers are the main drivers of ecolabels, evidence suggests other stakeholders such as retailers, NGOs, and governments are more influential in the proliferation and driving of eco-certification schemes (Lay, 2012). However, factors such as industry participation and stakeholder buy-in have not been well documented. Furthermore, the ability of labels to meet stakeholder needs and wants are not well understood, and often depends on local cultures and perceptions. As aquaculture ecolabelling schemes emerged relatively recently, this study also provides a comparative assessment of several leading schemes within Canada to reveal their potential role within the Nova Scotia finfish farming industry.

If ecolabels can relieve environmental and socio-economic concerns, are accepted by stakeholders and producers, and are available to producers, then it can be argued that they may provide industry benefits, support sustainable growth and improve social acceptability. Through a better understanding of stakeholder perceptions and a critical assessment of the leading ecolabelling schemes available to finfish producers in Nova Scotia, this research will provide recommendations to industry, managers, and policy makers about the benefits and challenges of incorporating ecolabelling into the finfish aquaculture industry.

#### 1.4 Overview of methodology

To answer the primary objectives of this study, a combination of quantitative and qualitative approaches was employed (Figure 1). The potential buy-in by stakeholders was explored by determining their perception of benefits, opportunities and challenges for

ecolabelling. This investigation applied frameworks similar to other perception studies, such as surveys (Whitmarsh & Palmieri, 2009) and Q-methodology (Rudell & Miller, 2012) to determine stakeholder attitudes and opinions about aquaculture ecolabels. An industry survey explored the willingness of fish farmers to become involved in ecolabelling schemes. The capability of the industry to become certified was determined by exploring the extent to which ecolabelling schemes would be accessible to producers. To do so, an ‘ecolabels analysis’ compared which sectors of the industry would be covered by four currently operating ecolabels in Canada. A literature review and media analysis was conducted to reveal prominent stakeholder concerns within Nova Scotia. To assess whether ecolabelling schemes have the potential to address stakeholder concerns, standards were analyzed against multiple sustainability criteria that spanned across environmental, social, economic and management-related concerns, which were elucidated from the media study.



**Figure 1** Methods used in this study to address research questions and objectives

1.5 Structure of thesis

This report is divided into four chapters. This first chapter introduces the research study, provides the research question, and an overview of the methodology employed in the sections that follow. Chapters 2 and 3 provide the results and discussion of the two primary objectives individually. Each of the above-mentioned chapters provides a review of relevant literature to deliver context for question-specific sub-objectives and delivers the detailed methodologies used. Chapter 4 synthesizes and discusses this study’s findings with relevance to the overall purpose of the research. This chapter also provides recommendations to support policy and decision-makers regarding ecolabelling in Nova Scotia’s aquaculture industry.

**Chapter 2: Assessing the potential uptake of eco-certifications by finfish producers and stakeholders**

2.1 Background context

2.1.1 Aquaculture

Aquaculture is defined by the Food and Agriculture Organization (FAO) as:

“...the farming of aquatic organisms: fish, molluscs, crustaceans, aquatic plants, crocodiles, alligators, turtles, and amphibians. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators ... and implies individual or corporate ownership of the stock being cultivated.” (FAO, 2002)

Aquaculture is one of the fastest-growing marine and animal food-producing sectors, and contributes more than half of fish produced globally (FAO, 2016; Figure 2). It is expected that aquaculture production will continue to grow in importance with increasing global demand for fish given expanding global populations and declining wild stocks (The World Bank, 2013).

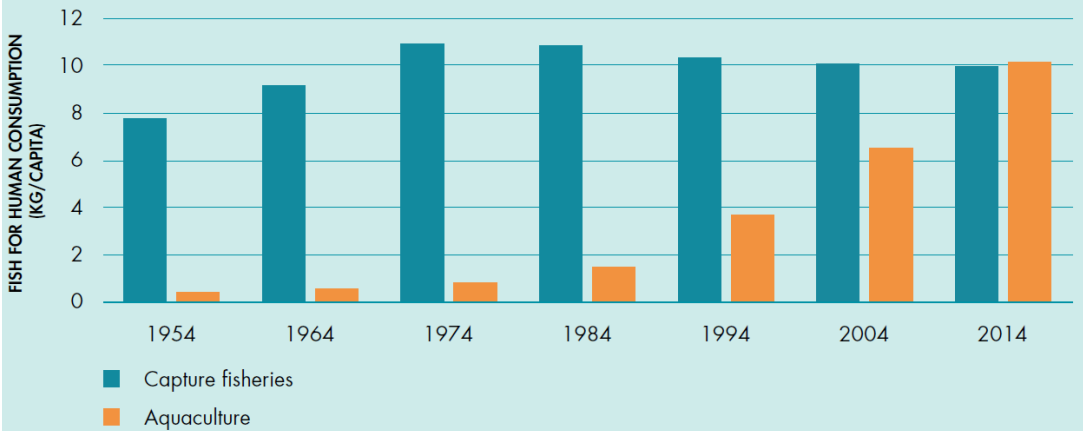


Figure 2 Contribution of aquaculture to total food supply (kg/capita) (Obtained from FAO, 2016)

### 2.1.1.1 Aquaculture in Canada

Aquaculture is a diverse, global industry that produces over 300 species of finfish (FAO, 2014). While farmed fish practices have existed for thousands of years, aquaculture is relatively new within Canada, and is seen as a significant industry for future development. Commercial aquaculture began in the 1950s with small-scale trout farming in Ontario and Quebec and oyster farming in British Columbia, New Brunswick and Prince Edward Island. However, the industry expanded rapidly since industrialization and the emergence of salmon farming in the 1970s. Between 1986 and 2008, aquaculture production in Canada expanded 1,300% from 10,488 to 144,684 tonnes (Suprenant, 2010). In 2014, aquaculture contributed \$735.4 million to Canada's GDP (Fisheries and Oceans Canada (DFO), 2014). Today, all provinces in Canada and the Yukon farm numerous species of finfish, shellfish and aquatic plants.

Overall, Canada and the United States together contribute only 0.86% of global aquaculture production (FAO, 2014). While Canada's contribution to global aquaculture is comparatively small, it supports the livelihoods of rural communities and has important niche markets such as those for Atlantic salmon (*Salmo salar*) (Nguyen & Williams, 2013). Canada is the fourth largest producer of Atlantic salmon in the world behind Chile, the United States, and Norway (Nguyen & Williams, 2013). Furthermore, while aquaculture accounted for only 0.06% of Canada's total GDP in 2007, it can be an important economic contributor locally. For example, aquaculture accounted for 26% of employment income in Charlotte County, New Brunswick.

The socio-economic benefits of aquaculture are only a fraction of their realized potential. Over the last 10 years, finfish production in Canada has remained relatively constant (Suprenant, 2010). Canada's vast undeveloped coastlines and suitable water conditions offer ideal environments for the growth of many species. Furthermore, unique access to global markets such as the United States and Europe offers economic advantages for Canada's aquaculture industry. Consequently, Canada's government is actively supporting aquaculture development.

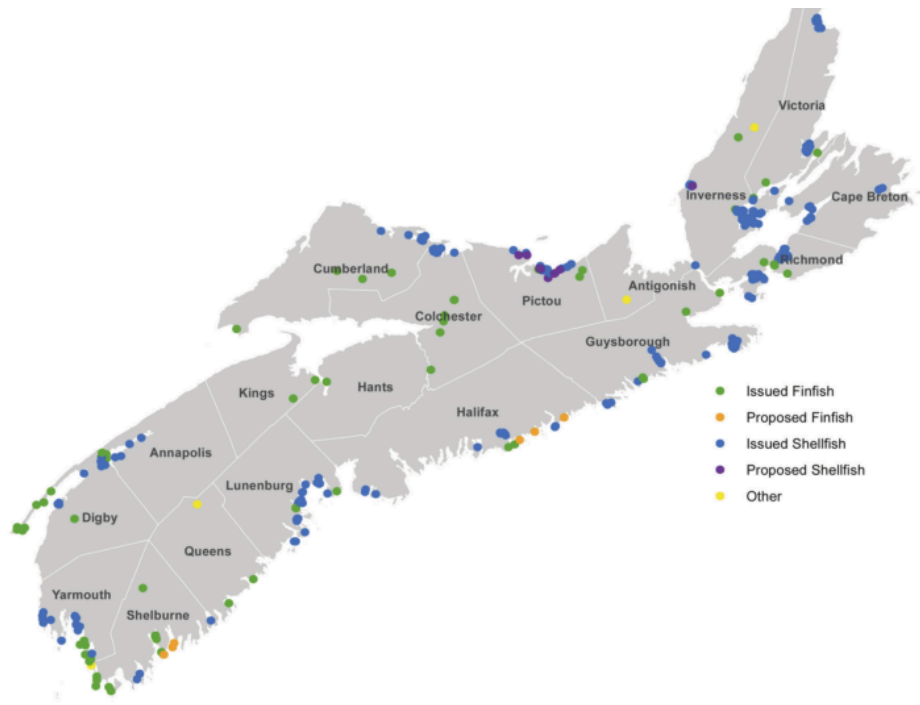


### 2.1.1.2 Aquaculture in Nova Scotia

Nova Scotia is a small Atlantic province on Canada's eastern coast. Nova Scotia's coastline extends 13,300 km and supports the livelihoods of rural communities throughout the province. Industries such as fishing, oil and gas, tourism, and aquaculture play important roles in Nova Scotian cultures and economies. While 43% of the province's population live in rural Nova Scotia, economic growth in coastal rural communities has been considered stagnant, and even in decline in recent years (Gibson et al., 2015).

The aquaculture industry has played an important role in revitalizing rural communities across Canada, and its growth can support necessary economic development in rural Nova Scotia. In the last 30 years, Nova Scotia's aquaculture industry has expanded to be worth \$60 million and provide over 800 jobs in 2015 (AANS, 2016). While only 5% of Canada's total aquaculture production value comes from Nova Scotia (Manning & Hubley, 2015), its suitable coastline and market proximity presents a promising opportunity for the growth of a diverse aquaculture industry (Stantec, 2009).

In Nova Scotia, over 200 individual aquaculture sites are scattered across the province (Figure 2). The oceanographic conditions in Nova Scotia have enabled the production of a diverse range of species. While the majority of farms grow shellfish (ex. mussels and oysters), the province's finfish sector is much higher valued, contributing to 93% of aquaculture's total \$60M GDP in 2014 (Statistics Canada, 2015). In Nova Scotia, Atlantic salmon contributes to 89% of those revenues. Nova Scotia also produces Atlantic halibut (*Hippoglossus hippoglossus*), striped bass (*Morone saxatilis*), rainbow trout (*Oncorhynchus mykiss*) and Arctic char (*Salvelinus alpinus*). A total of 53 aquaculture sites are owned and operated by 32 individual license holders across the province (Appendix i). The majority of finfish aquaculture is farmed using open ocean free floating net-pen cages (58% of farms), however, a few land based facilities have emerged in recent years (16% of farms). Multiple hatcheries also exist throughout the province for a diversity of species including brook trout and Arctic char. Open ocean finfish farming is concentrated around the Shelburne and Digby counties and along Nova Scotia's Eastern Shore (Figure 3).



**Figure 3** Locations of all shellfish and finfish aquaculture sites across all counties in Nova Scotia (Obtained from Nova Scotia, 2012)

### 2.1.2 *The Sustainable Seafood Movement*

As aquaculture outpaces wild capture fisheries for seafood, people are increasingly acknowledging the negative impacts of the aquaculture industry, and markets are increasingly demanding sustainable seafood (Potts et al., 2016). In Europe and North America, large supermarket chains such as Wal-Mart have made commitments to sourcing only sustainable seafood (Bush et al., 2013). These trends result from a powerful and growing sustainable seafood movement that began in the early 1990s (Konefal, 2013). Initiated by a consortium of environmental groups, aquariums and conservation groups, the sustainable seafood movement developed in response to failures in public policy and grassroots efforts to conserve and protect the ocean from overfishing and degrading fishing and fish farming practices (Konefal, 2013).

The sustainable seafood movement is aimed at fostering industry sustainability through market-based approaches and consumer projects such as boycotts, awareness campaigns, seafood certifications and ecolabels (Gutiérrez & Morgan, 2015). Early market-based approaches such as seafood guides aimed to empower and inform consumers by ranking seafood choices based on sustainability criteria (Roheim, 2009). Subsequently, the rise in certifications provide incentives not only to consumers and retailers within the supply chain to choose more sustainable seafood, but also to incentivize producers to improve their fishing and fish farming practices (Parkes et al., 2010).

### 2.1.3 Ecolabelling in aquaculture

Ecolabels are a unique logo that identifies products that meet a set of environmental criteria or standards. Ecolabels historically developed out of certification schemes, which provided assurances for food safety and quality control (Phillips et al. 2003). Ecolabels have traditionally aimed to inform about a product's characteristics, including kosher, halal or organic. Since each scheme has a specific purpose and motivation, the standards and criteria assessed by each standard will therefore vary (Ward & Phillips, 2008; Nadvi & Waltring, 2002). Ecolabelling schemes can fall into three general categories, according to the FAO (Wessels et al., 2001):





*First party labelling:* individual companies label their own products according to an internal set of standards set out by the company (self-declaration).

*Second party labelling:* industry associations set labels for their members. The standards for these labels can be based on academic or external expertise, but are often verified internally or through third-party certifiers.

*Third party labelling:* labels and certification criteria are established by an independent third party, and often includes requirements for traceability along the supply chain.

Seafood ecolabels first emerged in the 1990s from a growing recognition of the concerns and impacts of overfishing and poor fishing practices. The oldest seafood label is the 'dolphin safe' logo on tuna cans (Teisl et al., 2002). Today, the most widely recognized seafood ecolabel is the Marine Stewardship Council (MSC), which was established in 1997 (MSC, 2015). Currently, 256 wild capture fisheries are MSC certified in 36 countries. While many ecolabelling schemes are in operation globally, only a select few include aquaculture. In Canada, there are only four dominant labelling schemes available for farmed finfish: MSC's counterpart the Aquaculture Stewardship Council (ASC), GAA's Best Aquaculture Practices (BAP), Canada Organic Aquaculture Standard (i.e. "Organic") and Vancouver Aquarium's Ocean Wise recommendation program (Table 1).

**Table 1** Name, developing agency, and description of the main ecolabels applicable to farmed Nova Scotia finfish production

Scheme	Developer	Ecolabel	Description
Aquaculture Stewardship Council (ASC)	World Wildlife Fund (WWF)		Founded in 2010 by the World Wildlife Fund (WWF), the ASC label was a product of the WWF-led Aquaculture Dialogues. ASC has developed 7 species-specific standards and is the fastest-growing certification initiative in recent years (Potts et al., 2016)
Best Aquaculture Practices (BAP)	Aquaculture Certification Council (ACC)		Organized in 1997, Global Aquaculture Alliance (GAA) developed the BAP standards in 2004. GAA is an industry-led not for profit trade association. It has three species-specific standards and multiple standards across supply chain (Potts et al., 2016)
Ocean Wise Program	Vancouver Aquarium		Spearheaded by the Vancouver Aquarium, Ocean Wise is a recommendation program that works with suppliers, retailers and restaurants to provide sustainable seafood choices to consumers. It is not a certification program, but suppliers can work with Ocean Wise to get their products branded with the ecolabel.
Canada Organic Aquaculture Standard	Canadian General Standard Board (CGSB)		In 2012, a committee of industry members, governments, First Nations, consumer groups and environmental groups appointed by the Canadian General Standards Board (CGSB) developed the standards. The goal of the standard was to encourage sustainable and environmentally friendly seafood production.

### 2.1.3.1 Benefits and challenges of seafood ecolabels

Governments, industries and civil society groups all recognize the multitude of economic and environmental benefits that ecolabelling could provide (Wessels et al. 2001). The benefits of eco-certifications gained international recognition at the 1992 United Nations Convention on Environment and Development (UNCED) in Rio de Janeiro (Wessels et al., 2001). Since then, there has been an upsurge of interest in seafood ecolabelling schemes launched by governments, industry organizations and environmental groups (Phillips et al., 2003). These groups have all recognized eco-certification a tool for promoting sustainable resource management and adopting best management practices to support governance and conservation policies.

While ecolabels and certification schemes are becoming commonplace in the market (Potts et al., 2016), many challenges remain for the success and uptake of ecolabels

(Washington, 2008). Some academics question the effectiveness and rigour of the MSC label (Christian et al., 2013), and criticize the reality of meeting consumer demand (Washington & Ababouch, 2011) and conservation goals (Jacquet & Pauly, 2007). Others insist that the high volume of available aquaculture labels with no global standard undermine its effectiveness (Nguyen & Williams, 2013). Industry members may be hesitant to invest in ecolabelling due to costs of certification and advertising (Phillips & Ward, 2009), lack of knowledge surrounding ecolabel availability and uncertainty of competitive benefits (DeAngelis, 2013).

#### 2.1.3.2 Aquaculture ecolabels in Nova Scotia

Nova Scotia has been slow to adopt eco-certification and their associated labels. Currently, only four producers of marine-based and land-based farms and hatcheries have certified sites in Nova Scotia including: Kelly Cove Salmon Ltd (a division of Cooke Aquaculture), Canaqua Seafoods Ltd, Scotian Halibut Ltd, and Sustainable Blue. Of the 50 finfish farms and hatcheries in Nova Scotia, 15 sites (30%) are certified across different labelling and certification schemes. Cooke Aquaculture, the largest producer of Atlantic salmon in the Atlantic Provinces became BAP certified in 2014. No farms in Nova Scotia are ASC certified, although Cooke Aquaculture is pursuing ASC certification. However, academics (Doelle & Lahey, 2014), conservation groups, and governments (The Province of Nova Scotia, n.d.) recommend certification as an area of interest in Nova Scotia's aquaculture industry to support more sustainable practices and improve market competitiveness.

## 2.2 Research objectives

This section aims to answer the following question: What factors influence the uptake of ecolabelling and eco-certification schemes by industries and stakeholders? Specifically, this research explored the following areas of interest and asked the questions:

- i) **Accessibility:** Are ecolabelling schemes available to producers wishing to become involved in such schemes?
- ii) **Willingness:** How do producers perceive the benefits and challenges to certification, and what factors may influence their willingness to participate in ecolabelling?
- iii) **Acceptance/buy-in:** How do different stakeholders perceive the benefits, challenges and opportunities for eco-certifications in Nova Scotia's finfish aquaculture industry?

## 2.3 Methodology

### 2.3.1 *Ecolabel availability analysis*

To determine whether finfish aquaculture producers are certifiable, a comparative analysis was used to explore the potential accessibility of producers to four labelling schemes active within Nova Scotia: Global Alliance Aquaculture's (GAA) Best Aquaculture Practices (BAP), Aquaculture Stewardship Council (ASC), Canada's Organic Aquaculture Standard (hence referred to as 'Organic'), and Vancouver Aquarium's Ocean Wise program. All labelling schemes were selected based on at least one producer in Nova Scotia actively participating in the scheme.

Since eco-certification schemes have different standards and targets, not all certification schemes will likely be applicable to all sectors of Nova Scotia's aquaculture industry. Ecolabelling schemes were analyzed to reveal the coverage of ecolabels across sectors of the industry including farmed species and production system. This was done by analyzing the standards, webpages and reports of each ecolabelling scheme to reveal the coverage and scope of species and production systems targeted. Statistics from active finfish licenses in Nova Scotia (Nova Scotia Site Mapping Tool) were synthesized to calculate the proportion of finfish aquaculture producers with access to ecolabels.

### 2.3.2 *Industry Survey*

Nova Scotian finfish producers were surveyed between June and August, 2016 to explore the potential uptake of ecolabels within the industry. Participants included finfish aquaculture industry members (farmers, processors and hatchery owners), with surveys being distributed to industry members online using the Dalhousie University hosted survey software Opinio. The full survey can be found in Appendix ii.

The survey consisted of a range of questions to explore various factors influencing the willingness of fish farmers to participate in ecolabelling schemes. Questions were divided into four sections. The first set of questions provided contextual information about the producer, including geographical information, species farmed, and market indicators. To explore producers' corporate social responsibility, the second set consisted of questions about the producer's priorities and policies, and the pressure felt from other parties to adopt sustainable practices. The third set included questions about the producer's intended actions surrounding

ecolabelling. Finally, the last set comprised questions about the producer's perceptions and understanding of ecolabels. Responses were statistically summarized and analyzed using the software R 3.3.1 (R Core Team, 2016). Summary measures were calculated using descriptive statistics across question sets.

### *2.3.3 Q-methodology*

While perception studies about aquaculture often use survey-based methods (Mazur & Curtis, 2008; Whitmarsh & Palmieri, 2009), several recent perception studies have employed Q-methodology (Bacher et al., 2014; Ruddell & Miller, 2012). Q-methodology is a technique that identifies major themes in opinions shared by a range of stakeholders (Cross, 2005). Q-methodology does not require large population to produce statistically significant results (Brown, 1993) by providing an in-depth understanding of the perceptions and understandings of a given group of individuals while not attempting to generalize to a larger population. In a Q-study, participants are asked to sort statements about a topic along a scale about how they feel about each statement. How they sort these statements is then compared and contrasted to discover groups of people who share similar opinions. Statements were categorized across several topic areas to explore participants' attitudes towards the potential uptake, benefits/challenges and influence of ecolabels for Nova Scotia's finfish aquaculture industry.

#### *2.3.3.1 Selecting statements*

First, the 'concourse', or a comprehensive set of statements covering a multitude of topics surrounding eco-certification and ecolabelling in aquaculture was developed. A total of 281 statements were gathered from a range of research materials including text from newspaper articles, journal articles, government and private documents and reports, websites and informal interviews. This step was completed once the 'concourse' had reached a saturation point where no new statements about the topic surfaced.

Repetitive statements were removed and similar statements were combined to narrow the list down to 132 unique statements. Q-statements were then sorted based on a structured sampling technique which considered a broad balance of pro, con and neutral statements about a given topic (Brown, 1980). To determine how ecolabels can address stakeholder concerns, statements were grouped into three categories: the uptake of ecolabels, benefits and challenges of

ecolabels, and the potential influence of labels within Nova Scotia's aquaculture industry. Under each category, statements were further categorized into specific thematic areas, which covered the range of opinions and viewpoints expressed through the literature search.

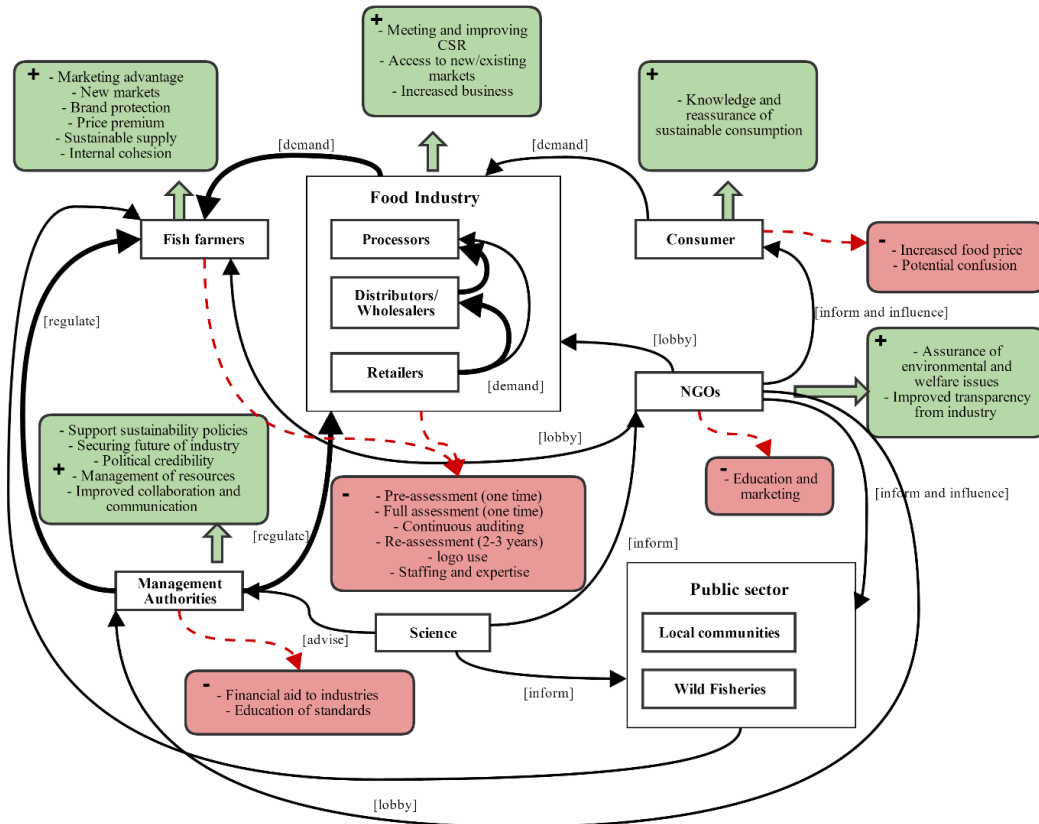
Next, statements were reduced to create a sample of 49 statements (the Q-sample) chosen to represent the key views and opinions about the range of themes and balance of pro, con and neutral viewpoints (Appendix iii). Statements were chosen to be as divergent as possible to avoid repetitiveness and reduce misinterpretation of similar opinions (Brown, 1980). Statements were numbered one through 49 and printed on individual index cards.

### 2.3.3.2 Selecting participants

Participants for the Q-methodology were chosen based on the expectation that they hold different opinions and views regarding aquaculture and ecolabelling in Nova Scotia. Given the extensive in-depth exploration of individual perceptions, most Q-studies only require 30-60 participants (McKeown & Thomas, 2013), although it is common and acceptable to have fewer participants (Webler et al., 2009).

Participants were chosen across broad categories of stakeholders who are linked within both the aquaculture industry and ecolabelling processes (Figure 4). Since this research employs a broad stakeholder approach, it is important that stakeholders who both stand to benefit from ecolabelling and who are connected within the supply chain and management of aquaculture are included. For the purposes of this study, a stakeholder was defined as a person or organization with an interest in, or is directly or indirectly impacted by the activities, consequences or benefits of an aquaculture eco-certification program. Selected stakeholders for this study included representatives from the fish farming industry (5), scientific community (4), managing authorities (4), environmental non-governmental groups (4), fishing industry (4), and food industry (4).





**Figure 4** Schematic representation of the interactions between key aquaculture stakeholders and the benefits (+) and costs (-) delivered to each through their involvement in eco-certification schemes. The thickness of arrows represents the strength of the influence, which is specified in square brackets (Adapted from OECD, 2011)

### 2.3.3.3 Sorting exercise

Between June and September 2016, 25 participants completed a Q-sorting exercise. Participants were given detailed instructions that first asked them to read all index cards and sort the set of randomly numbered, shuffled cards into three piles based on whether they agree, disagree or feel neutral about the statement. Participants then sorted cards further onto a 9-point grid chart ranging from -4 (least agree) to +4 (most agree). Participants were asked to place cards onto a ‘forced’ quasi-normal distribution, which encouraged participants to critically compare and systematically rank statements and opinions (DuPlessias et al., 2005). The placements of all cards, thus referred to as the Q-sort, were recorded onto score sheets (Appendix iv) by the researcher. Following the sorting exercise, stakeholders were interviewed informally and asked to comment on their placement of cards, any observations, recommendations or final comments.

#### 2.3.3.4 Statistical Analysis

The set of Q-sorts were loaded into the statistical software PQ Method 2.35 and analyzed with quantitative factor-analysis to determine the patterns in sorting choices (Shmolck, 2002). The analysis compared individual's Q-sorts to determine which individuals sorted the statements in similar ways. A correlation matrix was first produced for all 25 sorts to represent the level of similarity between participants. Principal Component Analysis (PCA) grouped shared viewpoints from sorts into common 'factors'. Preliminary un-rotated factors were then rotated using a varimax orthogonal rotation to reveal those factors that explained the most of the variance of the data. The process of choosing relevant factors is the result of using a variety of statistical and theoretical criteria (McKeown & Thomas, 2013). Thus, factors were selected based on the following conditions: a) eigenvalues greater than 2.00 (meaning at least 2 sorts loaded significantly), b) explanatory variable > 10%, and c) the factor was theoretically important. The final factor analysis generated a model Q-sort, which represents the idealized sort for each factor. Factor loadings, which are in effect correlation coefficients, were generated to express the degree to which each Q-sort agreed with the ideal model sort for the determined perspectives (McKeown & Thomas, 2013). Factor loadings and factor scores (scores of model Q-sort for each perspective) were then subject to interpretation.

## 2.4 Results

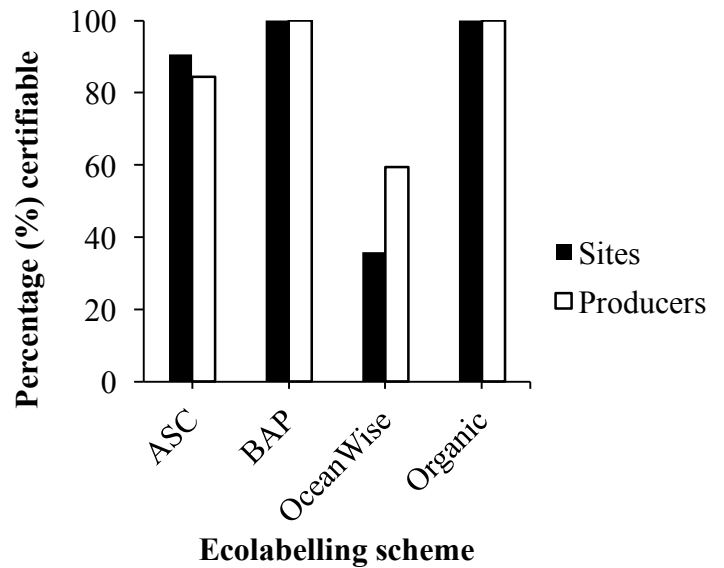
### 2.4.1 *Ecolabel availability analysis*

The ecolabel availability analysis determined that not all ecolabelling schemes are available to all farmed species and methods of production within Nova Scotia's finfish aquaculture industry (Table 2). Atlantic salmon is the only ubiquitously certifiable species across all schemes. Both ASC and Organic labels do not have separate standards for different production systems. Like Organic labels, BAP standards cover all finfish farmed in Nova Scotia. Conversely, BAP has created separate standards for both Atlantic salmon and rainbow trout, and for all production systems individually.

**Table 2** Species and modes of production for farmed finfish specified within various ecolabelling and certification schemes

	<b>ASC</b>	<b>BAP</b>	<b>Ocean Wise</b>	<b>Organic</b>
<b>Species</b>	Atlantic salmon/ Rainbow Trout	Atlantic salmon/ Rainbow trout; All other finfish (not specified)	Atlantic salmon; Atlantic halibut; Arctic char	All species (not specified)
<b>Production System</b>	All (unspecified)	Farm Hatchery Feed mill Processing plant	Farm (Land-based RAS only) Hatchery Processing plant	All systems (not specified); Includes feed

The coverage of ecolabelling schemes (ASC, BAP, Ocean Wise and Organic) revealed that at least one of the four ecolabels analyzed would be available to most finfish producers in Nova Scotia (Figure 5). All farms and producers in Nova Scotia could pursue both BAP and Organic ecolabels. However, only 36% of farms in Nova Scotia would be eligible to become recognized by Ocean Wise.



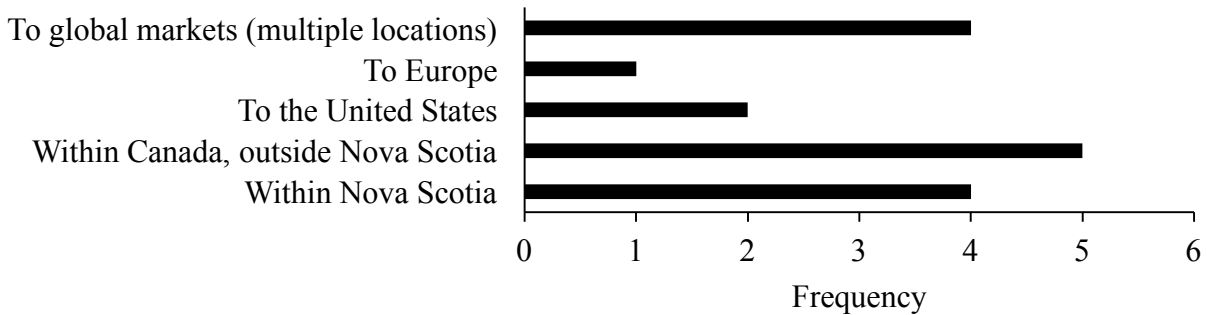
**Figure 5** Percentage of finfish aquaculture sites (N=53) and producers (N=32) in Nova Scotia eligible to become involved in various ecolabelling schemes

#### 2.4.2 Industry survey

Between June 13, 2016 and August 19, 2016, ten respondents completed an online survey designed to test the perceptions of eco-certifications by finfish farmers in Nova Scotia. Participants represented companies owning farms from nine counties across Nova Scotia, including Hants, Cumberland, Colchester, Kings, Annapolis, Lunenburg, Digby, Shelburne and Queens. Farms from Shelburne and Cumberland counties were more greatly represented. Surveyed farms produced primarily Atlantic salmon (55.5% farmers) and Atlantic halibut (44% of farmers). Nearly all farms (90%) had been in operation for over fifteen years. Only one farm has been in operation for a shorter five to ten years.

### 2.4.2.1 Market indicators

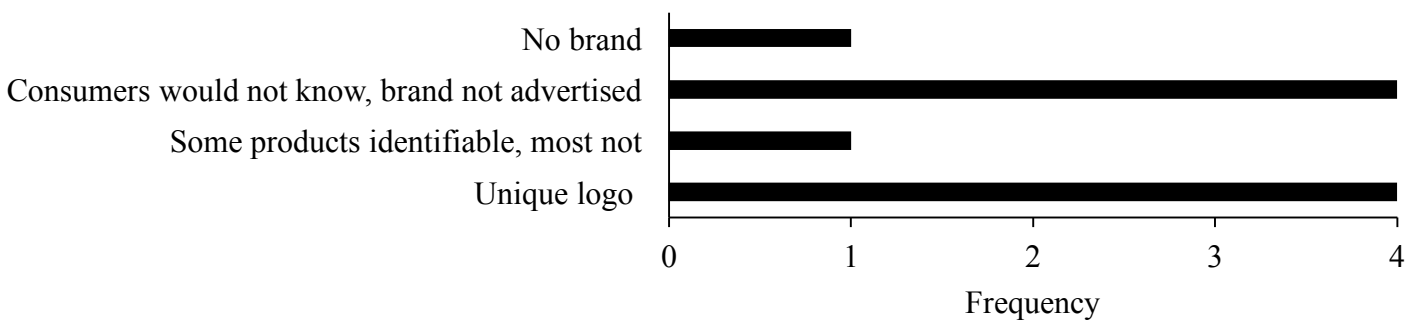
Surveys determined that the majority of farms sold products to markets primarily within Canada and across multiple locations globally (Figure 6). Both Canadian and Nova Scotian markets were important to several farmers, while only one producer stated Nova Scotia as their only primary market. Notably, no producer who sold primarily to global markets also sold to Canadian or Nova Scotian markets.



**Figure 6** Number of survey respondents who sell their farmed products to markets worldwide (n=10)

Half of the farmed products in Nova Scotia are sold to wholesalers (50%), while a large percentage of survey respondents serve on-growing farms (40%). On-growing farms are those that receive juvenile, smolt or adult fish from other farms for rearing to market size. Only one farm stated small retailers, including fish markets as the primary source they sell products to.

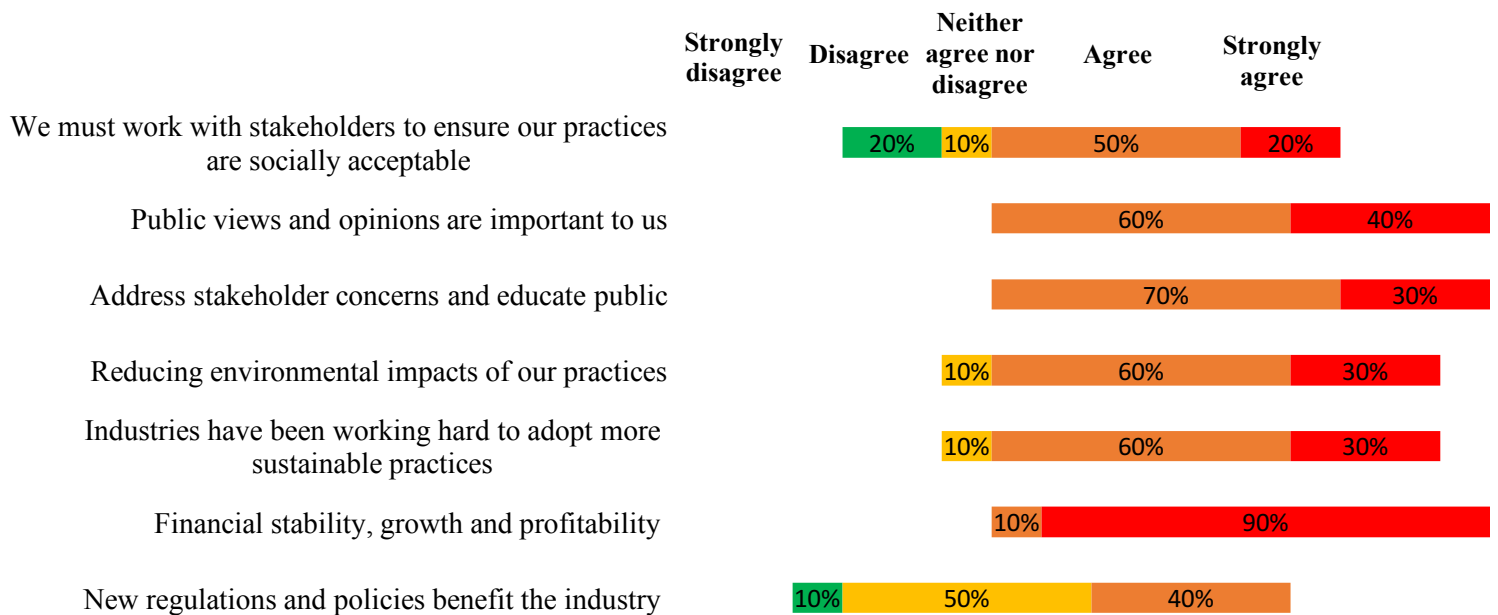
The degree to which farms in Nova Scotia are marketed by their own brand varies substantially between farms (Figure 7). While half of farms stated having some or all products that may be identified by a logo or brand, the other half noted that consumers would not recognize their brand or products because they either have no brand, or their products are not advertised.



**Figure 7** Number of survey respondents with varying degrees of product branding in Nova Scotia (n=10)

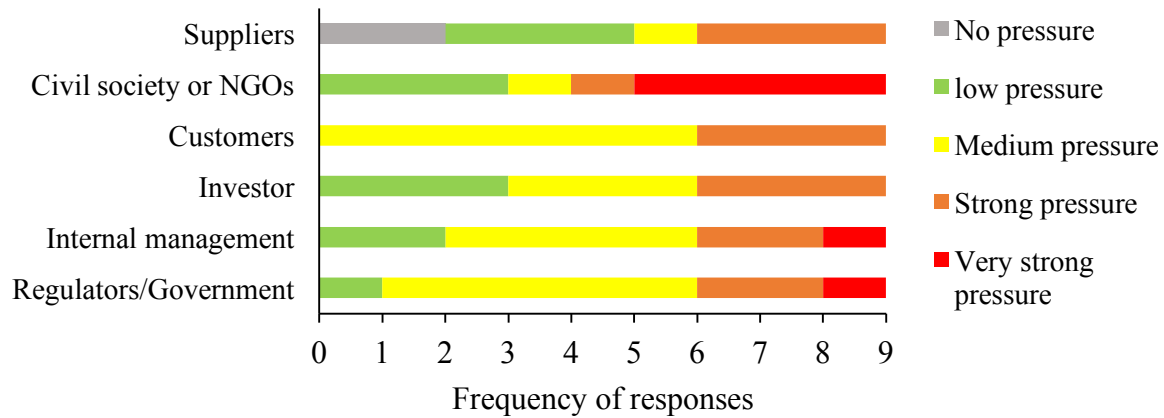
### 2.4.2.2 Corporate social responsibility and external pressures

Producers were asked questions regarding their company policies and priorities (Figure 8). Financial stability, growth and profitability was a high priority identified by all producers. All producers also agreed that addressing stakeholder concerns, listening to stakeholder and public concerns and views are also important priorities. However, only 70% of producers thought that they need to work with stakeholders to ensure social acceptance of their practices. Many producers claim that reducing environmental impacts is a priority and believe that the industry has been working towards improved sustainability. However, fewer believe that the new regulations benefit the industry.



**Figure 8** Percentage of survey respondents who agreed or disagreed with the priorities and responsibilities of finfish aquaculture industry from a corporate social responsibility perspective (n=10)

In general, producers perceived a medium to strong pressure from various groups to adopt sustainable practices (Figure 9). The strongest pressure to adopt sustainable practices came from civil society or NGO groups. Customers and regulators/governments also were primary groups to show high pressures. Conversely, the pressure from suppliers, investors and internal management varied per farm and ranged from low to very strong.

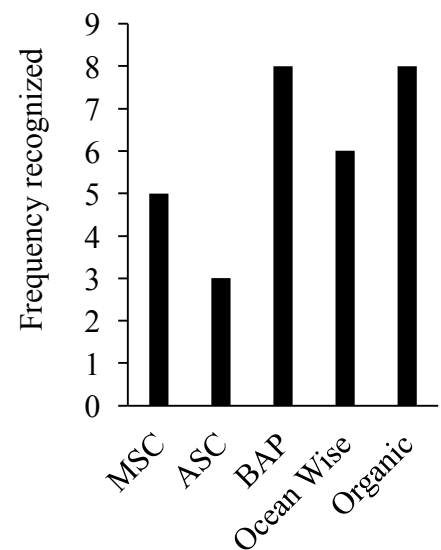


**Figure 9** Survey respondents’ perception of pressure exerted by various stakeholders to adopt more sustainable farming practices (n=9)

#### 2.4.2.3 Understanding of ecolabels and certification schemes

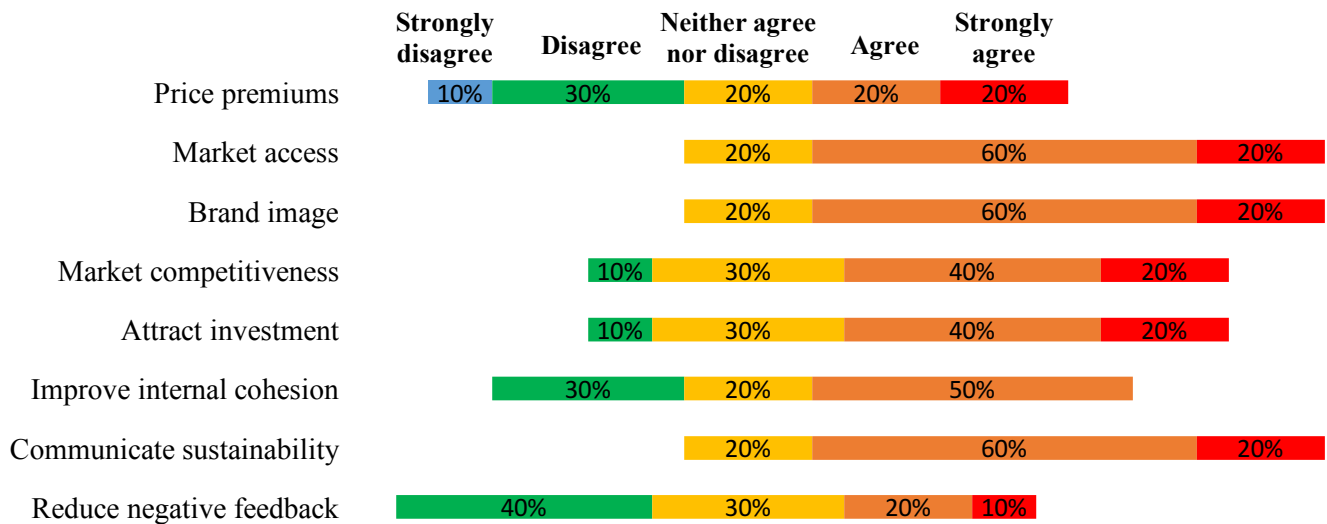
Given the diversity of eco-certifications and labels in the marketplace today, the meanings, interpretations and messages communicated by labels can differ substantially. To provide a sense of what comes to mind when producers think of ecolabels, they were asked to provide three words they would use to describe or would associate with seafood ecolabels. The most popular words associated included terms such as “sustainable” and “safe”. Other terms included “meaningful”, “standardized” and “trustworthy”. Producers also noted the importance of its use as a marketing tool, with descriptors such as “business” or “marketplace incentive”.

Producers were next asked to identify whether they recognized the labels from seafood ecolabelling and certification schemes to provide a sense of their familiarity with the respective schemes. Generally, producers were quite familiar with all ecolabels (Figure 10). Farmers recognized on average three of the labels presented, while some producers could recognize all five ecolabels. Organic and BAP labels were recognized by 80% of producers. While 50% of producers recognized the MSC label, comparatively fewer producers (30%) recognized its aquaculture sister label, ASC. Despite this variance, 70% of producers claimed they would know which labels would be applicable to them.



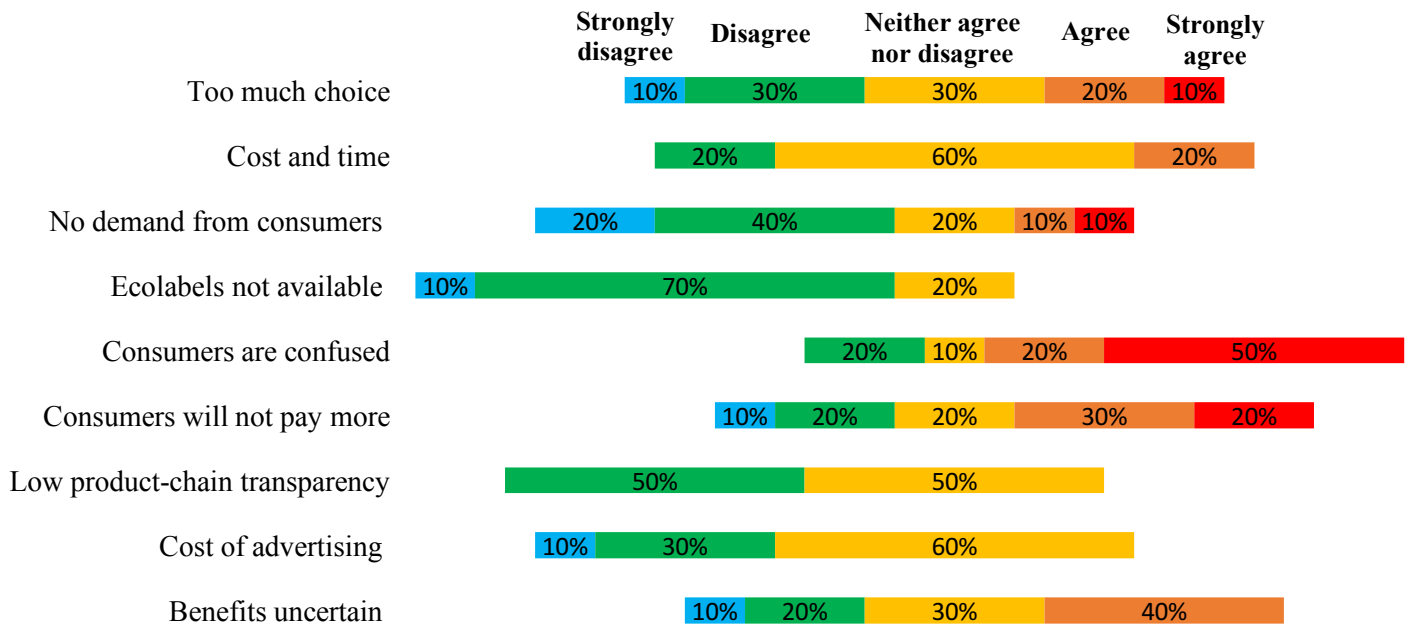
**Figure 10** Number of survey respondents who recognized certification and ecolabel logos (n=10)

Producers were asked questions about their opinions to various benefits of certification schemes. Most (80%) producers agreed that ecolabels could increase market access and had the ability to improve brand image (Figure 11). Other market advantages, such as the ability to attract additional investment and increase market competitiveness were benefits perceived by 60% of farmers. While 80% of respondents agreed that ecolabels can communicate the commitment that industries have to sustainable management, only 30% thought that they could reduce the negative feedback industries receive.



**Figure 11** Percentage of survey respondents who agreed or disagreed with the various benefits offered by ecolabelling schemes (n=10)

Likewise, producers were asked to give their opinions of several challenges to ecolabelling schemes. Opinions were mixed on the various challenges, and many participants felt neutral about many of the challenges (Figure 12). The greatest challenge identified was that consumers and stakeholders are confused by ecolabels and do not know what they mean. Many producers also agreed that consumers would not be willing to pay more for certification schemes.



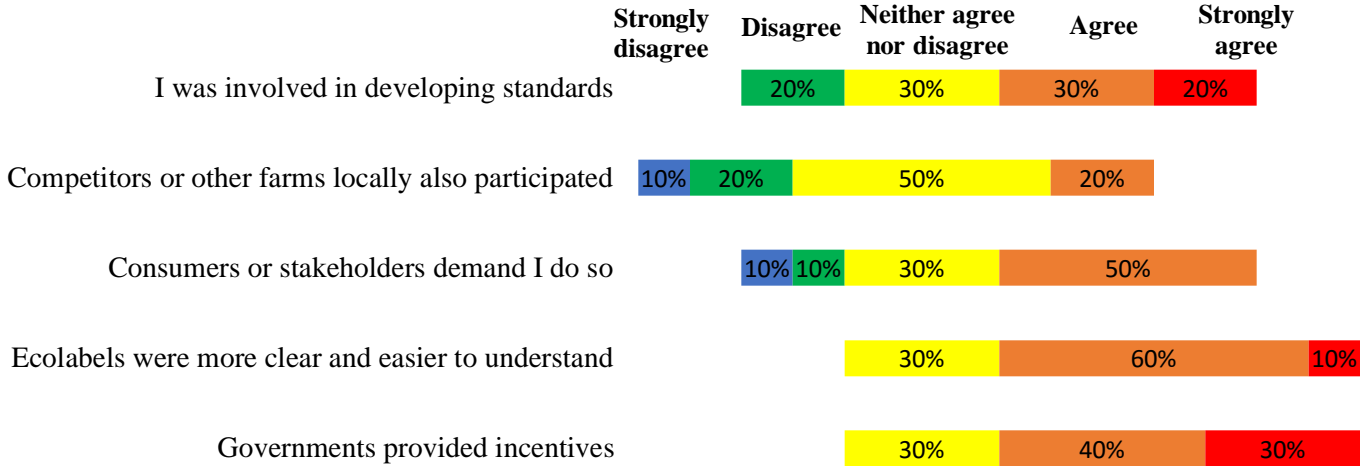
**Figure 12** Percentage of survey respondents who agreed or disagreed with various challenges of ecolabelling schemes (n=10)

#### 2.4.2.4 Intent and willingness to participate

Most respondents were in favour of or supported ecolabelling and eco-certification in aquaculture (80%). More than half of producers are currently involved in ecolabelling (60%), while two other producers are pursuing labelling schemes. All respondents involved with ecolabelling schemes said they still intend to participate on both short term (5 year) and long term (10 year) scales. All three respondents who are not involved noted hesitation of becoming involved in five years (either stating maybe or do not know), but showed a heightened interest in the long term (within 10 years).

Fish farmers were more likely to participate in ecolabelling schemes if governments provided financial or technical incentives, and if ecolabels were more clear and easier to understand (Figure 13). Half of respondents also agreed that they would be more likely to participate if they were involved in developing the standards for certification or if consumers and stakeholders demanded participation. Farmers were least incentivized by whether other farmers or competitors were also participating in ecolabelling schemes.





**Figure 13** Survey respondents’ perceptions of factors that would lead to their increased willingness to participate in ecolabelling schemes (n=10)

### 2.4.3 Q-methodology

Analysis revealed four well defined factors, or *shared perceptions* between stakeholders. Together, the four factors explained 52% of the variance between the 25 Q-sorts. Certain stakeholders share similar perceptions, indicated by the factor loading scores for all participants (Table 3). The loadings of three participants scored similarly between two factors, and were designated as “confounded sorts”. Factor sorts associated with each statement are listed in Appendix iii. The following sections describe the four factors, hence referred to as ‘perspectives’ and the stakeholders associated with them. To describe each perspective, this study interpreted only salient statements (those ranked at extremes (-4, -3, 3, 4) and distinguishing factors (p-values <0.05). The corresponding number of distinguishing Q-statements (Appendix iii) are indicated in brackets in the text that follows below (e.g. (#)).

**Table 3** Overview of factor loadings for each Q-sort ranging from 1 (complete agreement) to -1 (complete disagreement) with the model factor scores for each perspective. Values in bold represent individuals who scored significantly (values of coefficients > 0.44) for that factor

<b>Stakeholder</b>	<b>P1</b>	<b>P2</b>	<b>P3</b>	<b>P4</b>
<i>Perspective 1 (P1)</i>				
Fish Farming Sector	<b>0.72</b>	-0.15	0.13	0.19
Fish Farming Sector	<b>0.62</b>	0.05	0.13	0.42
Fish Farming Sector	<b>0.66</b>	-0.28	0.26	-0.18
ENGO	<b>0.80</b>	0.17	-0.17	0.03
ENGO	<b>0.54</b>	-0.10	-0.31	0.26
Wild capture fisheries	<b>0.63</b>	0.20	0.30	-0.01
Wild capture fisheries	<b>0.48</b>	0.10	0.30	-0.07
<i>Perspective 2 (P2)</i>				
Food Industry	-0.05	<b>0.55</b>	0.07	0.37
ENGO	0.43	<b>0.46</b>	-0.06	0.08
ENGO	0.39	<b>0.48</b>	0.01	0.29
Scientific Sector	-0.06	<b>0.57</b>	0.33	0.32
Scientific Sector	0.15	<b>0.66</b>	0.39	-0.05
Wild capture fisheries	0.05	<b>0.77</b>	-0.16	-0.07
Wild capture fisheries	-0.17	<b>0.67</b>	-0.34	0.01
<i>Perspective 3 (P3)</i>				
Fish Farming Sector	0.22	0.00	<b>0.78</b>	0.02
Fish Farming Sector	0.03	0.09	<b>0.70</b>	0.30
Administration	0.20	0.00	<b>0.58</b>	-0.17
Administration	-0.05	-0.13	<b>0.60</b>	0.36
<i>Perspective 4 (P4)</i>				
Administration	0.10	-0.13	0.05	<b>0.63</b>
Scientific Sector	0.00	0.24	0.10	<b>0.70</b>
Food Industry	0.36	0.06	-0.07	<b>0.60</b>
Food industry	-0.18	0.28	0.34	<b>0.51</b>
<i>Confounded sorts</i>				
Scientific Sector	<b>0.63</b>	<b>0.46</b>	0.15	-0.01
Administration	0.01	<b>0.45</b>	<b>0.46</b>	0.33
Food Industry	0.22	0.27	0.08	-0.08
<b>% explained variance</b>	<b>16%</b>	<b>14%</b>	<b>12%</b>	<b>10%</b>
<b>Total Defining Q-sorts</b>	<b>8</b>	<b>9</b>	<b>5</b>	<b>4</b>
Total Q-sorts	9	10	5	4

#### 2.3.4.1 Perspective 1 – The ‘Optimist’ perspective

Perspective 1 was characterized by the recognition of multiple benefits of certification to a range of stakeholders. This perspective is confident that eco-certifications can lead to improved resource and aquaculture management (48), by increasing the transparency and traceability of aquaculture operations (43). This perspective further recognizes the benefits of ecolabels as a communication tool. Certifications, when clear, can open channels of communication and potential collaboration between stakeholders (37, 33).

Unlike some critics, individuals who share this perspective believe that the environmental standards of ecolabels are strict (46) and that consumers would pay for these products (5). Furthermore, this perception disagrees with the idea that ecolabels set an unwanted precedent for the public to rely on non-governmental groups (21).

This perspective recognizes the importance of the market benefits of ecolabelling schemes to producers, and believes certification is increasingly becoming a pre-requisite for entry into some markets (12). Ecolabels can offer producers significant premiums (25) and greater market access (42) to producers committed to sustainability objectives. This perspective was supported by most finfish farmers, and half of participants from ENGOs and wild capture fishery stakeholders.

#### 2.4.3.2 Perspective 2 – The ‘Skeptic’ perspective

Central to this perspective are the concerns and challenges of ecolabelling. While this perspective recognizes that certifications are becoming increasingly important in a global marketplace (3) and that consumers would pay for sustainable seafood (5), it has an overall low confidence of industry use in Nova Scotia. Current regulations are not environmentally strict, so the uptake would not be easy or straightforward (47). Since this would be difficult and expensive, few producers in Nova Scotia producers could thus meet the standards (41).

Credibility of ecolabelling schemes was the greatest challenge identified by this perspective. The concerns are that not all ecolabels have equal credibility (35). Even if farms are certified, individuals who share this perspective do not believe this means they are sustainable (8), nor do they believe that all species and production systems should be able to become certified (39).

This perspective does not think that certification would address the environmental concerns of aquaculture (19), nor the concerns of local communities (34). This perspective agrees that fish are not healthier in certified farms (38), which are still as environmentally harmful (29). Finally, this perspective does not think that ecolabelling schemes address economic impacts or interactions with adjacent activities such as tourism or fisheries (30).

Diverse stakeholders loaded significantly with the skeptic perspective. Two participants from ENGOs, wild capture fisheries and scientific sector shared these beliefs. This perspective was also shared by one member of the food industry.

#### 2.4.3.3 Perspective 3 – The ‘Pragmatist’ perspective

Generally, this perspective has a positive outlook about ecolabelling schemes, but believes that benefits do not extend past market benefits. This perspective acknowledged that certification has reached a mainstream status (13) and that it will become increasingly important in the global marketplace (12). However, the number of certifications in the marketplace confuses consumers (2). Therefore, certifications only cater to a small demographic of individuals (24). Consequently, this perspective posits that the benefit comes from increased access to markets and retailers who are committed to sourcing sustainable seafood (42). This perspective insists that farms in Nova Scotia can meet certification standards and would be capable of attaining certification (6). However, these schemes should not prioritize certain production systems such as closed containment over other forms (7).

This perspective believes that ecolabelling schemes have the potential to address some of the concerns of local communities (34) and existing economic activities adjacent to farms (30). However, this would not mean that farms would receive less opposition for development (18). In fact, this perception does not think the public and consumers should have more of an active role in aquaculture management (11). Only two members from the administrative stakeholder group and two from the fish farming industry shared the ‘pragmatist’ perspective.

#### 2.4.3.4 Perspective 4 – The ‘Improver’ perspective

This perspective recognizes that ecolabelling schemes could benefit a range of stakeholders, but they need improvement before the benefits can be met. This perspective believes that multiple stakeholders could benefit from ecolabelling schemes (26) in different

ways. First, ecolabels can increase the communication and potential collaboration between stakeholders (33). Ecolabels may further provide producers with new market access (42) and significant price premiums (25). This perspective is optimistic that producers meet standards and criteria required by ecolabelling schemes and are thus capable of participating (6).

However, this perspective acknowledges that certain challenges exist before benefits can be attained. First, the uptake of ecolabels would not be necessarily straightforward and potentially expensive (47). Furthermore, the growing number of ecolabels in the marketplace leads to consumer confusion (2). Therefore, effective ecolabelling requires significant education and marketing efforts (17). Finally, certification should address both environmental and social issues (27). This perspective does not believe that certified farms are less environmentally harmful (29), and that producers who pursue ecolabelling will not necessarily be less subject to opposition from stakeholders (18). In conclusion, this perspective is distinguished by the statement that more research is needed to decide if ecolabels can bring positive benefits to Nova Scotia's aquaculture industry (44).

Two individuals from the food industry loaded significantly with the 'improver' perspective. One individual from the scientific sector and one individual from administration stakeholder group also shared this perspective.

#### 2.4.3.5 Areas of consensus

All four perceptions recognized the importance of certification as only one of many intervention tools to improve the environmental performance and management of aquaculture (10). Additionally, all participants agree that certification would not bring down or impact prices or demand for uncertified seafood in Nova Scotia (36).

#### 2.4.3.6 Stakeholders that share perceptions

Not all members of the same stakeholder group share a common perception (Table 3). Fish farmers were divided between Perspective 1 and Perspective 3. ENGO and wild capture fisheries were equally divided between Perspective 1 and Perspective 2. Participants from the scientific sector mostly shared Perspective 2, while one shared the view of Perspective 4 and one confounded with Perspective 1. The food industry primarily shared Perspective 4, while one

participant shared Perspective 2. Finally, half of the participants from managing authorities shared Perspective 3, while one other shared Perspective 4.

## 2.5 Discussion

This research explored three important factors influencing the potential uptake of ecolabelling schemes within Nova Scotia's aquaculture industry: accessibility, willingness and acceptance/buy-in. Overall, finfish farms in Nova Scotia were both willing and capable of participating in eco-certifications, but stakeholder acceptance was variable. Several challenges were identified, including the role of market drivers, variability and confusion between individual schemes, and the need for improvement and clarification of schemes.

### *2.5.1 Availability of eco-certifications for Nova Scotia's aquaculture industry*

Fish farms in Nova Scotia are well positioned to access and adopt ecolabelling schemes. While only 1% of global aquaculture production include species covered by eco-certification schemes (Jonell et al., 2013), this research found that all production locally could have access to at least one ecolabelling scheme. Atlantic salmon was the most widely covered species by all schemes. Atlantic salmon from marine net-pens contribute to 90% of the total value of Nova Scotia's finfish aquaculture industry (Province of Nova Scotia, 2015). This suggests that eco-certifications are therefore able to gain almost industry-wide adoption.

Ecolabels may provide opportunities for a wider array of finfish species in Nova Scotia. No producer of rainbow trout is currently certified. However, both ASC and BAP standards for salmon also include rainbow trout. This could offer the opportunity for producers farming rainbow trout to take advantage of early market-access given the lack of local competition. Since 68.8% of Nova Scotian producers are licensed to farm rainbow trout (Appendix i), ecolabels could benefit smaller scale farmers wishing to increase their market competitiveness. The broad coverage by ecolabels such as BAP and Organic also suggest potential for smaller-scale producers of species such as Atlantic halibut, Arctic char and striped bass.

Results show that while ecolabels are accessible to a high proportion of Nova Scotia's finfish industry, accessibility is variable between schemes. The Global Aquaculture Alliance's Best Aquaculture Practices (BAP) and the Canadian Organic Aquaculture Standard ("Organic") both have broad applicability; standards include all species of finfish and production systems.

While BAP's "Finfish and Crustacean Farms" standard takes a holistic approach regarding species and systems, BAP subsequently developed a set of individual standards for salmon farms, finfish hatcheries, feed mills, and processing plants (Global Aquaculture Alliance, 2016). Comparatively, the Organic standard is a single encompassing set of conditions that apply equally to various species of finfish, shellfish and aquatic plants grown using a multitude of production systems. A single all-encompassing standard requires standards to be broad and robust enough to ensure effective application to a range of species and systems.

Comparatively, producers wishing to have products certified through ASC or become recognized by Ocean Wise are limited regarding species and production systems. For example, ASC's standard only certifies Atlantic salmon and rainbow trout. Since ASC has not developed standards that include other commercially farmed species such as Atlantic halibut and Arctic char, producers of those species could not become ASC certified. Similarly, Ocean Wise recognizes only three species of finfish farmed in Nova Scotia: land-raised Atlantic salmon, Atlantic halibut and Arctic char. Finally, neither ASC nor Ocean Wise would be available for the few producers farming brook trout or striped bass. Finfish other than salmon and trout contributed to only 0.8% of Nova Scotia's production value in 2013 (Manning & Hubley, 2015), and only make up 7.5% of total aquaculture sites in the province (Appendix i). Nevertheless, industry members and academics are actively researching methods to grow striped bass, with the goal of making striped bass a viable production system in Nova Scotia (Rogers, 2015).

Of the four producers currently involved in ecolabelling schemes in Nova Scotia, three are involved with the Ocean Wise label. Despite its status as the most widely adopted scheme in Nova Scotia, it also has the most restrictive industry applicability. Since Ocean Wise acts primarily as a recommendation scheme, producers wishing to become partners and use their logo must have species and production systems recommended 'green' by Sea Choice. Currently, Atlantic salmon farmed in net pens in Atlantic Canada is red-listed on Seafood Watch's foods to 'avoid' (Voorhees, 2016), and so farmers in Nova Scotia could not certify their farms regardless of regulations, practices and industry standards.

### *2.5.2 Perceptions and factors influencing industry uptake of ecolabels*

There is a clear interest for ecolabelling and certification within Nova Scotia's finfish aquaculture industry. Cooke Aquaculture is currently trying to attain ASC certification and have

certified all their Nova Scotia products to 4-star BAP standards, meaning all their fish farms, hatcheries, feed mills and processing plants are BAP certified. Canaqua Seafoods Limited is currently an Ocean Wise partner and has attained an 85% transition towards Organic certification. This survey also identified two producers actively pursuing ecolabelling schemes.

These trends show not only a positive interest in ecolabelling, but a more general commitment to continuous improvement. Reducing environmental impacts, addressing concerns and listening to public and stakeholders were all regarded as important priorities for industries. However, many producers surveyed in this study think industries have been working hard in the last five years to adopt more sustainable practices (Figure 8). These efforts reflect a general positive outlook about Nova Scotia's finfish industry by producers. During an interview, one representative of the aquaculture industry emphasized that "Nova Scotia has a great story to tell". This reflects their belief that the industry is progressing in a way that sets the stage for easy access and ability to certification. This sentiment is also supported by the 'pragmatist' perspective from Q-methodology, shared not only by fish farmers but also managing authorities.

These findings suggest that most finfish producers in Nova Scotia support and trust ecolabelling in aquaculture. The alignment of fish farmers with either 'optimist' or 'pragmatist' perspective shows their overall positive outlook. In addition, producers described their perception of ecolabels with words such as 'safe', 'sustainable' and 'trustworthy'.

Since industries support eco-certification and are both willing to improve practices and address stakeholder concerns, industry uptake of ecolabels will thus be influenced by producers' understanding of ecolabelling benefits. Results from both surveys and the Q-study found that economic factors were the most prominent benefit identified by producers. Ecolabels can incentivize industries by providing market benefits such as price premiums, market access, and market differentiation (Ward & Phillips, 2008). While producers recognized all the above-mentioned benefits, the greatest market benefit identified by producers in Nova Scotia was the potential for access to new or different markets. This is consistent with global market trends and increasing retailer commitments to sourcing sustainable seafood (Bush et al., 2013). Ecolabelling can also offer indirect market benefits such as increased attractiveness for investment and improvement of internal cohesion of the sector and farm management (Ward & Phillips, 2008). However, fewer producers identified these benefits as important. Therefore, the industry uptake may depend on whether there is evidence that ecolabels can provide direct market benefits.



At the same time, market drivers and characteristics may pose significant challenges to the ability of ecolabels to offer market benefits to industry. Global seafood markets are often volatile due to combinations of price uncertainties and production variabilities (Dahl & Oglend, 2014). This could be especially applicable to ecolabelling, since market factors such as demand, market competition, marketability, and consumer willingness to pay can have a large influence on price premiums, market access and differentiation. The inundation of farmed Atlantic salmon in the global market has lowered market prices for salmon, making it challenging for competing brands and suppliers, including wild capture fisheries for salmon (Knapp, 2007). While the selling of fish has traditionally been without labels or packaging, branding has become an important part of diversification for seafood companies (Young and Matthews, 2010). However, half of the producers surveyed said their products are either not branded or would not be associated with their company. If ecolabels are to communicate about a farm's practices and sustainability, it is imperative that individuals know the company is certified. Therefore, market characteristics pose challenges to fully assessing the market benefits to individual farms, or to extrapolate to the entire aquaculture industry in Nova Scotia.

The market for ecolabels will also influence producers' choice of scheme to pursue. Over 90% of exports of whole Atlantic salmon are to the United States due to low transportation costs and market proximity (FAO, 2011). However, ASC-certified companies only presently export to Europe and Japan. Therefore, producers wishing to pursue ASC certification must have markets in Europe and elsewhere internationally. On the other hand, BAP-certified companies sell to 34 producers in the United States and Canada (Potts et al., 2016). However, this may limit their potential long-term growth, especially if the exporting markets have no consumer demand for ecolabels. Suppliers of Ocean Wise are restaurants and retailers/markets within Canada and the United States (Vancouver Aquarium, 2016). These considerations could be important given that results from this survey indicate a clear divide between producers who sell to only international markets and those who sell products within Canada exclusively.

Many producers agreed that there is demand from consumers for sustainably labelled products. The perceptions of consumer demand by a range of stakeholders agree with the mounting evidence of global consumer demand for sustainable seafood (Potts et al., 2016). Consumer demand for ecolabelled seafood is important to receive premiums and improve the financial viability of adopting certification.

However, one of the main challenges identified by producers and by those who share the ‘pragmatist’ perspective was that consumers may not pay for certified seafood. This supports the growing evidence of mixed results on consumer willingness to pay for ecolabels (Washington, 2008; Potts et al., 2016). These studies argue that factors such as freshness, quality and price are still the dominant forces impacting consumer choice for ecolabelled products. On the contrary, the other half of producers are ‘optimists’ and strongly believe that consumers are willing to pay for ecolabelled products. The experiences of already-certified producers may explain these differences in opinion. During an interview, an already-certified producer explained how they are currently unable to produce enough fish to meet the growing demand. This producer continued to clarify that while ecolabels may only cater to a small demographic of individuals willing to pay, that demographic is large enough to fulfill production capacities. A market assessment by Rommens and Desbarats (2011) found that there is a market, a demand, and a willingness of target consumers to pay for organically labeled farmed fish in Nova Scotia. These findings suggest a possible conflict of perception. Regardless, this discrepancy emphasizes the need for clear marketing and branding of products, and targeting to markets with known demand.

The perceptions of producers support that hypothesis that consumers are not necessarily the main drivers of uptake by producers in Nova Scotia. While 80% of surveyed farmers are either involved, or are interested in ecolabelling, only half of those producers have a brand or label that consumers could identify. Without labeled packaging or marketing, final consumers would not know whether the product adheres to a labelling or certification scheme. Furthermore, price premiums have not been empirically shown to accrue (Washington, 2008), causing mixed opinions of producers regarding the benefit of price premiums from ecolabels. This suggests that producers may be incentivized to adopt ecolabelling schemes despite final consumer benefits.

Industries may invest in ecolabelling due to a sense of corporate social responsibility. Ecolabels could help producers maintain brand image and communicate to stakeholders the sustainability of their practices (Gulbrandsen, 2006). Given that all producers identified addressing stakeholder concerns and public opinions as important, the majority of producers (80%) also identified important benefits being maintaining brand image and communication. Producers feel that a variety of stakeholders, including civil society, NGOs, governments, and consumers exert a strong pressure on them to adopt more sustainable practices (Figure 8). Gulbrandsen (2006) argues that the spread of certifications can often be driven by pressures from

advocacy groups. This is supported by half of producers in Nova Scotia who said they would be more willing to participate in ecolabelling schemes if stakeholders demanded they do so. These results suggest that whether ecolabels can communicate information about sustainability may be an important factor influencing industry uptake.

Producers have a good understanding and recognition of ecolabel schemes available to them. While recognition varied with different schemes, 70% of producers still said they would know which ecolabels are available to them. Results indicate that many producers are unaware of ASC as an option for their production. Remarkably, more producers recognized the Marine Stewardship Council (MSC) ecolabel compared to its aquaculture-sister label, Aquaculture Stewardship Council (ASC). This supports that MSC is the most globally-recognized ecolabel for seafood (Phillips et al., 2003), and reinforces its prominence in the global seafood sector.

Despite a high overall recognition of ecolabelling schemes, producers identified confusion, both by consumers and by industries and a wider range of stakeholders as a major challenge. These results support evidence that consumers are confused by ecolabels (Schmitt, 2010) and that industries perceive this confusion as a prominent concern (Roheim, 2009). The proliferation of different, detailed, and technical standards may limit widespread consumer recognition of individual labels (Ward & Phillips 2008). This is important not only regarding consumer demand, but can also influence uptake by producers. Fish farmers have the challenge of trying to navigate a sea of similar, but competitive labels (Washington et al., 2011). Many producers agreed that they would be more willing to participate in ecolabelling if the programs were clearer and easier to understand. Despite detailed requirements for record-keeping and monitoring by many schemes, few provide technical assistance to producers to transition to meet standards (Potts et al., 2016).

### *2.5.3 Acceptance/buy-in of ecolabels by key stakeholders*

The emergence of four distinct perspectives (the ‘optimist’ perspective, the ‘skeptical’ perspective, the ‘pragmatist’ perspective and the ‘improver’ perspective) illustrates stakeholders have multiple attitudes and beliefs towards ecolabels. A higher proportion of stakeholders shared either the ‘optimist’ or the ‘skeptical’ perspective (Table 3). ‘Optimists’ perceived multiple benefits and opportunities for certifications, whereas ‘skeptical’ emphasized concerns over the potential industry uptake in Nova Scotia, the credibility between schemes, and the ability of

ecolabels to address stakeholder concerns. Interestingly, not all respondents from a given stakeholder group shared the same perception. This suggests that the potential acceptance to ecolabels is not equally shared among groups. This variability further indicates lack of consensus about ecolabelling and introduces a potential challenge for acceptance by stakeholders.

All perspective except the ‘skeptic’ perspective recognized that ecolabels could bring multiple benefits and opportunities for various stakeholders within Nova Scotia’s aquaculture industry. Overall, most participants agree with recent evidence that argues that ecolabelling and certification will become more important in the global marketplace (Potts et al., 2016). Therefore, most participants shared the view that labelling could provide benefits to producers as market access, differentiation and premiums (Ward & Phillips, 2008). This indicates that many stakeholders in Nova Scotia identify ecolabels primarily as a market-tool. Communicability was also a major benefit identified in half of the perspectives. Not only do many stakeholders believe that ecolabels can communicate messages about sustainability, but they also believe ecolabelling can open doors for communication and collaboration between stakeholders. As one interviewee explained, “ecolabels can be like the translator between groups with different priorities and values, creating a common vision and goal”.

However, most participants believed that not all ecolabels have equal credibility. Credibility was an important issue for stakeholders who share the ‘skeptic perspective’. This emphasizes the need for further research into how stakeholders perceive different ecolabelling schemes. Getting a better understanding of which schemes stakeholder deem as more credible, rigorous and trustworthy can help producers make decisions about which ecolabel to pursue.

Confusion about ecolabels was also a prominent challenge identified by a range of stakeholders. The proliferation of ecolabels is often largely to blame for a large portion of the confusion experienced by a range of stakeholders including fish farmers, retailers, governments and consumers (Washington et al., 2010; Washington & Ababouch, 2011). The need for better education, marketing and research about ecolabels was strongly supported as an important means for improvement. Confusion may undermine the confidence in the standards overall (Washington et al., 2011). This could impact the overall effectiveness of ecolabelling and certification schemes, and negatively impact buy-in from stakeholders and consumer demand. ‘Skeptic’ and ‘improver’ perspectives also identified that costs and complexity would make the uptake by producers difficult, thus challenging the certifiability of fish farms. However, industry

participants from surveys and Q-methodology do not share those perceptions. This suggests that while cost is an important consideration for uptake, the importance of this factor is likely a perceived issue, rather than a realized one.

The ‘optimist’ and ‘skeptic’ perspectives contained the most opposing views, indicating a strong disagreement over whether ecolabels could improve the sustainability and social acceptance of finfish aquaculture in Nova Scotia. While optimists held by stakeholder believe that ecolabels have the potential to improve the sustainability of aquaculture and address stakeholder concerns, the skeptic perspective challenged this belief. Optimists argue that through improved transparency and strict environmental regulations, ecolabels can produce significant benefits to sustainable resource management. However, even ‘pragmatists’ and ‘improvers’, who believe ecolabels could address stakeholder concerns and offer multiple benefits, do not think this will reduce opposition by certain groups. Indeed, this supports findings from conversations with stakeholders who identify a strong presence of a ‘not in my backyard’ (‘NIMBY’) attitude among certain individuals. This strongly held perception may suggest poor acceptance towards using ecolabels as a management tool to improve social acceptance.

This research has found that no stakeholder group was completely represented by a single perspective. Interestingly, members of a stakeholder group can be equally divided into multiple perspectives, often with conflicting views and perceptions. For example, both ENGO and wild capture fisheries were divided between optimists and skeptics. However, these divisions are not necessarily surprising. Since NGO groups are often responsible for the creation, promotion and proliferation of ecolabelling schemes, it is not surprising that many of these respondents were optimists. Those individuals who held the opposing skeptical perspective emphasizes the influence of controversy within Nova Scotia. Strong advocacy groups may have prominent concerns that may not be addressed by labelling. Similarly, wild capture fisheries were equally divided between competing perspectives. Wild capture fisheries could both support and oppose ecolabelling for two distinct reasons: experiences of the benefits of certification with their own industry and the interaction of aquaculture with wild capture fisheries. For example, one representative from the lobster industry explained his skepticism about the ability of ecolabels to change practices was due to the ease and rapid proliferation of MSC certification in the lobster industry. This variable distribution across the two, very distinct ‘optimist’ and ‘skeptic’ perspectives is representative of the array of views about both aquaculture and ecolabelling. In

addition, both the ‘pragmatist’ and ‘improver’ perspectives provide more balanced views on ecolabels, both of which recognize benefits and challenges.

These results suggest that stakeholders have a range of perspectives on the role of ecolabelling within Nova Scotia’s finfish aquaculture industry. There is overall high stakeholder support for market benefits. While many stakeholders advocate the benefits of ecolabelling as a communication tool and to improve sustainability of farming practices, many challenges facing ecolabels were identified. The main challenges identified were confusion from stakeholders and consumers, and the variability in credibility between schemes. Variability in how stakeholders perceive the ability of ecolabels to improve environmental sustainability and address stakeholder concerns suggests not all individuals will have equal buy-in.

#### *2.5.4 Challenges and limitations*

When considering the potential limitations of perception study methodologies such as surveys and Q-methodology, it is important to consider that perceptions can be missed if key stakeholders do not participate. The low response rate from producers for the industry survey (n=10) limited the statistical power of these findings and restricted the ability to test hypotheses regarding factors producers may or may not pursue ecolabelling. Furthermore, since 60% of participants were already involved in ecolabelling, there is potential for response bias towards producers willing to participate in the survey. While representatives from coastal communities are important stakeholders within coastal management and have an important voice for social acceptance of the industry, none responded to requests for study participants. This may suggest a lack of interest or may simply infer a time constraint of the current research.

It should also be emphasized that Q-methodology exposes the perceptions most common and shared between stakeholders. Since results only accounted for 52% of variance in Q-sorts, a significant amount of residual variations between individuals remain. While the concourse of statements aimed to provide a balanced and holistic focus on various perceptions of ecolabelling, the diverse expertise of participants meant that some participants felt they could not accurately express their opinions about many of the statements. Consequently, decision-makers should recognize that perceptions are not black and white, and acknowledge the differences in perceptions among groups and individuals.

Many other factors may influence the industry uptake of ecolabelling. For example, cost of certification was identified by industries as a significant challenge. Therefore, a more thorough cost/benefit analysis should be pursued to further explore whether a wider proportion of the industry is certifiable. Ultimately, the uptake of ecolabels will depend on the ability of farms to meet standards. A recent report by consultants Gardiner-Pinfold found that Nova Scotia practices and regulations would only be able to meet 68% of ASC standards (Gunn, 2016). Nevertheless, this was substantially higher than other Atlantic provinces.

Furthermore, the accessibility of farms to ecolabelling schemes was analyzed from the listing of species that companies are licensed to farm. It should be recognized that salmon farms undergo 3 to 4-year production cycles, and so not all species licensed for production are necessarily being farmed. Nevertheless, species included in license conditions indicate the potential of those companies in the foreseeable future to access ecolabelling schemes.

#### *2.5.5 Conclusions*

This study argues that uptake of ecolabels is not just about the consumer and depends on a wider set of decisions from industry about corporate social responsibility and buy-in from stakeholders. Identifying and exploring factors that may influence industry uptake and stakeholder buy-in can be used to help industry and resource managers make decisions about whether to pursue ecolabelling. Relatively high capability and willingness of producers indicates a growing and important place for ecolabels in the global marketplace. Results of this study have found that overall, producers perceive multiple benefits from ecolabels, and are thus incentivized to adopt schemes. However, factors that influence producers' decisions include whether there is evidence that ecolabelling can offer market benefits and whether they can effectively communicate to stakeholders. This research also identified that variations between schemes and the extent to which they are accessible to different species and production systems could impact the relative uptake of producers.

This study revealed four prominent stakeholder perspectives on aquaculture ecolabels. The 'optimist' perspective regards ecolabelling as an effective tool for meeting many means, including economic benefits, improved sustainability and better communication. Conversely, the 'skeptic' perspective emphasizes many concerns over the credibility and confusion about ecolabels and does not view ecolabels as a way to reduce social concerns. The 'pragmatist'

perspective focuses mainly on economic aspects. The ‘improver’ perspective provides a more balanced view, recognizing the multiple benefits of ecolabels while expressing the need for research and clarification. These variable and sometimes conflicting stakeholder perceptions indicates the inconsistencies for potential buy-in. Finally, the confusion identified as important by both producers and stakeholders, suggests that education and outreach about ecolabels will be needed to improve the uptake of ecolabelling by both producers and stakeholders.

## **Chapter 3: Exploring how ecolabels can address stakeholder concerns**

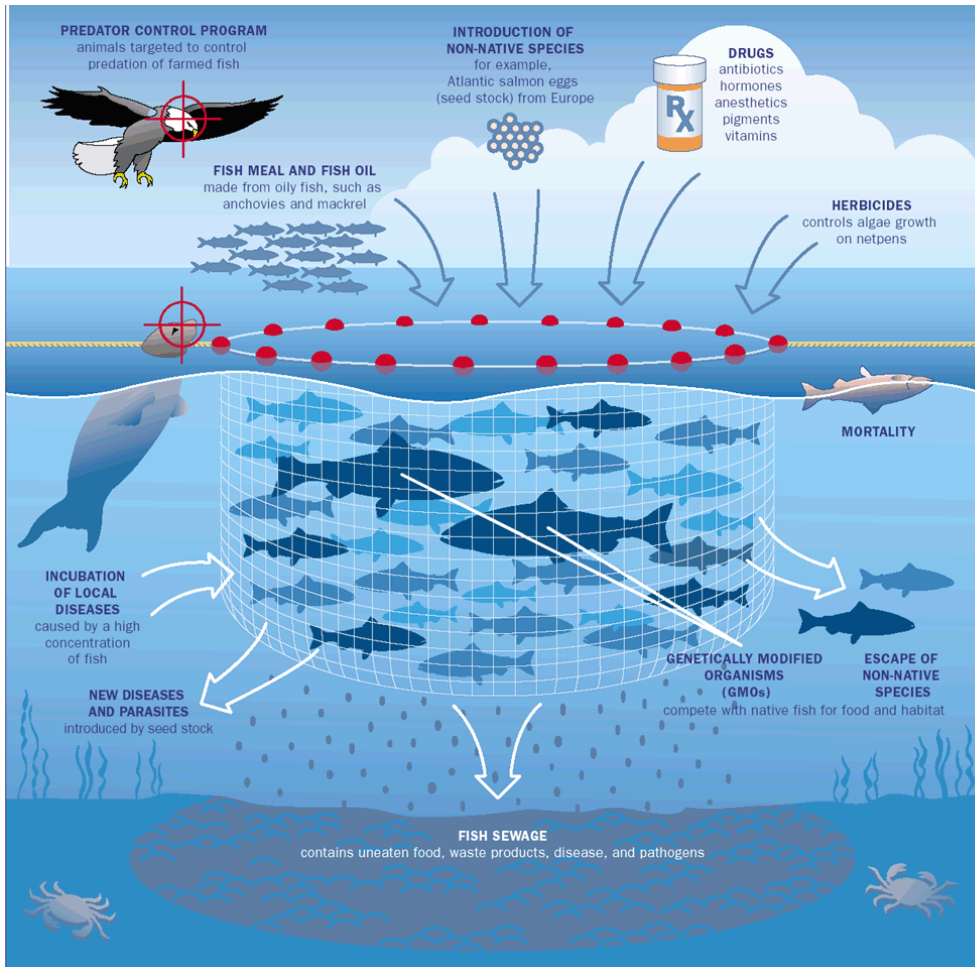
### *3.1 Background context*

#### *3.1.1 Concerns about aquaculture*

Aquaculture in the Atlantic Provinces is growing in scale and value, but its success has been overshadowed by concerns across various environmental, social and economic dimensions. While proponents highlight aquaculture’s opportunity to bring untapped economic benefits, jobs and development to rural communities, public trust and support has been an enduring problem and has engulfed the industry in controversy. The impacts of aquaculture are wide-ranging, and centre on negative environmental and socio-economic impacts of finfish aquaculture, with particular focus on certain species such as Atlantic salmon raised in open-ocean cages.

Since farming of most fish species occurs in the open waters, aquaculture operations can impact the surrounding environment in multiple ways (Figure 14). For example, fish feces and uneaten food particles deposited below net cages could alter the sediment composition and influence benthic habitats (Giles, 2008). These impacts have stirred concerns about the risk of aquaculture to not only habitats, but entire marine and coastal ecosystems. For example, Naylor et al. (2000) argue that the need for wild fish to produce oils and proteins for aquaculture feed overshadows aquaculture’s claims to reducing pressure on wild stocks. The risk of escapes from fish cages may also threaten wild populations due the potential for transfer of disease and parasites and genetic mixing with native species (Naylor et al., 2005). These concerns raised questions as to aquaculture’s sustainability (Read & Fernandes, 2003), which have been communicated beyond the scientific community into media and public outlets (Bacher, 2015; Bocking, 2012).





**Figure 14** Representation of several environmental risks of marine finfish aquaculture (Art by John Michael Yanson)

Increased tension between coastal users and perceived risks to livelihoods and cultures is embodied by several socio-economic concerns. Most fish farms are located in coastal waters, where communities are increasingly pressured by existing impacts and conflicting activities (Masser & Bridger, 2007). Complex user-conflicts add tension to a limited coastal space. In Nova Scotia, lobster fisheries and tourism industries are concerned over ecosystem effects and visual impacts of existing marine aquaculture sites (Doelle & Lahey, 2014).

Social concerns also include public health concerns and animal welfare issues. While fish products are advertised for their healthy lipid contents and omega-3 fatty acids, a controversial study by Hites et al. (2004) heightened health concerns of farmed salmon due to the use of pesticides, chemicals and additives. This has led many in the public to believe that wild fish are healthier than farmed fish. The use of antibiotics and chemicals to treat disease is often a product of high stocking densities of cages, and this has resulted in welfare concerns. Other welfare concerns emerged from mortality events associated with cold weather and disease outbreaks.

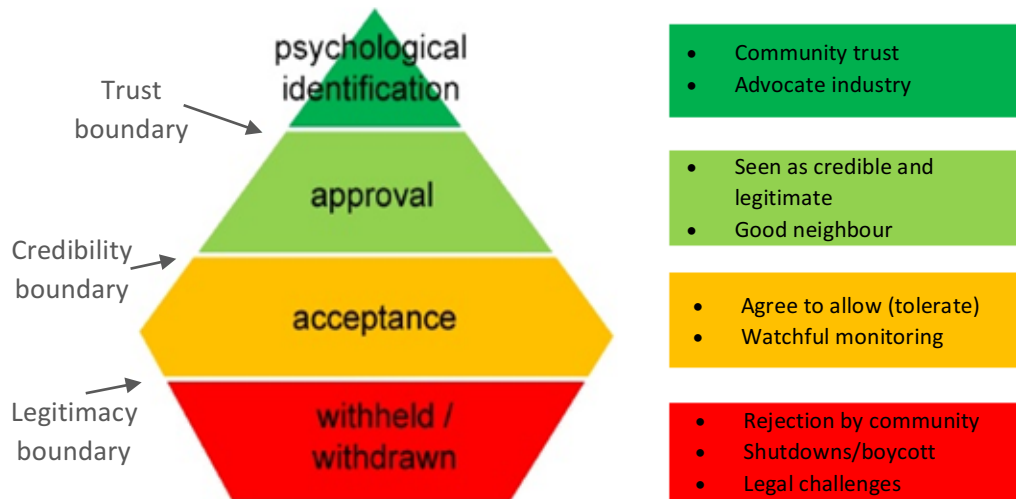
### *3.1.2 Dimensions and complications of the aquaculture controversy*

Aquaculture's challenges to development are often complicated by a myriad of actors, mixed priorities and contributing social and economic factors (Young & Matthews, 2010). At the same time as public concerns over food security and traceability increase, the public is increasingly bombarded with conflicting scientific evidence of aquaculture risks, leading to a prominence of misinformation and misrepresentation (Bacher, 2015). A history of poor governance and lack of transparency have led to mistrust of the industry and the government that supports and regulates it. Finally, the media exposes the public to a range of stories that can emphasize risks in response to major 'trigger events' (Amberg & Hall, 2008) such as disease outbreaks, superchill events or escapes. These forces may together act to perpetuate the negative perceptions and mistrust between supporters and opposition of aquaculture development throughout Canada and Nova Scotia.

### *3.1.3 Social acceptance*

Negative perceptions, environmental concerns and criticism over aquaculture's initiatives, communication and practices all hinder industry's public image and can pose challenges to sustainable development. Canadian mining executive Jim Cooney first coined the term 'social licence to operate' (SLO) in 1997 to describe the growing controversy on the impacts in the mining industry (Prno, 2013). An industry's SLO, otherwise known as social acceptability, can be defined as the degree to which an industry's activities, in this case aquaculture, are accepted by communities and stakeholders. Social acceptance is embodied within the industry principle of corporate social responsibility (CSR), whereby companies take additional responsibility to address environmental, economic and social concerns (Heikurrien & Ketola, 2012). Theoretically, companies can retain their reputation and gain financial rewards from considering the social needs of their consumers (Gunningham et al., 2004).

Social acceptability is an outcome, but is rooted in the beliefs, perceptions and opinions held by communities and stakeholders (Thomson & Boutillier, 2011). Measuring SLO is thus specific to the location and scale of the proposed activity or industry (Quigley & Baines, 2014). Nonetheless, attaining a social license can be seen as a hierarchical process (Figure 15). When social license is withheld, it can lead to boycotts, and legal challenges. Therefore, social licencing has become essential for sustainable resource management (Brunson, 1996), and is necessary for the aquaculture industry to prosper (Hishamunda et al., 2014).



**Figure 15** Model of Social License to Operate (Adapted from Thomson & Boutilier, 2011)

### 3.2 Research objectives and hypotheses

This section addresses the second research question: could ecolabels be an effective tool at addressing stakeholder concerns within Nova Scotia’s aquaculture industry? Specifically, this study asked the sub-questions:

- i) What are the current and prominent concerns across public and stakeholder groups in Nova Scotia?
- ii) How do ecolabelling and certification schemes address identified stakeholder concerns across various dimensions of sustainability?

### 3.3 Methodology

#### 3.3.1 Determining stakeholder concerns – Literature and Media analyses

To determine whether ecolabels address stakeholder concerns, a content analysis of literature and media sources were used to reveal the dimensions and topics of concern raised by a range of stakeholders in Nova Scotia. Exploring how aquaculture is portrayed in the media can provide an indication as to the present-day discourse surrounding finfish aquaculture. Media are powerful sources for providing a narrative about controversial issues, and have been an important vector for the communication of dissemination of viewpoints within the aquaculture controversy (Young & Matthews, 2010). The messages portrayed in the media can help shape how stakeholders’ perceptions are formed around a given topic and what issues are likely to cause conflict and influence social acceptability. Following the general procedures outlined in

Gould (2004) an article analysis and spokesperson analysis were conducted for newspapers and broadcasts within the last 1.5 years.

The analysis of media coverage of finfish aquaculture in Nova Scotia was based on the reading and coding of articles and broadcasts featured in 20 Canadian newspapers between January 1, 2015 and June 1, 2016. Sources of articles for analysis included the top two nationally distributed papers, three daily newspapers, six local papers, four broadcast outlets, two wire services, two top read magazines, and one internet source (Appendix v). Highest circulation national and daily newspapers were obtained from Cision Canada Inc's list of Canada's top 20 daily newspapers. Two magazines were identified through Masteed's Top 50 magazines report in 2011 (Hayward, 2012). Channel Canada's 2015 website was used to identify the four broadcast outlets. Wire services and internet sources were identified through google searches.

Online archives of sources were searched for the terms "aquaculture", "salmon aquaculture", "finfish aquaculture", "net-pen", "fish farm", and "fish farming". Articles were selected based on relevance; to be included, only articles prominently featuring aquaculture in general or speaking to finfish aquaculture were included. Therefore, articles about shellfish or algae farming were not included.

Articles were read closely and organized by story type, timing, placement and theme. Story types included opinion (editorial, column), news (latest events), or features (ex. profiles, lighter stories). The timing of release can provide important context since some news events are more prominent following a major event that sparks additional stories. Since editors make informed decisions as to where articles are placed within the paper (Gould, 2004) the section of paper in which the article was released (National News, Regional News, Business, Environment etc...) was recorded. To provide an indication of the major stakeholder concerns, articles were also scanned to identify themes. Themes provide an indication of the range of issues being expressed and to what degree they are discussed.

To tease out whose voices are being represented through the media, a stakeholder analysis was conducted alongside the article analysis. As articles were read, the number and type of stakeholder being directly quoted was recorded. As per Gould (2004), stakeholders were divided into five broad categories including: government officials, advocates, business leaders, public groups and academics. Categories were further broken down. Government officials included municipal, provincial and national levels. Advocates included environmental NGOs and

community interest groups. Business leaders included industry representatives as well as members in other fields (technology production, retailers, etc...). The ‘academics’ group was expanded to include researchers and experts (ex. in law, i.e. Judges).

In addition to media sources, a broader range of public documents were analyzed. Literature sources analyzed included publically accessible primary and secondary research articles, government and private industry reports, ENGO webpages and petitions documents. Given the extent of conflict within Nova Scotia, documents analyzed included those published within the last 15 years (2001-2016). A content analysis of documents identified topics or themes relating to various environmental, social and economic concerns.

### 3.3.2 *Ecolabel sustainability analysis*

To determine whether ecolabels address stakeholder concerns, the degree to which ecolabelling standards meet various pre-established sustainability criteria across social, economic, environmental and management dimensions was analyzed for four ecolabelling schemes (ASC, BAP, Ocean Wise and Canadian Organic). The degree to which each ecolabel meets each criterion was judged by a numeric score ranging from 0 to 1 (Table 4). Where species-specific standards exist, the standards for ocean-raised Atlantic salmon were used given salmon’s economic importance and controversial impact in Nova Scotia.

**Table 4** Explanation of criteria used to assign numerical scoring to indicators of sustainability

<b>Score (numerical)</b>	<b>Criteria</b>
0	The indicator was not identified, present or recognized in any direct or focused means
0.25	The indicator was present, but the standard only required legal or data recording compliance
0.5	The indicator was present, but emphasis was weak. Indicator may be mentioned as part of a larger section with no particular emphasis. Evaluation was limited and lacked specificity
0.75	The indicator was present and evaluated over one or several areas. Record-keeping requirements were often outlined
1	The indicator was present and evaluated over multiple areas. Principles of certification may encompass indicators. Thresholds and record-keeping requirements provided (but not necessary)

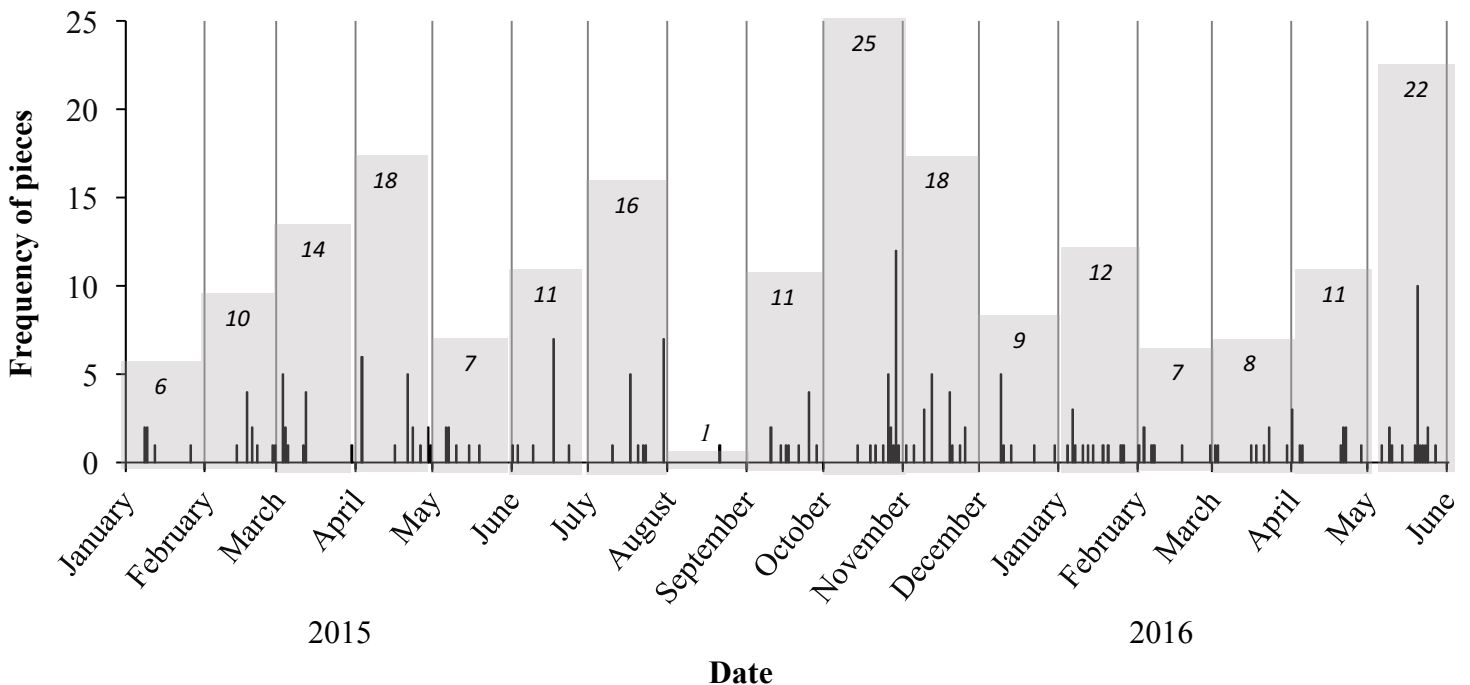
### 3.4 Results

#### 3.4.1. Determining stakeholder concerns

##### 3.4.1.1 Media's portrayal of aquaculture

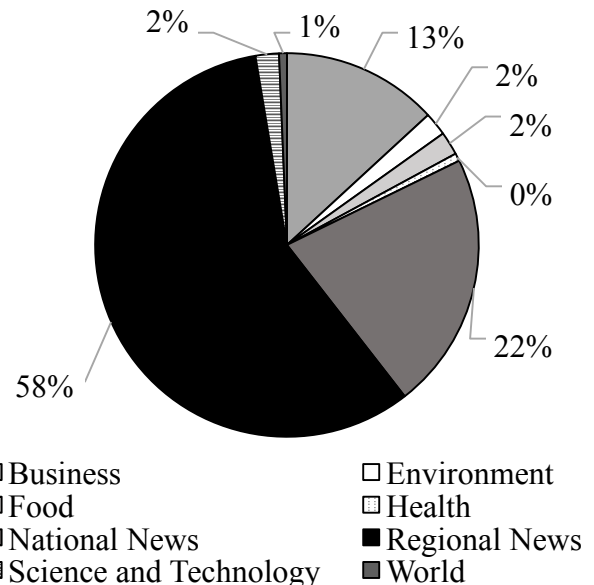
A total of 209 pieces were analyzed, including 196 written articles and 13 broadcasts published between January 1, 2015 and June 1, 2016. Articles and broadcasts were gathered from 20 Canadian newspapers and broadcast outlets (Appendix v). Most pieces were News (162 pieces), followed by Opinion (35 pieces) and Features (12 pieces).

Articles were published in pulses or waves throughout the year, with certain months harbouring higher frequencies of aquaculture-related stories than others (Figure 16). High numbers of articles in some months can be explained by duplicate publications of a story. A total of 54 articles appeared in more than one publication, and were considered duplicates. Four articles showed up in over four different news outlets, while one article appeared in 8 different news outlets. Duplicates were still included for analysis, since they indicate a wider coverage and provide an indication of preferential importance of certain articles.



**Figure 16** Time series of the frequency of aquaculture media pieces from newspapers between January 1, 2015 and June 1, 2016. Numbers in italics within grey bars represent monthly totals, where thin black bars represent frequency of articles on individual dates

News articles appeared throughout eight different newspaper sections (Figure 17). Many articles were located in Regional News sections (58%), which included provincial news from individual provinces (Nova Scotia (38 pieces), British Columbia (23 pieces), etc...). Articles were also prominently featured in National News and Business sections.

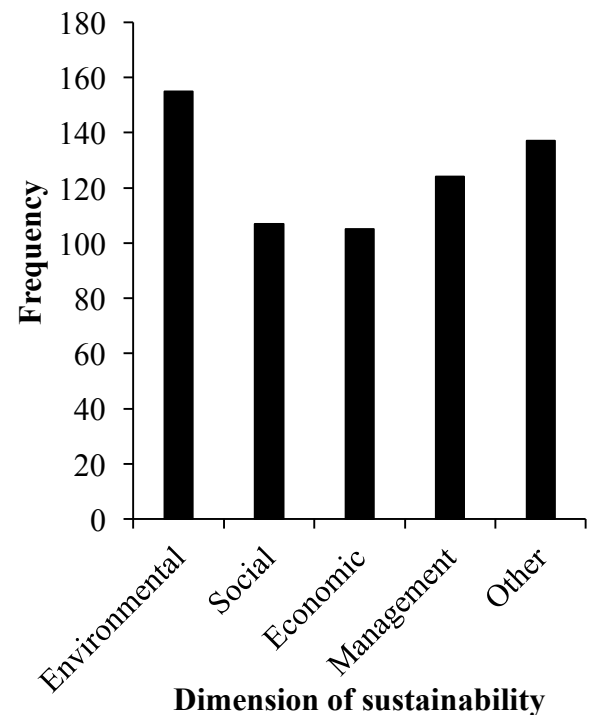


**Figure 17** Proportion of news articles distributed across various paper sections (N= 152) for articles analyzed from Canadian newspapers between January 1, 2015 and June 1, 2016

### 3.4.1.1.1 Topic Analysis

To provide an indication of present-day stakeholder concerns within Nova Scotia, articles were read carefully to reveal topics, or ‘themes’ that appeared consistently. A total of 24 topics emerged from articles and broadcasts across environmental, social, economic and management dimensions of sustainability. Five additional topics emerged that were categorized as “other” since they either did not fall into the pre-determined dimensions of sustainability listed above, or whose topic has characteristics that span multiple dimensions. These include topics such as wild salmon, impact to wild capture fisheries and overall sustainability. Individual articles covered between one to eight topics, while the average number of topics covered was three (sd= 1.4, N= 628 from 209 articles).

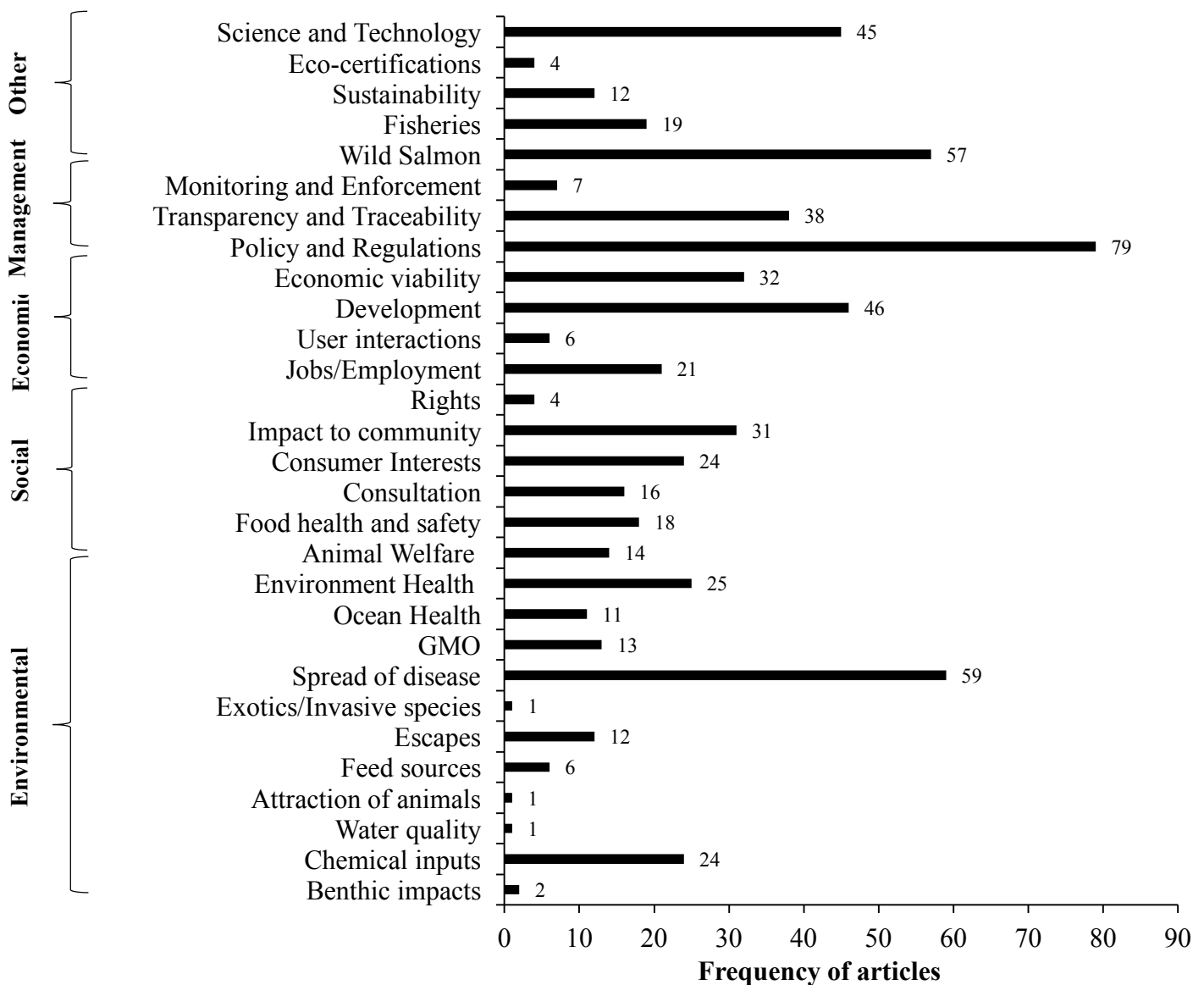
The proportion of topics across dimensions of sustainability were not equally distributed across articles (p-value < 0.01,  $X^2 = 14.07$ , df =4). Environmental topics appeared most frequently across articles (Figure 18), appearing in 57% of all articles. This is further reflected in a higher diversity of topics (11 environmental topics, 5 social topics, 4 economic topics, 3 management topics and 5 other topics). Comparatively fewer social and economic topics appeared throughout articles.



**Figure 18** Frequency of topics appearing in media articles (N=628) across various sustainability dimensions, analyzed from Canadian news sources between January 1, 2015 and June 1, 2016

The most prominent topics that appeared across articles included Policy and Regulations (appeared in 79 articles), Disease or Pathogens (59 articles) and Wild Salmon (57 articles) (Figure 19). Other highly discussed topics included Science and Technology and Development.

Since 85% of articles discussed more than one topic, an interaction matrix was generated to discover which topics appeared more often together within the same article (Figure 20). The most frequent topics to occur together within an article include “Disease” and “Wild Salmon” (30 shared articles), “Policy and Regulations” and “Development” (27 shared articles) and “Policy and Regulations” and “Transparency and Traceability” (26 shared articles).



**Figure 19** Number of articles that express a range of environmental, social, economic and management topics analyzed from Canadian newspapers between January 1, 2015 and June 1, 2016 (N= 628 occurrences of topics across 209 articles)

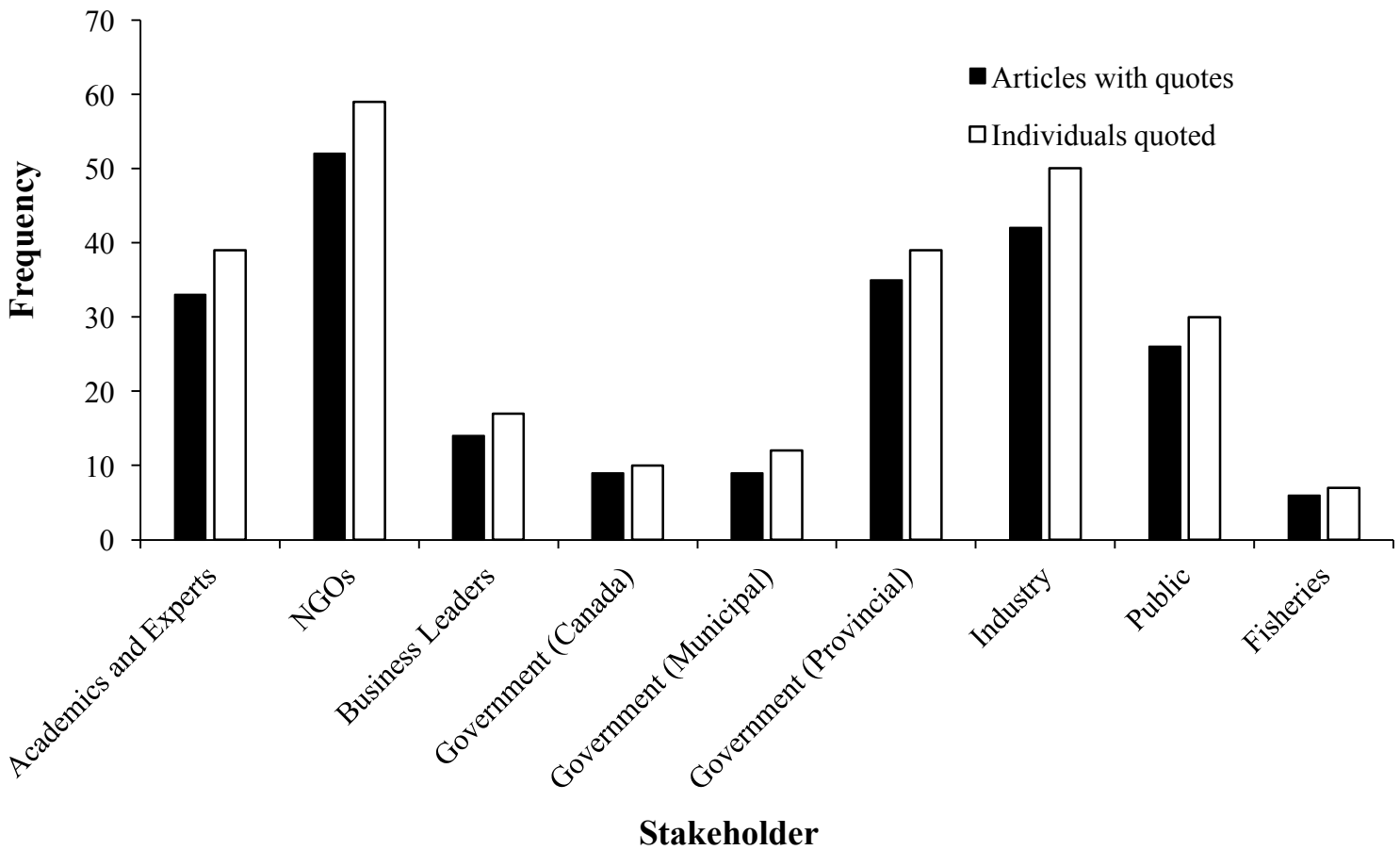




### 3.4.1.1.2 Stakeholder Analysis

A total of 60% (124 articles) of articles explored in this study contained quotes from one or more stakeholder. The clear majority (79%) of articles quoted either one or two stakeholder groups. Only four articles quoted over three different stakeholders. Eighteen different stakeholder groups were quoted across five broad categories that included: government officials, advocates, business leaders, public groups and academics (Appendix vi).

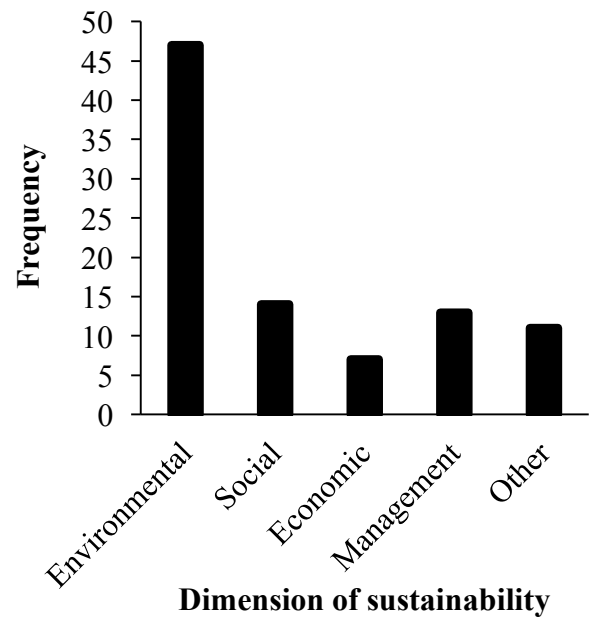
The most common stakeholder groups quoted across articles included NGOs and industry, who together accounted for 41% of all individuals quoted in articles (Figure 21). Numerous articles also quoted representatives from the public (26 articles), academics and experts (33 articles) and provincial government officials (35 articles). Only 15% of articles quoted over one individual per stakeholder group, totalling 263 individuals quoted across all 209 articles analyzed.



**Figure 21** Number of articles containing quotes from various stakeholder groups and the number of individuals quoted across 124 media articles from Canadian newspapers published between January 1, 2015 and June 1, 2016

### 3.4.1.2 Aquaculture in the literature

Within the last 15 years, 16 public documents (including webpages, reports and petitions) that expressed a diversity of concerns about finfish aquaculture were analyzed (Figure 22). Half of the documents were written by conservation groups. Other stakeholder that published public documents include public interest and community groups, scientific community and industry. 25 unique concerns were identified, with 10 of those expressing environmental topics alone. Individual documents expressed between one and 12 different concerns, with an average of 5.75 topics expressed per article. Significantly higher frequency of environmental concerns was expressed in public documents (Figure 23), which appeared in 81% of documents. The most frequent concerns expressed included: disease, chemical inputs, benthic impacts, escapes, and impacts to wild salmon, all which appear in 35% or more of public documents.

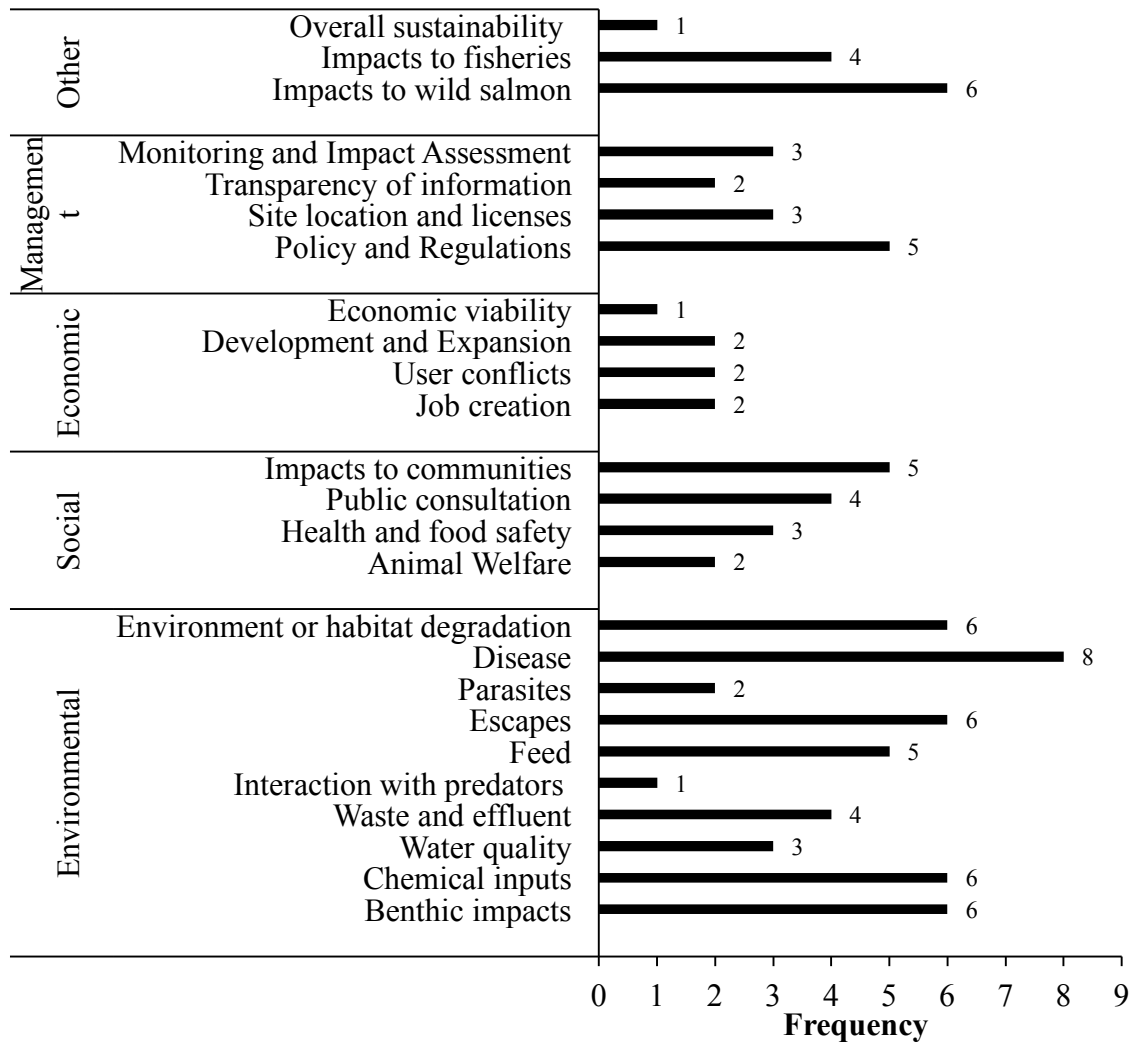


**Figure 22** Frequency of topics appearing in Canadian public documents (filled boxes, N=92) across various sustainability dimensions

### 3.4.2 Ecolabel sustainability criteria analysis

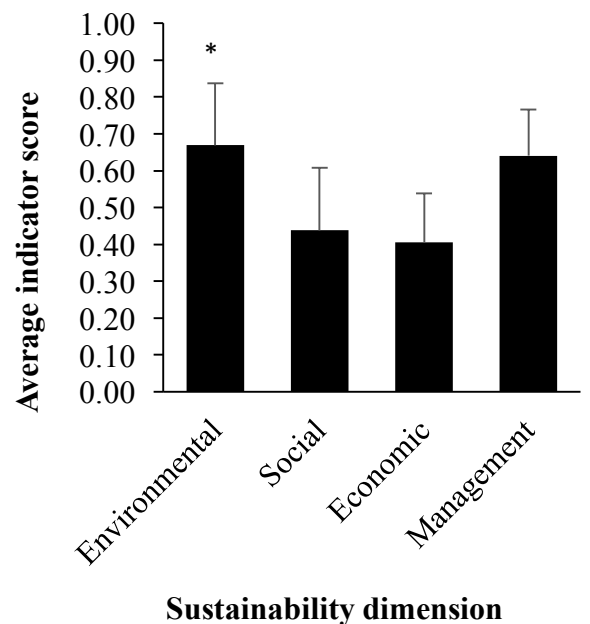
The extent and scope of the indicators of sustainability criteria covered by each ecolabelling scheme were evaluated by assigning numerical scores to indicators ranging from 0 to 1 (Table 4). Higher scores represent criteria extensively covered, whereas indicators with scores of 0.5 or less were considered ‘weak’ or ‘lacking’. The average indicator score differed significantly across sustainability dimensions (Kruskal-Wallis chi-squared = 8.59, df = 3, p-value = 0.035). Aquaculture ecolabelling schemes had higher coverage of environmental and management criteria (Figure 24) than social and economic themes, although only environmental scores were statistically higher than social and economic scores (Appendix vii).

Table 5 shows that the degree to which sustainability criteria are addressed varied between aquaculture ecolabelling schemes (justification for scores can be found in Appendix viii). In general, higher coverage of criteria was found in both ASC and BAP than Ocean Wise



**Figure 23** Number of public documents that express a range of concerns across various environmental, social, economic and management dimensions of sustainability (from 16 public documents)

and Organic standards. This was supported by a statistically significant difference of mean indicator scores between ecolabels (Appendix vii). BAP scored higher on most social and management criteria, while ASC had a more rigorous coverage of environmental criteria. While Ocean Wise scored well on most environmental criteria, its standards lacked considerably in many social, economic and management criteria. Organic certification, had poor consideration of many environmental criteria, very poor coverage across most social criteria and completely lacked attention to economic criteria.



**Figure 24** Average indicator score for four ecolabelling schemes across various dimensions of sustainability. \* Indicates significance at  $p > 0.05$

**Table 5** Average scores across multiple indicators for sustainability criteria among four aquaculture ecolabelling and eco-certification schemes. Critical scores (red): <0.25, low score (orange): 0.25-0.50, medium scores (yellow): 0.51-0.74, high scores (green): 0.76-1.00

Dimension	Criteria	ASC	BAP	Ocean Wise	Organic
<i>Environmental</i>					
	Benthic impacts	1.00	0.25	1.00	0.50
	Water and farm environment quality	0.67	0.83	0.67	0.58
	Impacts to local species/environment	0.88	0.88	0.75	0.38
	Hazardous chemical inputs	0.75	0.75	1.00	0.50
	Managing disease or parasites /Biosecurity	1.00	0.75	0.83	0.75
	Escapes	1.00	0.75	1.00	0.50
	Feeding practices and materials	0.54	0.50	0.38	0.46
	Genetic modification	1.00	1.00	0.00	1.00
	Energy Use/GHG emissions	1.00	0.00	0.25	0.00
<i>Social</i>					
	Health and food safety	0.25	0.88	0.25	0.63
	Labour rights	0.89	0.83	0.00	0.00
	Impacts to local communities	0.33	0.17	0.00	0.00
	Public consultation and engagement	1.00	0.88	0.00	0.00
	Public transparency and communication	1.00	0.50	0.50	0.00
	Fish health and welfare	0.35	0.90	0.35	0.95
<i>Economic</i>					
	Living and minimum wage	0.58	0.67	0.00	0.00
	Impacts to coastal users	0.75	0.50	0.75	0.00
<i>Management</i>					
	Legal Requirements	1.00	1.00	0.25	0.25
	Monitoring and Environmental Assessment	0.88	0.63	0.38	0.00
	Record keeping and traceability	0.75	1.00	0.38	0.75
	Geographical Farm Location	0.50	0.75	1.00	0.75
Average across themes		0.71	0.71	0.35	0.39

### 3.5 Discussion

#### 3.5.1 Determining stakeholder concerns

An analysis of the media and public literature available to Nova Scotians identified several perceived issues and concerns about finfish aquaculture. The media is an important vehicle for transmitting information, and can greatly impact public opinion (Nelkin, 1995). It can be important for framing the context of scientific evidence, but can also involve journalistic perceptions and biases (Bocking, 2012). Identifying how the media represents public concerns about aquaculture can help governments and decision-makers prioritize efforts to improve public trust and acceptance of the aquaculture industry. Issues in the coastal zone are often complex and impact a range of interests and users. The diversity of topics (24 unique topics), the range of

document types, and broad placement within newspapers, further illustrates the variability and complexity of aquaculture-related concerns.

While it is important to recognize that concerns are dynamic and connected to each other and multiple users, it is relevant to identify the most prominent concerns of stakeholders. Based on the popular themes identified through media analyses and literature reviews, the top concerns, those that appeared in approximately 10% of media articles and which featured prominently from literature analysis were identified (Table 6). Some concerns were not featured highly in the media, but appeared prominently in the broader public literature. This reflects how media selectively portrays certain types of stories over others. Furthermore, the degree of interaction of given concern was an important consideration given their relationships to other concerns.

**Table 6** Top 10 concerns about finfish aquaculture in Nova Scotia, ranked by representativeness in publically available literature and media. The degree of interaction represents the number of other topics associated with a given concern where over 10 articles interact (from Figure 20)

Concern	Representativeness in media (% of articles)	Representativeness in Literature (% of articles)	Average Representativeness (% of articles)	Degree of interaction
1 Spread of disease	28.2	50.0	39.1	3(2)
2 Policy and Regulations	37.8	31.3	34.6	7
3 Impacts to wild salmon	27.3	37.5	32.4	6(5)
4 Release of chemicals	11.5	37.5	24.5	2
5 Impacts to environment health	11.9	37.5	24.7	0
6 Impacts to local communities	14.8	31.3	23.1	2
7 Development and expansion	22.0	12.5	17.3	6
8 Transparency and traceability	18.1	12.5	15.3	3
9 Impacts to wild capture fisheries	0.9	25.0	13.0	2
10 Provision of jobs and employment	10.0	12.5	11.3	2

Many authors have previously recognized the multi-faceted nature of the perceived risks and concerns about aquaculture (Bacher, 2015; Schlag, 2010; Young & Matthews, 2010). This research supports these prior findings that suggest that perceptions about aquaculture focus on a wide diversity of environmental issues. Concerns over the risk of escaped fish, animal welfare

and food safety were not dominant concerns in Nova Scotia, contrary to previous literature that found these to be important (Bacher, 2015; Schlag, 2010). A DFO-led public survey on perceptions of aquaculture in 2005 found that food safety was a major concern. The lack of emphasis on food safety concerns in this study emphasizes that public perceptions and values change over time. This may show that industries have been working hard to address public concerns. While the media has little coverage of concerns such as escapes, feed, animal welfare, and food safety, the wider public literature prominently features these concerns. This suggests that the messages provided by public sources are not homogenous. This may be because perceptions often vary with differences in demographics and cultural identities (Bacher, 2015).

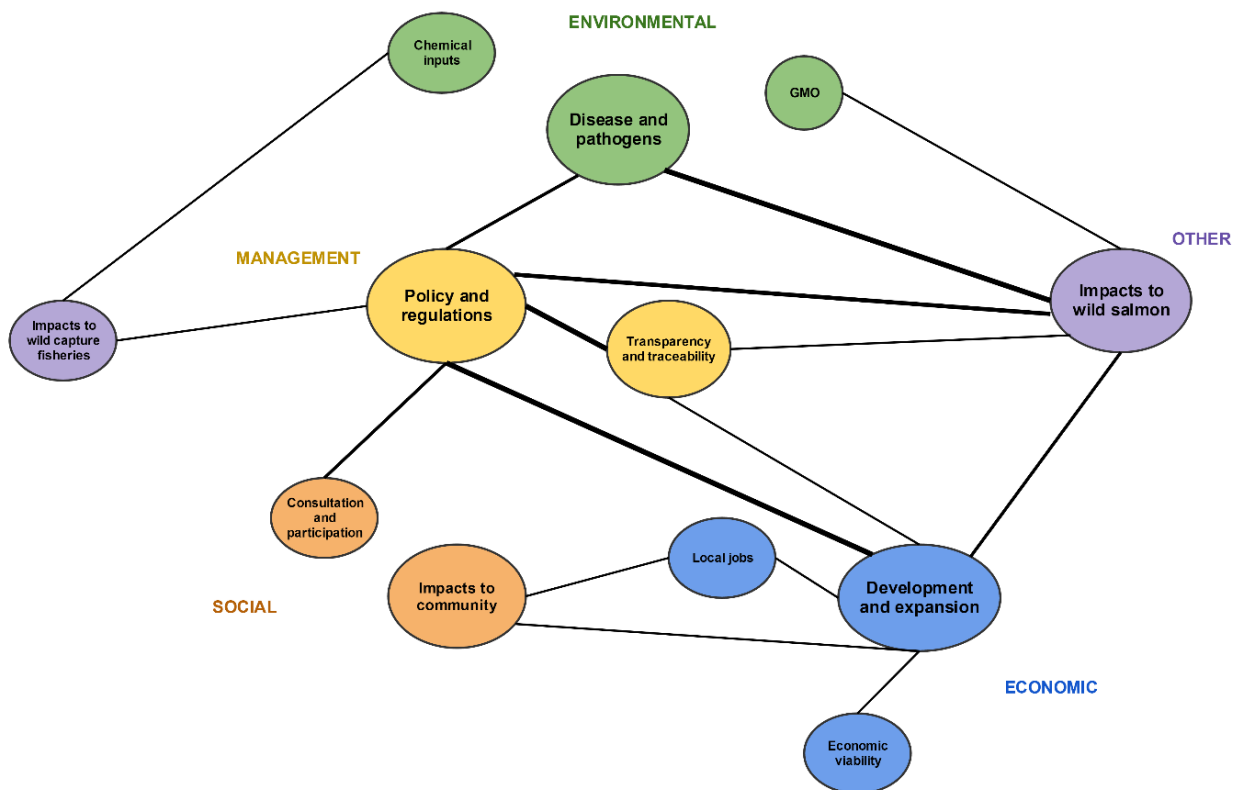
Over the last few years, the discourse around aquaculture in Nova Scotia has focused around concerns about the development, expansion and growth of aquaculture industries. These conversations may be prevalent since Nova Scotia was experiencing a period where both federal and provincial governments were enacting significant policy and legislative aquaculture reform. In October 2015, Nova Scotia released new aquaculture regulations. Since Nova Scotia has long held a moratorium on new finfish leases, these changes might lead to acceptance of new leases and the potential for renewed growth of the industry. Consequently, the media showed more articles during October and November of 2015, only to decline not long afterwards (Figure 16).

Within the last 1.5 years, the media exposed Nova Scotia to mostly negative stories about aquaculture. This supports findings from the US, which found that the public is often exposed to negative information about farmed salmon (Amberg & Hall, 2008). However, these trends reflect a more general discourse about aquaculture. A global review of aquaculture perceptions by Bacher (2015) likewise found that the discourse around aquaculture has focused preferentially on the risks, rather than a balanced distribution of risks and benefits.

These issues are especially relevant due to the nation-wide and international reach of the media. This can be particularly challenging due to potential 'negative spillover effect'. Evidence suggests that the media coverage of a focal company will be more negative if others in the industry are performing wrongdoing (Zavyalova et al., 2012). Bocking (2012) showed how media stories from Europe that appear in Canadian newspapers instilled caution and concern. Likewise, this study found many pieces emphasizing concern were stories from finfish farming in British Columbia. While Nova Scotia and British Columbia aquaculture distinctly differ, the tone and message can remain entrenched in public perceptions, regardless of local context.

The prominence of topics in the ‘other’ category emphasizes the cross-disciplinary nature of public concerns. For example, lobster fishermen are concerned that both the release of harmful chemicals and alteration of benthic habitats can negatively impact the health and population of lobster (Walters, 2007). This can affect the health of the stocks on which their livelihoods rely. However, lobster fishermen also have concerns over the aquaculture pens restricting their access to fishing grounds. The cause for concern is encompassed by the combination of both environmental, economic, social and management factors.

This emphasizes that aquaculture concerns are highly connected, as shown in the interaction matrix produced in Figure 20. Topics identified as having a high degree of interaction (>10 articles connecting two topics) can be defined as ‘nodes’ of influence (Figure 25). These ‘nodes’ identify concerns that may strongly influence other topics. These interactions suggest that it is unlikely that approaches to address individual topics will produce significant changes in stakeholder opinion or behaviour. Therefore, to effectively address stakeholder concerns, management should take a comprehensive and integrated approach, one that considers multiple dimensions of sustainability and how those dimensions interact with each other.



**Figure 25** Interactions between ‘nodes’ of public concern surrounding finfish aquaculture in Nova Scotia show that topics are often expressed together. The thickness of connector line indicates higher number of articles linking nodes



Stakeholder concerns vary across diverse environmental, social and economic issues that are ever-changing and influenced by a myriad of sources (Young & Matthews, 2010). This study found that these diverse concerns interconnect dynamically. Therefore, this study argues that stakeholder concerns regarding aquaculture can be grouped to include concerns over:

- 1) The economic viability and the ability of aquaculture development and expansion to create and supports local jobs
- 2) A poor consultative and participatory process that results in a lack of consideration for the impacts to and interests of local communities
- 3) Farming practices that negatively impact health of environment and inhabitant species
- 4) Farming practices that negatively impact species and ecosystems important for the cultural, social, recreational or commercial purposes of local communities

A stakeholder analysis identified stakeholders who were most frequently quoted to understand who can be influential in disseminating knowledge to the public. Groups quoted most often are informative because they can indicate who is viewed as important and influential in discussions about aquaculture (Gould, 2004). Advocacy and environmental non-governmental groups (NGO) were the most quoted stakeholders in the media. Furthermore, these same groups wrote or distributed half of the public documents analyzed. This is not surprising, since NGOs often use public and media forums with overall goals to educate public and gain public support for their campaigns. These results suggest that NGOs are a key public voice with a large impact on how aquaculture is portrayed to the public. However, industry members were also frequently quoted. An earlier media analysis of aquaculture in Nova Scotia found similar results (Boaler, 2014). However, Boaler (2014) found that the Nova Scotia public does not always trust those being quoted. Regardless, the representativeness of industry in the media suggests that industry could play an important role communicating information about aquaculture to the public.

### *3.5.2 Ecolabels to address stakeholder concerns*

To determine the extent to which ecolabels may address stakeholder concerns, the prominent concerns identified in the media analysis were compared against the coverage of sustainability criteria (Table 7). Schemes provided an adequate coverage of environmental and management criteria, designated by scores above 0.5 (on a scale of 0 to 1). Considering most seafood ecolabels aim to address environmental impacts as a primary goal, the heavy emphasis

on environmental sustainability is not surprising, and is consistent with previous findings (Potts et al., 2016). Despite a poor overall coverage of environmental criteria such as aquaculture feed and GHGs (Table 5), those concerns were not as important for stakeholders in Nova Scotia. Table 7 shows the standards of ecolabelling schemes had relatively high coverage of all primary environmental concerns. However, not all ecolabels had the same depth of coverage across dimensions and across individual criteria. Ecolabelling schemes had higher coverage of environmental sustainability criteria than other dimensions of sustainability. This is consistent with criticisms that certifications have a narrow definition of sustainability (Bush et al., 2013).

**Table 7** Relative coverage of ecolabelling schemes on key stakeholder concerns about aquaculture in Nova Scotia. ++ high scores, + medium scores, - low scores, 0 not included/mentioned, NA unable to determine analytically. Data compiled from ecolabel sustainability analysis (Table 5)

<b>Dimension of sustainability</b>	<b>Key concerns</b>	<b>ASC</b>	<b>BAP</b>	<b>Ocean Wise</b>	<b>Organic</b>
<i>Environmental</i>					
	Spread of disease	++	+	++	+
	Environment health	++	++	+	-
	Chemical inputs	++	+	++	+
<i>Social</i>					
	Impacts to local communities	-	0	0	0
<i>Economic</i>					
	Development	0	0	0	0
	Jobs/Employment	0	0	0	0
<i>Management</i>					
	Policy and regulations	++	++	-	-
	Transparency and traceability	+	++	-	+
<i>Other</i>					
	Impacts to wild salmon	NA	NA	NA	NA
	Interaction with capture fisheries	+	+	+	0

\*note: scoring for 'environment health' used the average of water/farm environment quality and impacts to local species/critical habitats

Table 7 further shows that both ASC and BAP have similar coverage of stakeholder concerns. Overall, both ASC and BAP have the same total score when looking to the coverage of a wider range of sustainability criteria (Table 5). BAP performed substantially lower than ASC on some environmental criteria such as GHGs, benthic impacts and aquaculture feed (Table 5). However, those criteria were less prominent public concerns in Nova Scotia. Therefore, both ASC and BAP could address stakeholder concerns to a similar extent.

Comparatively, ecolabels performed poorly on most social and economic criteria (Table 5), and no scheme included standards to address key social or economic stakeholder concerns. While BAP and ASC standards included many social criteria such as public consultation, engagement and labour rights, these issues did not have as high priority for the public. The inability to address socio-economic concerns was recognized by some stakeholders in Nova Scotia, who believed that ecolabels should encompass a wider range of issues (Q-methodology).

Individual schemes differ in their ability to address concerns. ASC, BAP and Ocean Wise have, overall, similar attention to environmental, social, and economic concerns. While ASC and BAP standard address management concerns such as consideration for adherence to regulations and requiring transparency of productions, Ocean Wise is comparatively lacking. While Ocean Wise emphasizes well most environmental sustainability criteria (Table 5), its coverage is comparatively low for most other criteria. Canada's Organic Aquaculture Standard is the lowest performing standard across dimensions, and only moderately addresses public concerns. This is supported by criticisms about the Organic Standard from several environmental groups (Ecology Action Centre, 2012; Roebuck, 2012).

The language and structure of ecolabelling standards is inconsistent with how the public may perceive aquaculture. The focus of standards was to promote practices and principles, rather than focusing on impacts. For example, the scoring system used in this research could not determine whether ecolabels addressed impacts to wild salmon. This was because concerns relating to wild salmon include the impacts of disease, escapes, environment health, impacts to coastal users, and consideration of the geographical extent of farms. This presents a challenge since the public must therefore understand how ecolabels address a diverse range of criteria related to the specific area of concern. The technical aspects of standards may increase confusion and limit the ability of ecolabels to communicate effectively to non-expert stakeholders.

This research found that individual ecolabelling schemes differ in their ability of to address stakeholder concerns and a range of sustainability criteria. While some labels (ASC, BAP) adequately cover many criteria, others score comparatively much lower. This can be problematic since the public, consumers and stakeholders find the proliferation of ecolabelling schemes confusing (Schmitt, 2011; Washington et al., 2010). The extent to which stakeholders understand these differences between schemes and perceive the credibility of different schemes is not well known and was beyond the scope of this research.

### 3.5.3 *Challenges and Limitations*

While this study used information in the media and public literature as a proxy for public opinion, it should be noted that the exact influence of the media to shape perceptions is ambiguous and subject to debate (Schlag, 2011). The influence of perceptions on behaviours is not straightforward. According to Stern's (1999) 'value-belief-norm' theory, behaviours are influenced by a series of interacting factors such as demographic, knowledge, experiences, and values. This research identified several public concerns, but could not explore how the public balances concerns against benefits, nor how perceptions guide their decisions about aquaculture.

It should be acknowledged that this research's analysis of ecolabels was not an attempt at benchmarking. In recent years, there has been several applications of indicator-based systems to assess the coverage of ecolabelling and certification schemes against performance indicators. These initiatives include a set of indicators launched by the State of Sustainability Initiatives (SSI) in 2008 and the Global Benchmark Tool launched by the Global Sustainable Seafood Initiative (GSSI). Indicators assessed a range of criteria across various levels of sustainability, often referencing internationally recognized best practices. Comparatively, this analysis does not evaluate how 'sustainable' ecolabelling schemes are. Rather, this analysis evaluated the extent to which ecolabel standards address aspects of sustainability, with the objective of exploring whether the goals of ecolabels align with the concerns of stakeholders. Therefore, these results do not give indicator to suggest a scheme is 'good' or 'bad'.

### 3.5.4 *Conclusions*

Considering the conflicts, concerns and issues identified by the public and key stakeholders is important when discussing solutions to improve social acceptance and public confidence in aquaculture. This research identified ten prominent environmental, social, economic and management concerns surrounding finfish aquaculture in Nova Scotia. Given the interconnectedness of issues and the relevance of issues that cross multiple dimensions of sustainability, this research compiled concerns into four main groupings: 1) economic viability and the supporting local jobs, 2) lack of consideration for the impacts to and interests of local communities, 3) negative impacts to environment and species, and 4) negative impacts to commercially or socially important species and ecosystems. Overall strong attention to environmental sustainability indicators shows that ecolabels may address environmental

concerns in Nova Scotia. Comparatively, ecolabels are less likely to address social and economic concerns. The ability of ecolabels to address concerns is complicated by their interconnectedness. Finally, variations between and within schemes to address concerns challenges the ability of labels to address stakeholder concerns.

## Chapter 4: Synthesis and Discussion

The purpose of this research was to act as a preliminary exploration into the potential role of ecolabels in Nova Scotia’s finfish aquaculture industry. By exploring stakeholder perceptions and analyzing certification standards, this research identified several potential opportunities and challenges of ecolabelling within Nova Scotia’s finfish aquaculture industry. This information was synthesized to discuss the potential role of ecolabels and highlight considerations about their ability to improve social acceptance of a controversial industry. For a summary of the discussion to follow, a SWOT analysis is provided (Table 8).

**Table 8** SWOT matrix for the evaluation of ecolabelling as a management tool within Nova Scotia's finfish aquaculture industry

<b>Strengths (Benefits)</b>	<b>Opportunities</b>
<ul style="list-style-type: none"> <li>• Ecolabels widely accessible to producers</li> <li>• High acceptance and willingness of producers</li> <li>• Ability to address environmental concerns</li> <li>• Offer transparency and traceability of fish farms</li> </ul>	<ul style="list-style-type: none"> <li>• Increasing importance in global markets</li> <li>• Early market entry for some producers</li> <li>• Increased market competitiveness of Nova Scotia farmed fish</li> <li>• Shared vision among stakeholders</li> </ul>
<b>Weaknesses (Challenges)</b>	<b>Threats (Limitations)</b>
<ul style="list-style-type: none"> <li>• Poor coverage of social and economic sustainability criteria</li> <li>• Ecolabels not equal in terms of applicability to species and production systems, and to the extent to which they address sustainability criteria</li> <li>• Credibility unequal between schemes</li> </ul>	<ul style="list-style-type: none"> <li>• Unlikely to reduce opposition</li> <li>• Variable potential buy-in by stakeholders</li> <li>• Market uncertainty</li> <li>• Not a market for Nova Scotia (little consumer demand)</li> <li>• Confusion: need for education, research and clarification about ecolabelling</li> </ul>

## 4.1 Identified Opportunities and Challenges

Overall, results found that producers are both willing to participate and would have access to ecolabelling schemes. This shows that the proposed benefits could have wide acceptance and uptake within the industry.

### 4.1.1 *Economic benefits*

Stakeholders identified that ecolabels can offer market benefits to Nova Scotia finfish producers, especially as improved market access. Globally, certified aquaculture is growing twice as fast as certified wild-catch. Certified aquaculture production has grown at a rate of 76% per year from 2003 to 2013 (Potts et al., 2016). This growth, combined with sustainable commitments from large retailer chains such as Wal-Mart (Bush et al., 2013), suggests that ecolabelling will continue to become more important in a global marketplace. This growth presents numerous opportunities to Nova Scotia producers to take advantage of the market benefits. A recent analysis of seafood certifications around the world found that 56% of the total certified products are for Atlantic salmon (Potts et al., 2016). Since 89% of the Nova Scotia's finfish production value in 2014 came from Atlantic salmon (Statistics Canada, 2015), ecolabels could help Nova Scotia producers become more globally competitive.

Currently no farm producing rainbow trout in Nova Scotia is certified. Therefore, these producers could enjoy early entry access to ecolabels. Early access to markets, or 'first-mover' advantages include increased prices, market access and demand (Liebermann & Montgomery, 1988). Similarly, Atlantic halibut farmers could receive similar early access benefits. In 2008, a marketing study by Beibei et al. (2008) on Atlantic halibut found a potential promising market in the United States. Given the increasing demand of sustainable seafood in the US and globally, early adoption of ecolabels in this market may increase the competitiveness of local farms and encourage economic growth.

However, the variabilities and uncertainties within the global seafood market creates both benefits to producers but also poses challenges for the success of labels. Given the emphasis of ecolabels as a market-based tool, market uncertainty is a big consideration for producers. Furthermore, differences between the locations of market demand and where producers export sets the boundaries for the direct impacts of ecolabelling initiatives. Consequently, these market characteristics can be indicators for the overall potential impact of ecolabels (Potts et al., 2016).

For example, an important limitation for ecolabelling is the potentially restricted local consumer demand. Many stakeholders identified that consumers in Nova Scotia are largely unaware of ecolabels and would be unwilling to pay for certified products. Therefore, producers selling primarily to Nova Scotian markets may be less willing to participate in ecolabelling.

#### *4.1.2 Ecolabels as a communication tool*

Several stakeholders in Nova Scotia recognized that ecolabelling schemes have the potential to improve the transparency and traceability of finfish aquaculture. These findings support previous social science studies which argue that building public trust relies on credible disclosure of information (Bacher, 2015). In addition, improved transparency can allow investors and retailers to recognize strengths of companies and identify potential problems (i.e. food safety) and minimize risk to them.

Consequently, the ability of ecolabels to communicate with stakeholders can greatly influence stakeholder buy-in and producer uptake. However, the benefits from transparency and communication are only relevant if they offer meaningful information to those groups that have interest in the data (Sustainable Fisheries Partnership, 2011). Ecolabels could theoretically address many of the environmental concerns of stakeholders in Nova Scotia. This is consistent with the suggestion that ecolabels are a means for producers to communicate to a range of stakeholders their commitment to sustainability (Gulbrandsen, 2006). However, ecolabels had low to critical coverage of many prominent social and economic stakeholder concerns. This suggests that ecolabels may only be effective communicating environmental sustainability.

While ecolabels could theoretically address stakeholders' environmental concerns, this research finds that ecolabels may not communicate the same messages to all stakeholders. Stakeholder perceptions were divided in whether they believe ecolabels can improve their concerns. A prominent 'skeptical' perception indicates that many stakeholders do not believe ecolabels can reduce any of the social, environmental or economic concerns of stakeholders. A general expression of distrust of ecolabels and the identification of multiple limitations and weaknesses supports these beliefs. This might suggest that many stakeholders may not trust or understand the criteria and benefits of ecolabels. Consequently, ecolabels may not communicate to stakeholders that their concerns are being addressed.

Conversely, a prominent ‘optimist’ perspective shows that many stakeholders view ecolabelling favourably and that many believe that ecolabels could not only address concerns, but also bring multiple benefits to the sustainable development of the industry. Indeed, all producers, most government participants, and half of the NGO stakeholders aligned with ‘optimist’ or ‘pragmatist’ perspectives in Q-methodology. These perspectives believed that ecolabels can benefit multiple stakeholders and open doors for communication. Furthermore, this research argues that ecolabels can offer multiple benefits to different stakeholder groups, including market benefits to producers, addressing the environmental concerns of civil society and NGOs, and contributing to government policy objectives to grow local businesses. Therefore, ecolabels may offer a shared vision among differing stakeholders. This may help reduce conflicts, build trust, and improve the collaboration between groups, which is necessary for effective coastal and resource management (Weinstein et al., 2007).

#### *4.1.3 Choosing the right label*

This study argues that variability is a prominent feature distinguishing ecolabelling schemes. This produces inconsistencies in the ability of individual schemes to influence the uptake of labels by producers, buy-in by stakeholders and the ability of ecolabels to address stakeholder concerns. Multiple characteristics that can influence uptake differ substantially between ecolabelling schemes examined (Table 9). This paper previously argued that the differences in target market demographic, accessibility and farmed species between individual ecolabelling schemes will influence the relative uptake by producers (see Chapter 2). However, other characteristics can interact to complicate the ability of individual labels to produce benefits and attain acceptance.



**Table 9** Characteristics of four ecolabelling schemes as they would apply to finfish aquaculture in Nova Scotia

	<b>ASC</b>	<b>BAP</b>	<b>Ocean Wise</b>	<b>Organic</b>
Accessibility to producers	High	Full coverage	Low	Full coverage
Developed by	Non-profit	Industry-led association	Non-profit	Government
Species coverage	Atlantic salmon/rainbow trout	All finfish	Land-based Atlantic salmon, Arctic char, Atlantic halibut	All finfish
Current # of producers certified	0 (1 pursuing)	1	3	0 (2 pursuing)
Target markets	Europe, Japan	Canada and USA	Canada, USA	North America, Europe
Perceived trust*	High	Medium	High	Low
Average coverage of sustainability criteria	Medium	Medium	Low	Low
Average coverage of stakeholder concerns	Medium	Medium	Medium	Critical-low

\*Based on conversations, literature reviews etc...

While ASC and BAP both have overall good coverage of sustainability criteria and ability to address environmental concerns in Nova Scotia, differences between them may influence their respective uptake by producers and stakeholders. Since its inception in 2012, ASC has seen a growth rate of 98% per year, making it the fastest-growing certification initiative today (Potts et al., 2016). This suggests that ASC will continue to have rising market influence and demand. The growing recognition of ASC suggests it has potential to reach a wide audience and impact public perceptions. Excerpts from interviews revealed that stakeholders may exhibit greater reception and trust for ASC. During interviews, several study participants considered ASC to be one of most ‘strict’ or ‘stringent’ eco-certification schemes. Comparatively, many Canadians do not think government or industry labels would be reliable (DFO, 2005). While BAP is not an industry-certified label, an industry association (Global GAP) initiated its development. Therefore, consumers and stakeholders may not strongly trust BAP.

Despite the global growth of ASC certified farms, only two producers (totalling 12 sites) of Atlantic salmon in British Columbia are ASC-certified compared to the 170 BAP-certified sites across Canada. This may suggest that technical or financial challenges are preventing wider adoption of ASC. Finally, compared to the all-inclusive, broad scope of BAP, only producers of salmon and rainbow trout are certifiable by ASC. This narrower availability of finfish farms to certification by ASC may also create certification challenges.

Organic certifications for aquaculture can have advantages over other types of ecolabelling schemes since the ‘organic’ label has wide consumer recognition and growing

demand, especially in markets in the United States (Lee, 2008). An earlier market study by Rommens and Desbarats (2011) found significant consumer demand for organic certification. This study also found that expected premiums outweighed relative costs to certification. This study supports these findings and shows that the Canada Organic Aquaculture Standard is not restrictive, since producers need only follow a single standard for all species and production systems. While market benefits and producer uptake may be high, the ecolabel sustainability analysis showed that organic certification has low overall coverage of sustainability criteria. This is consistent with critics who claim that practices of open system finfish farming are inherently incompatible with organic principles (Cottee & Petersan, 2009). Therefore, Canada's Organic Aquaculture Standard may be poorly trusted, and may not address stakeholder concerns or improve social acceptance.

Comparatively, the Ocean Wise label has the opposite problem regarding trust and certifiability. As an ecolabel developed out of a non-profit organization, Ocean Wise has gained popularity from environmental organizations. Its prominent Canadian market base and wide consumer recognition in restaurants and local retailers means that the public in Nova Scotia would greatly recognize and trust the Ocean Wise label. Additionally, this analysis found that Ocean Wise can address several prominent stakeholder concerns, despite a comparatively lower overall score on sustainability criteria. However, only 36% of farms in Nova Scotia could become recognized by Ocean Wise (Figure 5). Despite benefits of stakeholder buy-in and ability to address concerns, many producers could not pursue Ocean Wise.

Finally, the species farmed may influence consumer demand and stakeholder acceptance (Johnston et al., 2009). Most Atlantic salmon dominates most of the discourse and concerns surrounding finfish aquaculture in Nova Scotia. This suggests that acceptance of ecolabelled salmon may be lower than other finfish species. The acceptance of ecolabels may be greater for producers of Atlantic halibut or Arctic char, regardless of the scheme's reputation.

This research supports the assertion that the variability between schemes might increase the confusion experienced by producers, stakeholders and consumers (Parkes et al., 2010). While one goal of ecolabels is to communicate messages of sustainability, confusion and inconsistencies between schemes may undermine the effectiveness of this goal. The inconsistencies in the scope of sustainability criteria between labels increases complexities and may lead to increased confusion (Parkes et al., 2010). To improve uptake and buy-in, both

stakeholders and producers must be aware of the ecolabels available to them, the benefits they offer, and their potential differences. This research argues that improved marketing and education of ecolabels is needed to resolve confusion and help producers, decision-makers, consumers, and the public make appropriate decisions regarding ecolabels.

## 4.2 Ecolabelling for social acceptance

According to Brunson's (1996) definition of social acceptance, stakeholders make acceptability judgements based on a process of comparison. Regarding aquaculture, acceptance is therefore contingent on whether stakeholders believe the benefits of aquaculture outweigh the costs. Identified benefits and costs are highly linked to the beliefs and values that individuals attribute as important. Currently, a low acceptance in Nova Scotia indicates a general perception that costs outweigh benefits. Therefore, to influence social acceptance, aquaculture must develop in a way that promotes and enables better adherence to perceived benefits and minimize or address the concerns or costs perceived by stakeholders.

This research shows that stakeholders in Nova Scotia have diverse values, which revolve around several dynamic and interacting economic, social, and environmental concerns. Environmental risks of aquaculture play an important role in affecting social acceptability of aquaculture (Whitmarsh & Palmieri, 2008). Most prominent concerns in Nova Scotia focused around environmental issues such as degradation of environmental health, spread of disease, and release of chemicals. Results from this study support other ecolabel benchmarking studies (Potts et al., 2016), which found that aquaculture ecolabels can adequately address many environmental sustainability criteria, and have good coverage of criteria such as chemical inputs, water quality, and biosecurity. This suggests that ecolabels could address many primary environmental concerns, and positively contribute to the improvement in social license of finfish aquaculture.

It is evident that ecolabels are a step in the right direction towards improved resource management and sustainable development (Wessels et al., 2001). However, ecolabels should not be seen a panacea. While ecolabels can play a role in improving environmental standards of finfish farms, it is unlikely to reduce opposition. While ecolabels have a good coverage of environmental concerns, ecolabels revealed poor coverage of socio-economic stakeholder concerns. Given the interconnectedness of stakeholder concerns across dimensions, the inconsistency of ecolabels to address concerns limits its usefulness to improve social acceptance.

Furthermore, Boutillier and Tompson's (2011) model of SLO proposes that there must be a level of perceived trust, legitimacy and credibility adopted to reach acceptance. However, the analysis of stakeholder perceptions revealed significant concerns over the credibility and variability between labels.

Imperative to the conversation about social acceptance is how the public is getting their information about aquaculture. It is through various modes of knowledge-acquisition that individuals define their values and beliefs. Confusion identified as a major challenge by stakeholders suggests that ecolabels may not be effective at sharing knowledge about sustainability. The Atlantic Canada Fish Farmers Association (ACFFA)'s proposed farmed Atlantic salmon strategy (ACFFA, 2011) suggested that education and conversation can help increase public support for aquaculture in Nova Scotia. Therefore, communication tools and engagement about the industry are important in building trust and acceptance. Given the widely stated perception of confusion about ecolabels and the variability in perception between and within stakeholder groups, the ability of ecolabels to share knowledge can be optimized with substantial communication and outreach about ecolabels.

The variability and skepticism about ecolabels by certain stakeholder groups presents a potential challenge for ecolabels to influence social acceptance. Certain groups of individuals may be more important for mobilizing knowledge and shaping public attitudes. Evidence has shown that scientists' involvement and influence can be highly important in the processes that enable social license (Leith et al., 2014). The media analysis conducted in this study also revealed that NGOs are a trusted public source of information, and who have an important voice in the media. The perception of caution and hesitation about ecolabels among participants from the scientific sector presents a potential barrier to social license. Similarly, the divided perceptions of NGOs between skepticism and optimism may pose challenges for ecolabels to gain a wide public acceptance.

Ecolabelling aims to inform the public about farming practices through consumer influence (Ward & Phillips, 2008). Therefore, the public's main access to messages from ecolabels appears to be through consumption of products. However, many stakeholders believe there is little demand for sustainably labelled seafood in Nova Scotia. In addition, many producers in Nova Scotia sell their products primarily to international markets in Europe and the United States. Therefore, the ability of ecolabels to communicate sustainability in Nova Scotia

likely depends on how well the public and stakeholders understand and are aware of individual companies and producers in Nova Scotia. This emphasizes the need for continued public outreach and education about Nova Scotia's industry by governments and industry.

Finally, strong opposition groups in Nova Scotia may be a limiting factor to reaching the social acceptability of finfish aquaculture. For some individuals, the only acceptable solution for finfish aquaculture is either complete removal from the area of impact (the NIMBY perspective), from the province, or a complete transition to land-based production systems. Therefore, ecolabels will have little influence on the behaviours and perceptions of these individuals. While the number of groups who fully oppose finfish aquaculture is small, the influence of opposition on overall social acceptability is not well understood, and therefore difficult to assess.

In conclusion, this study argues that the ability of ecolabels to improve social acceptance depends on a myriad of context-specific factors including local politics, cultures and perceptions. Nevertheless, social acceptance is poorly understood and defined (Brunson, 1996). While social license is formed through communities' perceptions, beliefs and opinions about the industry (Thompson & Boutilier, 2011), it remains difficult to fully predict how implementing ecolabels, or other management strategies may influence acceptance.

#### 4.3 Implications for the study of ecolabels and eco-certifications

The findings of this study emphasize the importance of understanding perceptions of a wide range of stakeholders within the study of ecolabelling and eco-certifications. Many criticisms of certification schemes for seafood question consumer demand or the improvement on fisheries management (Bush et al., 2013). However, the influence of a wider range of stakeholders on a local level is often underappreciated. This study supports the hypothesis that incentives to adopt labelling are not primarily from consumers, but in fact from pressure by retailers or conservation groups (Gulbrandsen, 2006). Furthermore, this study argues that ecolabels can provide multiple benefits to a range of stakeholders. Therefore, understanding the potential use and application of ecolabelling and certification schemes requires a consideration to a wider range of stakeholders, including retailers, governments, NGOs and civil society.

The observed variability between individual ecolabelling schemes regarding coverage, applicability, demand, and stakeholder perceptions emphasizes the importance of a comparative perspective to understanding ecolabels and eco-certifications. Given the rapid proliferation of

various types of labels and standards within the global marketplace, this approach is necessary to help reduce complexity (Nadvi & Waltring, 2002). It can further help guide consumers and user groups to differentiate labels, and subsequently increase the confidence and trust of these groups to the benefits and potential of ecolabels.

#### 4.4 Future considerations

Future research should explore the practical applicability of ecolabels to aquaculture in Nova Scotia. This would require a full feasibility assessment and cost-benefit analysis for producers to adopt ecolabels. While Rommens and Desbarats (2011) have done this for Canadian Organic certification, it is recommended that research assess other certifications such as ASC and BAP, which focus more holistically on a range of sustainability criteria. A more complete assessment exploring producer uptake would increase our understanding of the drivers of industry uptake. While this paper discussed the potential applicability differences of each scheme, future research should pursue a more focused assessment of perceptions of industries and stakeholders towards individual labelling schemes. Finally, governments, industries, NGOs, and ecolabelling organizations should develop knowledge outlets and promote education for public, consumers, and stakeholders regarding ecolabelling to help resolve confusion about the standards, what they mean and what benefits they could provide locally and regionally.

#### 4.5 Management considerations and recommendations

This paper argues that ecolabelling should be recognized as a management tool to promote the sustainable development and improve social acceptance of Nova Scotia's finfish aquaculture industry. Effective tools for the management of fisheries and aquaculture should support and contribute to achieving policy objectives defined by the appropriate authorities. Federally, DFO's Aquaculture Policy Framework defines the following

**Table 10** Strategic pillars and policy objectives of Nova Scotia's Aquaculture Strategy (2012)

<b>Strategic pillars</b>	<b>Specific objectives</b>
Farming Responsibly	<ul style="list-style-type: none"> <li>- Extension role</li> <li>- Monitor and audit</li> <li>- Fish, shellfish, and aquatic plant health</li> </ul>
Aquaculture engagement	<ul style="list-style-type: none"> <li>- Improved communication and outreach</li> <li>- Aboriginal interests</li> </ul>
Regulatory safeguards	<ul style="list-style-type: none"> <li>- Provincial, Regulation, and Policy</li> <li>- Licensing and Leasing</li> <li>- Intergovernmental cooperation</li> </ul>
Jobs and the Economy	<ul style="list-style-type: none"> <li>- Building skills for a strong economy</li> <li>- Supporting productivity and innovation</li> <li>- Becoming globally competitive</li> </ul>

objectives: “DFO will, through its legislation, regulations, policies and programs, seek to support industry competitiveness in global markets and increase public confidence in the sustainability of aquaculture development” (DFO, 2008). Nova Scotia’s Aquaculture Strategy has similar objectives, outlined across four key pillars (Table 10) (Nova Scotia, 2012).

The objectives of public policies and ecolabelling schemes can overlap, making ecolabels attractive to policy makers and governments. Given the growing importance of ecolabelling in the global marketplace (Potts et al., 2016), and limited number of certified aquaculture producers in Canada, ecolabelling in Nova Scotia could contribute to policy objectives of making industries globally competitive. Given the perceived market benefits, ecolabels could support building local businesses and promoting the local economy. Since aquaculture ecolabels generally have a high coverage of important environmental sustainability criteria, ecolabels could contribute to responsible farming practices, helping both Nova Scotia and Canada meet their commitments to sustainable development. Therefore, ecolabels could potentially contribute to meeting several of the primary objectives of provincial and federal governments.

International organizations such as the FAO believe that governments play an integral role in the success of ecolabelling schemes to meet management objectives (Wessels et al., 2001). Governments have numerous options for the degree to which they can become involved in ecolabelling schemes ranging from passive support and information provision to the fully active role and responsibility of developing their own national or regional labels (OECD, 2011). Research suggests that private certification schemes where the government is involved in the creation, advertising and auditing of schemes has the potential to improve uptake and consumer awareness (Washington & Ababouch, 2011). These types of schemes could also be beneficial for their ability to be developed to cater carefully around local stakeholder concerns and involve the local stakeholders. However, caution is exercised in pursuing these schemes. The credibility of labels was identified as a major challenge by stakeholders in Nova Scotia. Furthermore, a DFO-led public survey on aquaculture in 2005 further found that the public was receptive to a logo, but that government or industry logos were not reliable (DFO, 2005). Many stakeholders in Nova Scotia maintain that credible ecolabels are only administered by third-party authorities. In general, this study found that some stakeholders are critical of government’s involvement in ecolabelling schemes due to their primary objective as a market-based tool. Consequently,

governments must carefully consider the role they should play regarding ecolabelling, and whether to take a more active ‘hands-on’ or a passive ‘hands-off’ approach (Washington & Ababouch, 2011).

The OECD (2011) proposes that governments could play an important role as a facilitator for ecolabelling and certification. One method is through the inclusion of a supporting framework to facilitate or enable certification. This may involve building a management framework that uses principles and standards from ecolabelling schemes to standardize procedures and facilitate the uptake of private certification schemes by producers. Governments may also become involved by providing incentives for producers to become involved with ecolabelling (OECD, 2011). Incentives can come in the form of financial subsidies or through the provision of technical and administrative aid. These incentives can not only help finance the certification itself, but also be used towards development projects or traceability systems to facilitate future certification.

An important consideration for decision-makers supporting ecolabels and eco-certifications is whether to promote a ‘gold standard’ approach to reward best performers, or a wider, more inclusive approach to raise the overall standards of the entire industry. Stakeholders that criticize the credibility of labels often prefer the ‘gold standard’ approach. Furthermore, several stakeholders expressed that not all types of finfish aquaculture should be able to be certified. There are many that believe that only by removing fish completely out of the water will concerns be mitigated. Indeed, growing fish on land in closed-containment facilities will mitigate many of the concerns and impacts of finfish aquaculture (Hutchings et al., 2012) such as the risk of escapes and impacts to wild salmon.

However, the second approach is more pragmatic and aims to include a wider set of producers to improve the shift a more inclusive set of producers to overall better sustainability. An inclusive approach is recommended for Nova Scotia to meet policy objectives and maximize benefits. Given the confusion about labels and the variable stakeholder perceptions, it is unlikely that even only focusing on ‘gold standard’ approach would change the opinions of those who are opposed to development. This approach also is costlier for producers, and thus it is practically unlikely to be widely adopted by producers. Furthermore, certifying only the best performers would not necessarily reduce environmental impacts, since many of the farms producing the most impacts would not be able to attain certification (Jonnell et al., 2013).



Based on the findings from this study in conjunction with analysis of previously published literature, the following recommendations are made for policy development and government involvement with regards to ecolabelling for aquaculture:

- 1. Governments should continue to support industry and stakeholder-led initiatives to adopt ecolabelling and eco-certification schemes.** Ecolabelling schemes have a high potential acceptance by producers, and could potentially support local businesses and improve the global competitiveness of the aquaculture industry. Many stakeholders in aquaculture support them, including some NGO groups and wild capture fisheries. With adequate education, ecolabels may be an effective communication tool between industries and the public, and could engage a range of stakeholders. However, taking advantage of these opportunities and benefits provided by certification and ecolabelling will require continued public and private investment in labelling and sustainable aquaculture development, supported by national and regional policies (Potts et al., 2016).
- 2. Financial and technical assistance to fish farms will provide incentives to adopt better management practices, but they should be only funded as part of, but necessarily the only component in farm improvement projects.** Financial and technical assistance may be required for small-scale farmers to meet certification costs. Furthermore, producers identified that they would be more willing to pursue ecolabels if given assistance by governments. Since many of the objectives of ecolabels and public policy overlap, ecolabels can be considered one mechanism used in farm improvement plans. Given the public criticism on government's unfair promotion of industry interests, the government should take caution funding ecolabelling for producers for the purpose of increasing market competitiveness or growing the business.
- 3. Given the high variability between schemes, both in scope, applicability in the industry and ability to address concerns, governments should not promote a single ecolabelling scheme above others.** Currently, there is too much variability between schemes to provide an accurate recommendation on which scheme is superior. Furthermore, governments should recognize that a 'gold standard' approach is not a practical approach for Nova Scotia and would not benefit policy objectives. Finally, there is intrinsic value in raising the bar on environmental sustainability for the entire industry.

4. **Ecolabelling of farmed finfish should be recognized as one of multiple tools to improving sustainability practices of fish farms to promote economic viability and improved social acceptance.** Given that multiple challenges still exist with ecolabelling schemes including the uncertainty in consumer demand and lingering skepticism, a wider set of tools to reach sustainable development goals and improve social acceptance is recommended. This was recognized as highly important for all stakeholders in this study.
5. **Governments should consider and incorporate standards and best management practices into current regulations and management frameworks. Through a better alignment of management frameworks to ecolabelling schemes, it could provide the technical means that could enable easier adoption and uptake of ecolabels.** The standards outlined in certification schemes are often viewed by stakeholders and public as more environmentally rigorous. Since standards are often developed out of widely accepted and important sustainability indicators, aligning regulations and management frameworks with certification schemes will likely help farmers produce more responsibly. Aligning frameworks and requirements by farms with existing schemes can help facilitate or encourage the transition of farmers to adopt ecolabelling schemes. Finally, harmonization between ecolabelling standards and the management frameworks and regulations for aquaculture could minimize unnecessary duplication and reduce overall costs to attain certification (Washington & Ababouch, 2011).
6. **Better education and outreach about ecolabelling and certification in aquaculture to both producers, stakeholders and the public should be encouraged.** Variability and confusion was included in many of the challenges and limitations of ecolabelling found in this study. Therefore, outreach and educative programs should be established to maximize the uptake of ecolabels by producers and stakeholders, and to help ecolabels fulfill their potential to influence social acceptance. As has been suggested by Gutierrez & Thornton (2014), education about ecolabels should be a component of ocean literacy efforts to educate the public on the need for sustainable development of fisheries and aquaculture.

## 4.6 Conclusions

The study of stakeholder perceptions can help identify priority issues and critical values to be considered in management and planning (Mazur & Curtis, 2008). This research found that stakeholders want sustainable aquaculture, and that industries are both willing and capable of adopting ecolabelling to address public concerns. Ecolabelling can bring economic benefits to Nova Scotia finfish producers and support government policy objectives to grow local businesses and increase the competitiveness of aquaculture in a global market. Ecolabels might address many environmental concerns and promote a more responsible farming of aquaculture. This paper argues that ecolabels may therefore represent a shared vision among multiple stakeholder groups. However, many stakeholders perceived ecolabels with skepticism, or recognized that they need improvement before they can be effective instruments for sustainability. Furthermore, ecolabels would not address many prominent socio-economic concerns. Such concerns include impacts to local communities, providing jobs, and rural growth. This emphasizes the complexity and multitude of drivers within the aquaculture controversy (Young & Matthews, 2010). This paper argues that, while ecolabelling can contribute to improving social acceptance, it is not a panacea for resolving issues of public confidence, trust, and acceptance of aquaculture. Researchers should aim to better understand the underlying uncertainties and complexities of social acceptance drivers to better evaluate how management options and interventions can influence acceptability.

Some argue that Nova Scotia has the potential to become a world leader in aquaculture (ACFFA, 2011). However, aquaculture must be developed in a way that is sustainable and socially accepted. This research can contribute to sustainable management of aquaculture by helping define current public concerns and exploring the implications management options can have on social acceptance of a controversial industry. Through a better understanding of public and stakeholder perceptions, governments and industries can help reduce conflicts (Mazur & Curtis, 2008). Information about stakeholder perceptions can help industries reduce uncertainty and develop more effective communication tools (Bacher, 2015). This research can help create a dialogue between stakeholders about the opportunities and challenges of ecolabelling. This research highlights the need to recognize the complexity and variability within ecolabelling. Finally, this research emphasizes that incorporating stakeholder perceptions within management decisions is important to help develop sustainable and socially accepted industries.

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## Appendices

**Appendix i.** Total number of a) sites and b) individual license holders in Nova Scotia farming various species of finfish. Data were extracted from the Province of Nova Scotia site mapping tool.

a)

<b>Species</b>	<b>Marine Farm (n=30)</b>	<b>Land-based Farm (n=9)</b>	<b>Hatchery (n=14)</b>	<b>% of TOTAL (N=53)</b>
Atlantic salmon	30	4	11	84.9
Atlantic halibut	0	4	1	9.43
Rainbow trout	27	3	10	75.5
Brook trout	5	1	10	30.2
Arctic char	5	2	7	26.4
Striped Bass	0	2	2	7.55

b)

<b>Species</b>	<b>Marine Farm (n=9)</b>	<b>Land-based Farm (n=9)</b>	<b>Hatchery (n=14)</b>	<b>% of TOTAL (N=32)</b>
Atlantic Salmon	9	4	11	75.0
Atlantic halibut	0	4	1	15.6
Rainbow trout	9	3	10	68.8
Brook trout	1	1	10	37.5
Arctic char	1	2	7	31.3
Striped Bass	0	2	2	12.5

**Appendix ii.** Survey distributed to finfish producers in Nova Scotia between June and August 2016.

### **Industry Perception Survey**

Q1: What county in Nova Scotia is your farm located?

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Q2: What species of fish does your farm raise/produce? **Check all that apply**

- |   |  |
|---|--|
| <input type="checkbox"/> Atlantic Salmon  | <input type="checkbox"/> Rainbow Trout |
| <input type="checkbox"/> Arctic Char      | <input type="checkbox"/> Striped Bass  |
| <input type="checkbox"/> Atlantic Halibut | <input type="checkbox"/> Brook Trout   |

Q3: How long has your farm been in operation?

- Less than 2 years
- Two to Five years
- Five to ten years
- Ten to fifteen years
- More than 15 years

Q4: Where are your products primarily sold? **Choose more than one option if appropriate**

- |  |   |
|--|---|
| <input type="checkbox"/> Within Nova Scotia                              | <input type="checkbox"/> To Europe                              |
| <input type="checkbox"/> Within Canada, primarily outside of Nova Scotia | <input type="checkbox"/> To global markets (multiple locations) |
| <input type="checkbox"/> To the United States                            |   |

Q5: What markets do you primarily sell your products to? **Please choose only one**

- Wholesalers
- Small retailers (fish markets)
- Restaurants
- Directly to consumers/individuals
- Processors
- Ongrowing farms

Q6: Are your products identified in stores by a unique trademark, brand or logo? **Choose the position that best reflects your organization.**

- Our products have a unique logo and brand that consumers can easily identify
- Some of our products can be identified by a trademark or logo, but the majority is not
- Consumers may not know the products are associated with our farm since our brand is not always advertised on our products
- We have not created a unique brand for our products, nor do final consumers link our products to our company.

Q7: For the following questions, please rate how much you agree or disagree with the following statements regarding your practices and policies?

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
The public's views and opinions are important to us	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It is our responsibility as an industry to educate the public and address stakeholder concerns	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Financial stability, growth and profitability are important to us	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
New regulations and policies benefit the industry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We must work with stakeholders to ensure our practices are socially accepted	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reducing the environmental impacts of our practices is a top priority	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Industries have been working hard in the last five years to adopt more sustainable farming practices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q8. How much pressure does your organization feel from the following sources to adopt more environmentally or sustainable farming practices?

	No Pressure	Low Pressure	Medium Pressure	Strong Pressure	Very strong Pressure
Regulators/Government	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Internal management or other employees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Investors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Customers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Civil society or NGOs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Suppliers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q9: Based on your personal understanding, please list three words that you would use to describe or define a seafood eco-label.

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Q10: In general, are you in favour/support ecolabelling in fisheries and aquaculture?

- Yes
- No

Q11: Is your farm currently involved in any of the following certification or labelling schemes? **Check all that apply**

- Codes of Conduct
- Third-party certification (B.A.P, ASC)
- Organic certification
- ISO Standards of practice
- Ocean Wise classification
- Other: \_\_\_\_\_

Q12: Are your products currently eco-labeled?

- Yes Specify which scheme(s): \_\_\_\_\_
- No, but we are in the process of pursuing ecolabelling
- No

Q13: Does your farm plan to participate in ecolabelling programs in the next 5 years? **Please select the choice that best reflects your opinions**

- Yes
- No
- Maybe
- Do not know / Prefer not to say

Q14: Does your farm plan to participate in ecolabelling programs in the next 10 years? **Please select the choice that best reflects your opinions**

- Yes
- No
- Maybe
- Do not know / Prefer not to say

Q15: For the following situations, please rate how much you agree or disagree with the following question: I would be *more likely* to participate in ecolabelling programs *if*:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
Competitors or other farms locally also participated in ecolabelling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Consumers or stakeholders (government, NGOs, public) demanded I do so	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I was involved in developing the standards for certification	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ecolabels were more clear and easier to understand	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Governments provided incentives (e.g. financial or aid) to get our products certified	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q16: Which ecolabels below do you recognize? **Choose all that apply.**



- 
- 
- 
- 
- 

Q17: Do you know which ecolabels would be available and applicable to your products?

- Yes Specify which scheme(s): \_\_\_\_\_
- No

Q18: For the following questions, please rate how much you agree or disagree with the following statements regarding the *benefits* of ecolabels.

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
Ecolabels can offer price premiums on products	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ecolabels can provide us access to more markets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ecolabels can improve our brand image	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ecolabels can tell consumers and stakeholders that we are committed to sustainable management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ecolabels can improve our competitiveness in the market	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ecolabels could reduce the negative feedback our industry receives	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ecolabels could attract investment into our company	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ecolabels could improve internal cohesion of our company's operations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q19: For the following questions, please rate how much you agree or disagree with the following statements regarding the *challenges* to ecolabels.

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
The cost and time of certification outweighs benefits	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
There is no demand from customers or retailers for ecolabels	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ecolabel programs are not available to us	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
There are too many ecolabels and I would not know which to choose	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Consumers are confused by ecolabels and don't know what they mean	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Customers are not willing to pay more for our products if they are ecolabeled	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Suppliers and other companies involved in product-chain are unwilling to share information and transparency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The cost and effort to advertise ecolabels are too great	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The benefits to ecolabelling are too uncertain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Appendix iii.** Factor sort values for statements for Q-methodology (Q-sample) grouped by category and thematic area. \* Indicates a distinguishing factor at  $p < 0.05$ , \*\* indicates a distinguishing factor at  $p < 0.01$ .

Category	#	Statement	F1	F2	F3	F4
<b>A. Ecolabel Uptake</b>						
A1. Market Use						
	3	There is currently a strong demand for sustainably labelled seafood products in Nova Scotia	-2	-1	0	0
	5	Consumers are not willing to pay more for ecolabelled farmed fish products	-4**	-3**	2**	-1**
	12	Certification is increasingly becoming a pre-requisite for entry into some markets and will continue to be important in the global marketplace	3	3	4	0**
	13	Eco-certification has reached mainstream status that is globally recognized and used	-1	-1	3**	-2
	28	Most aquaculture ecolabels are too new to have enough market pull and consumer demand	-1	0	-1	1
A2. Industry Use						
	6	Few farms in Nova Scotia are capable of becoming certified/labelled because they do not meet the standards of such labels	-2	-1	-3	-3
	41	Paying for certification is expensive so many producers in Nova Scotia will not be able to meet costs	-1	-3**	0	-1
	47	Since Nova Scotia has strict aquaculture regulations, the uptake of ecolabels by producers would be relatively straightforward and inexpensive	-2	-4**	1**	-3
	49	Fish farmers in Nova Scotia are willing to participate in ecolabelling given proper incentives	1*	-1	2*	-1
A3. Government Involvement						
	15	National and provincial policies should promote the implementation of aquaculture certification	1**	-2*	0	0
	21	Certification schemes set an unwanted precedent for the public to trust and rely more heavily on non-governmental groups for information than the government	-4**	-2	0	-1
	23	Government support in labelling improves the uptake of labels so that they could reach a wider audience with greater brand recognition	1	-1	-2	1
<b>B. Benefits and Challenges</b>						
B1. Consumer interests						
	2	The growing number of ecolabels and other ethical product differentiations leads to confusion	0**	0**	3	4
	4	Labelling of Nova Scotia aquaculture products would allow consumers to make informed decisions	2	0	0	2
	11	The public and consumers should have more influence in sustainable aquaculture management	-1**	2	-4**	2



24	Ecolabels only cater to a small demographic of consumers	-2**	2	4*	1
<b>B2. Communicability</b>					
17	Effective ecolabelling require significant marketing and consumer education and awareness	1	0	1	3*
20	Ecolabels help show that industries are working at addressing important environmental, social and economic issues of the public and stakeholders	2	1	1	-2**
22	The environmental standards of most ecolabels are not very accessible or understandable	-2	0*	-2	2**
33	Ecolabelling can open up channels for communication and collaboration between industries and other aquaculture stakeholders	3	1	2	3
37	Ecolabels are not good communication tools between stakeholders because not everyone knows about, recognizes or understands ecolabels	-3	-2	-1	2**
<b>B3. Economic incentives</b>					
9	Investment in technical and financial assistances for small-scale farmers is required to enable their participation in certification programs.	0	0	-2*	2
16	Differentiation into a premium eco-certification market offers Nova Scotia the opportunity to maintain a strong financial position in the face of challenges in the commodity market.	2	0	0	0
25	There is little evidence of industries actually receiving significant premiums from ecolabelling	-3	0**	2**	-3
36	By creating higher valued certified products, it may bring down prices and demand for the rest of Nova Scotia's existing uncertified farmed products	-3	-3	-3	-4*
42	Ecolabels gives industries greater market access to retailers committed to sustainably sourced seafood	4	2	3	3
<b>B4. Credibility</b>					
1	Credible ecolabels are administered only by a third-party certification process	3	2	2	-2**
14	Seafood ecolabels provide assurance that sustainable practices are being applied in a consistent and verifiable way	2	-2	1	-2
35	Not all ecolabels have equal credibility	3	4	3	1*
39	Demand for certified seafood has set a low bar for what should be certified or not; not all species or production systems should be able to become certified	-1*	3**	-2	-2
<b>C. Potential influence</b>					
<b>C1. Address environment concerns</b>					
8	Even if an ecolabel implies that better methods are practiced, this does not necessarily mean the system is sustainable, i.e., somewhat less unsustainable does not imply sustainable	0	4**	0	0
19	Eco-certification and ecolabels would address many of the environmental concerns of aquaculture	1	-3**	-1	0
29	Certified aquaculture production is less environmentally harmful than non-certified production	0**	-4	-2*	-4

46	The environmental standards for most ecolabels are not very strict or exhaustive	-3*	2**	-1	-1
C2. Address social concerns					
27	Eco-certification should address not only environmental issues, but also social ones	0	2	1	4**
34	Certification does not address the concerns of local communities living adjacent to farms (visual impact, impact to businesses)	0*	3**	-3**	1*
38	Fish are healthier in certified farms because of strict standards on stocking densities, chemical use and other requirements	1**	-4**	-2	-1
45	Animal welfare issues specific to Nova Scotia (superchill) are not considered in most ecolabel schemes	-1	0	0	-2
C3. Address economic concerns					
30	Certification of fish farms does not reduce their negative economic impacts to other activities such as fisheries or tourism	0	3**	-3**	0
40	Certification could create more jobs in farms because of the additional administration staff and opportunities for development	0	-2**	0	1
C4. Address management concerns					
10	Certification should be viewed as only one of many intervention tools to improve the environmental performance of the aquaculture industry	4	4	4	-1**
43	Ecolabelling could increase the transparency and traceability of fish farms above status quo requirements	4	1*	2	2
48	There is little evidence that eco-certification results in improved resource management in aquaculture	-4**	1	-1**	1
C5. Social acceptance					
18	Growers that pursue ecolabelling will receive less opposition for future development and expansion	0	-1	-4	-3
31	Ecolabelling can improve the social acceptance of Nova Scotia's aquaculture industry	1	-1	1	0
C6. Other influence					
7	Innovative technologies such as closed containment should be prioritized within ecolabel standards	2	1	-4	-4
26	Industries, governments, consumers and NGOs all stand to benefit from eco-certification	2	-2	-1	3
32	Ecolabels are unlikely to address stakeholder concerns because they only address a limited number of environmental, social and economic concerns	-2	1**	-1	0
44	More research on ecolabels is needed to determine whether they can create positive impacts in Nova Scotia's aquaculture industry	-1**	1	1	4**



**Appendix v.** Types of articles found from a diversity of major newspaper and broadcast sources.

<b>Source</b>	<b>Type of article</b>			<b>Total</b>
	<b>Feature</b>	<b>News</b>	<b>Opinion</b>	
Canadian Press	0	23	0	23
Cape Breton Post	0	7	1	8
CBC News	4	24	0	28
Chronicle Herald	0	37	30	67
CityNews	0	5	0	5
CTV News	0	3	0	3
Global News	0	9	0	9
Globe and Mail	1	11	0	12
La Presse	0	2	0	2
MacLeans	1	0	0	1
Metro	0	12	0	12
National Post	0	1	0	1
Newswire	0	4	0	4
Reader's Digest Canada	3	0	0	3
The Coast	0	1	1	2
The Tye	0	2	0	2
Toronto Star	0	5	0	5
Truro Daily	1	9	2	12
Vancouver Sun	2	7	1	10
<b>Grand Total</b>	<b>12</b>	<b>162</b>	<b>35</b>	<b>209</b>

Appendix vi. Total number of unique articles and individuals quoted across various stakeholder groups.

<b>Stakeholder group</b> <i>Stakeholder</i>	<b>Number of articles quoted</b>	<b>Number of individuals quoted</b>
<b>Academics and Experts</b>		
Academic	27	33
Expert (Health)	1	1
Experts	1	1
Experts (Law)	2	2
Lawyer	2	2
<b>Advocates</b>		
Advocate (Conservation)	8	8
Advocates	39	45
Advocates (Community)	5	6
<b>Public groups</b>		
Chef	3	3
Community	1	1
First Nation	3	4
Public	19	22
<b>Government officials</b>		
Government (Canada)	9	10
Government (Municipal)	9	12
Government (Provincial)	35	39
<b>Business Leaders</b>		
Aquaculture industry	42	50
Fisheries	6	7
Other Business Leaders	14	17

Appendix vii.

*A. Test for significance of average indicator scores between dimensions of sustainability*

**Kruskal-Wallis rank sum test**

data: x and g

Kruskal-Wallis chi-squared = 8.5902, df = 3, p-value = 0.03527

**Pairwise comparisons using Dunn's-test for multiple comparisons of independent samples**

data: x and g

	Environmental	Social	Economic
Social	0.017	-	-
Economic	0.032	0.605	-
Management	0.649	0.135	0.109

P value adjustment method: none

*B. Test for significance of average indicator scores between ecolabelling schemes*

**Kruskal-Wallis rank sum test**

data: x and g

Kruskal-Wallis chi-squared = 15.942, df = 3, p-value = 0.001165

**Pairwise comparisons using Dunn's-test for multiple comparisons of independent samples**

data: x and g

	ASC	BAP	Ocean Wise
BAP	0.36499	-	-
Ocean Wise	0.00546	0.06115	-
Organic	0.00042	0.00882	0.45542

P value adjustment method: none

Appendix viii. Evaluation and scores for each individual indicator explored to assess sustainability criteria of ecolabelling schemes. A full listing of the locations within standards where criteria were met can be found in supplemental material available from the author upon request.

Criteria	Indicator	Standard	Requirements	Numerical score
<b>ENVIRONMENTAL</b>				
Water and farm environment quality	<b>Impacts to farm environment</b>	Organic	Sited in locations where little risk to contamination and that outputs do not exceed assimilative capacity of environment. Must have a dissolved nutrient and particulate plan. Must have a plan that outlines environmental effects to farm environment and how they will be mitigated	1
		ASC	Third-party analysis must show that farm is located in area with 'good' or 'very good' water quality	0.75
		BAP	Outlines nutrient monitoring requirements for water quality but no consideration for site or assimilative capacity etc...	0.5
		Ocean Wise	Assesses management framework that looks for area based, cumulative approach that considers the impacts as they relate to the carrying capacity of the receiving water body	1
	<b>Effluent and water quality monitoring</b>	Organic	Effluent monitoring carried out at least annually	0.25
		ASC	Weekly monitoring for nitrogen and phosphorous. Consideration for feed based effluents, dissolved oxygen, biochemical oxygen demand etc...	1
		BAP	At least three years of monitoring data. Cumulative area monitoring in some areas. Must have monitoring and recording of feed-based nitrogen and carbon discharge	1
		Ocean Wise	Requires calculation of nitrogen discharged from farm as a function of waste and feed. Detailed calculations would require monitoring of these aspects.	1
	<b>Non-biological waste management</b>	Organic	Little mention - retired equipment reused or recycled when possible	0.5
		ASC	Presence of a policy for proper disposal and recycling of non-biological waste and evidence of recording (plan + recording requirement	0.25
		BAP	Farms must have written Material Storage, Handling and Waste Disposal Plan and waste reduction plans. Standards detail specifics about training, waste disposal and cleaning of equipment	1
		Ocean Wise	No mention - throughout, it mentions evidence of chemical use, but does not consider how waste is managed, treated or stored	0
		Organic	Sited so sediment does not exceed assimilative capacity, and requires a plan to back up how this will be tested	0.5
Benthic impacts	<b>Benthic biodiversity and impacts</b>	ASC	Site specific Allowable Zone of Effect, and multiple measures to test biodiversity, infaunal diversity etc... within that area	1
		BAP	Documents to show that farms meet a designated 'benthic trigger' level	0.25
		Ocean Wise	The Habitat Criterion assesses the impacts, or risk of impacts, within the farm boundary or an Allowable Zone of Effect (Factor 3.1) and the scope and effectiveness of management or regulatory systems which govern them (Factor 3.2)	1
		Organic	No use of leachable toxic materials in construction or housing materials	0.5
Hazardous chemical inputs	<b>Discharge of chemicals and toxins</b>	ASC	Provides conditions for cleaning and treating of copper nets. Documentation otherwise required for most chemical inputs, treatments etc...	0.75
		BAP	Chemicals stored in a safe place and disposed of responsibly. Must have precautions established to prevent spills and plans to manage spills or leaks	0.75
		Ocean Wise	Criterion 4 assesses the farm's discharges of chemicals directly and the management plans to address them	1

Genetic modification	<b>Genetic engineering</b>	Organic	Genetic modification prohibited	1
		ASC	No use of transgenic salmon	1
		BAP	Stocked fish must not be transgenic	1
		Ocean Wise	No mention	0
Managing disease or parasites /Biosecurity	<b>Parasites</b>	Organic	Comprehensive plan for parasites including preventative measures and measures for when they fail	0.75
		ASC	Annual review of ABM scheme for sea lice. Frequent monitoring of sea lice on farms. Monitoring of sea lice on outmigration salmon and limitations when in areas of wild salmon	1
		BAP	Comply with regulations to minimize parasites. Fish must be monitored for parasitic infection	0.5
		Ocean Wise	Must have no parasites shown or little mortality of impacts to fish from the. Risk analysis also done which considers farm location, stocking densities and proximity to wild populations which can amplify impacts of parasites	1
	<b>Use of antifouling chemicals</b>	Organic	No chemical antifoulants permitted	1
		ASC	Monitoring of copper in sediments and restrictions. Evidence of proper cleaning and nets are not allowed to be cleaned in the water	1
		BAP	Conditions for the proper cleaning of nets, but no restrictions. Farms should explore alternatives, however.	0.75
	<b>Biosecurity management</b>	Ocean Wise	Chemical Criterion aims to reduce the use and release of chemicals into the environment. Antifoulants would be considered in that chemical index and thus would have to be demonstrated to be reduced. (Not a major portion)	0.5
		Organic	Disease should be identified and treated immediately. Where possible, cause of outbreaks and mitigation measures to prevent should be identified.	0.5
		ASC	All diseases must be reported and have minimal disease related mortalities or unexplained. Must have a plan for monitoring and dealing with disease	1
BAP		Written health and biosecurity plans, with monitoring and data recording of any disease outbreaks which are publically available and reported. Must check smolts coming in for disease	1	
Impacts to local species/environment	<b>Interaction with critical or sensitive habitats and species</b>	Ocean Wise	Evidence of little/no transmission of disease to wild populations. Assesses the risk which involves site location, stocking densities etc... Which may increase the risk of infection. Robust fish health and biosecurity plans must be in place	1
		Organic	Not mentioned	0
		ASC	Farms must not be located in a protected area. Farms must also have Evidence of an assessment of the farm's potential impacts on biodiversity and nearby ecosystems	0.75
		BAP	Farm shall not be located in an area officially listed as "critical" or "sensitive" unless proper documentation. A risk assessment shall look into the interactions with environment or species in these areas. Will have a written wildlife interaction plan	0.75
Impacts to local species/environment	<b>Predator deterrence</b>	Ocean Wise	Should not have mortalities or population effects to endangered or protected species	0.75
		Organic	Must have predator deterrence plans that use non-lethal methods of deterrence first. List various substances that may not be used and conditions for it. No mention of acoustic devices	0.75
		ASC	Limits numbers of mortalities from lethal procedures. There must be evidence that non-lethal methods were used first. Acoustic harassment devices may not be used on endangered animals. Within 3 years of certification, must have no use of acoustic devices	1
		BAP	Written wildlife interaction plan which includes measures for predator deterrence. Operators should active seek non-lethal measures. No lethal action shall be taken against endangered species. Must record all predator mortalities. Acoustic harassment devices may be used under extenuating circumstances	1



Escapes	<b>Management of escapes</b>	Ocean Wise	No or very low (with little impact) of mortalities to predators. Does not consider acoustic devices	0.75
		Organic	Controls must be in place to minimize escapes and a contingency plan as well. Escapes must be recorded to certification body and government	0.5
		ASC	Maximum amount of escapes. Escape prevention planning and employee training. Escapes must be made publically available.	1
		BAP	Written Fish Containment Plan with employee training. Must provide evidence that any escapes that happen were in compliance with Containment Plan and certification requirements	0.75
Energy/GHG	<b>Energy Use, GHG emissions</b>	Ocean Wise	Criterion 6.0 The Escapes Criterion is therefore developed to assess the risk of escape from the production system, and the risk of invasiveness and potential ongoing impact to the surrounding ecosystem of those escapes.	1
		Organic	Not mentioned	0
		ASC	Energy use assessment, records of GHGs, and annual assessment. Recording and assessment of GHGs in feed considered	1
Feeding practices and materials	<b>Feed efficiency</b>	BAP	Not mentioned	0
		Ocean Wise	Recording requirement only	0.25
		Organic	Compatible with diets that would be natural for the species	0.5
	<b>Feed practices: waste, sloughing to benthos</b>	ASC	Included within the calculation for dependence on wild feed (Economic Feed Conversion Ratio)	0.5
		BAP	Feed conversion ratio calculated and a FIFO of 1.5 or less	0.75
		Ocean Wise	Net Protein = (Harvested Protein Output – Edible Feed Protein Input)/ Edible Feed Protein Input x 100	0.75
		Organic	Feed shall only be offered in a way that minimizes loss of feed to environment	0.75
		ASC	Not mentioned	0
		BAP	Not mentioned	0
		Ocean Wise	Not mentioned	0
	<b>Traceability of fish feed</b>	Organic	Not mentioned	0
		ASC	Traceability of all feed ingredients that make up more than 1% of feed. Third party certified chain of custody traceability	1
		BAP	Documents must support traceability of feed, proteins and describe the characteristics of the feed and quantities used	1
	<b>Use of wild fish for feed</b>	Ocean Wise	Not mentioned	0
Organic		Fish oil and fish meal must be organic, where available. If not available, they must come from sustainable fisheries	0.5	
ASC		Specifies calculations and specific limitations for fish oil and fish meal dependency	0.75	
<b>Feed additives and pigments</b>	BAP	The applicant shall source feed from a BAP-certified feed mill or a feed mill that declares and documents compliance with the BAP feed mill standards criteria for fishmeal and fish oil conservation	0.5	
	Ocean Wise	Factor 5.1 combines the amount of wild fish used (Factor 5.1a) with the sustainability of the source fishery (Factor 5.1b) to give a score from 0-10 for “wild fish use”.	1	
	Organic	No artificial colouring or synthetic additives	1	
	ASC	Not mentioned	0	
	BAP	Only mention in reference to another section: No antibiotics or drugs in non-medicated feed and that PCBs and heavy metals are below acceptable levels	0.5	
<b>Source of non-marine additives in feed</b>	Ocean Wise	Not mentioned	0	
	Organic	Not mentioned	0	
	ASC	Must have a responsible sourcing policy for non-marine additives. Must be switching towards more plant-based but have	1	

<b>SOCIAL</b> Fish health and welfare	<b>Survival, health and welfare of farmed fish</b>	BAP	documents and evidence of non-transgenic plant materials Record keeping requirements only	0.25	
		Ocean Wise	As part of the protein in and efficiency calculations, must calculate the amount of protein from non-edible sources	0.5	
		Organic	Dedicated section that requires effective monitoring of health, disease, water quality requirements etc...	1	
		ASC	Fish health management plan in place with detailed record-keeping requirements. Mortalities must be limited and small.	0.75	
		BAP	Fish health plan in place, with required monitoring by veterinarian for health, behavioural monitoring and water quality. Whole section addresses welfare and health of fish	1	
		Ocean Wise	Fish health management plans should prove to be robust with little mortality. Considered within disease and parasite risk assessment. No dedicated section	0.5	
		<b>Stocking density</b>	Organic	Specific requirements : open (10kg/m) and land (40kg/m)	1
			ASC	Not mentioned	0
			BAP	Generally below 25kg/m but may rise higher if shown good water quality etc...	1
			Ocean Wise	Mentioned as a small requirement in the consideration of vulnerability and risk of disease amplification	0.5
	<b>Fish handling and Slaughter practices</b>	Organic	Slaughter practices shall minimize stress and pain. No toxins or chemicals, or suffocation	1	
		ASC	Not mentioned	0	
		BAP	Recording requirement of transfer, time out of water etc... Staff shall handle, transport and slaughter with care. Shall be slaughtered humanely	1	
		Ocean Wise	Not mentioned	0	
		<b>Steroids and hormones</b>	Organic	Steroids and hormones are not permitted	1
			ASC	No mention	0
			BAP	Antibiotics shall not be used as growth promoters	0.75
			Ocean Wise	No mention	0
		<b>Use of therapeutants or vaccines</b>	Organic	Must conform to specific conditions. Lists potential alternatives.	0.75
			ASC	Criterion 5.1 entirely deals with therapeutants. Records for all drugs used. Drugs must be authorized and administered by health professional. Details specific drug limitations that must be evidenced.	1
Health and food safety	<b>Food safety considerations</b>	BAP	Records for all drugs used. Drugs must be authorized and administered by health professional. No growth promoters allowed. No therapeutants listed as critical for human health.	0.75	
		Ocean Wise	No therapeutants that would be harmful to human health. Therapeutants used must be recorded and should be minimized. Assesses management framework as well.	0.75	
		Organic	Waste management and general hygiene. Waste management and general hygiene. Considerations for chemical inputs, antibiotics etc...	0.75	
		ASC	No antibiotics critical to human health. Focus on transparency of information about food safety risks	0.5	
		BAP	Dedicated criterion that outlines multiple standards for minimizing risk of hazards and chemicals critical to human health. Include proper hygiene considerations, biosecurity plans etc...	1	
		Ocean Wise	Only consideration are for assessment of chemicals critical to human health	0.5	
		<b>Hygiene considerations</b>	Organic	Requires defined protocol for cleaning of equipment, utensils etc... and hygienic considerations for disease	0.5
			ASC	Not mentioned	0

Public consultation and engagement	<b>Community engagement and consultation</b>	BAP	Require written health plan which outline cleaning procedures, disposal etc... Able to demonstrate compliance. Specifics on other hygiene related aspects	0.75
		Ocean Wise	Not mentioned	0
		Organic	Not mentioned	0
	<b>Respect for indigenous cultures and territories</b>	ASC	Evidence of regular meetings, conflict resolution and communication. Evidence of regular and meaningful consultation (defined in standard)	1
		BAP	Criterion 2 deals with community relations and includes standards relating to annual meetings, documents of correspondences and transparency. Must demonstrate interaction with communities)	1
		Ocean Wise	Not mentioned	0
Organic		Not mentioned	0	
Impacts to local communities	<b>Minimize noise and odour</b>	ASC	Comply with regulations, evidence of proactive consultation, develop protocol of agreement with indigenous groups	1
		BAP	Must demonstrate dialogue with indigenous peoples for conflict resolution only	0.75
		Ocean Wise	Not mentioned	0
	<b>Access to resources</b>	Organic	Not mentioned	0
		ASC	Not mentioned	0
		BAP	Not mentioned	0
		Ocean Wise	Not mentioned	0
	<b>Consider visual impact of farms</b>	Organic	Not mentioned	0
		ASC	Evidence of community impact assessment and changes restricting access need community approval	1
		BAP	Cannot block public access to fishing grounds or recreation	0.5
Ocean Wise		Not mentioned	0	
Organic		Not mentioned	0	
Public transparency and communication	<b>Public transparency of information</b>	ASC	Not mentioned	0
		BAP	Not mentioned	0
		Ocean Wise	Not mentioned	0
		Organic	Not mentioned	0
Labour rights	<b>Freedom of association and collective bargaining</b>	ASC	Extensive list of publically available and recording information	1
		BAP	Should consider complaints and requests for information (only when requested)	0.5
		Ocean Wise	Within habitat criterion, enforcement of management must be contactable and licensing and leasing information must be transparent	0.5
	<b>Child labor</b>	Organic	Not mentioned	0
		ASC	Evidence of employees available to join unions, bargain rights, etc...	1
		BAP	Policies allow employers to freely join unions (not evidence required)	0.75
		Ocean Wise	Not mentioned	0
		Organic	Not mentioned	0

		ASC	No child labour, comply with laws. Young workers are protected from hazard work conditions and must not go overtime	1
		BAP	No child labour, comply with laws. Young workers are protected from hazard work conditions and must not go overtime	1
		Ocean Wise	Not mentioned	0
	<b>Forced, bonded or compulsory labor</b>	Organic	Not mentioned	0
		ASC	Not permitted	1
		BAP	Not permitted	1
		Ocean Wise	Not mentioned	0
	<b>Contracts (labor) including subcontracting</b>	Organic	Not mentioned	0
		ASC	Must have written contracts, and policy for social compliance	0.75
		BAP	Must have written recorded contracts and subcontracts. Subcontractors shall have similar training, wage benefits etc... to employees.	1
		Ocean Wise	Not mentioned	0
	<b>Conflict resolution</b>	Organic	Not mentioned	0
		ASC	Grievance access and timeframes	0.75
		BAP	Not mentioned	0
		Ocean Wise	Not mentioned	0
	<b>Disciplinary practices</b>	Organic	Not mentioned	0
		ASC	No abusive form of disciplinary action. Presence of a disciplinary policy.	1
		BAP	No physical abuse or wage deduction as part of disciplinary action	1
		Ocean Wise	Not mentioned	0
	<b>Education and training</b>	Organic	Not mentioned	0
		ASC	Encourage of extra training and need to be trained in health procedures	0.75
		BAP	Various training requirements and provisions detailed as to specifics	1
		Ocean Wise	Not mentioned	0
	<b>Discrimination</b>	Organic	Not mentioned	0
		ASC	No incidence of discrimination. Active policy and procedures for antidiscrimination	1
		BAP	Provide equal opportunities to employment, access to resources etc...	0.75
		Ocean Wise	Not mentioned	0
	<b>Work environment health and safety</b>	Organic	Not mentioned	0
		ASC	Require considerations for risk assessment, use of PPEs but not specific requirements or extensiveness	0.75
		BAP	Extensive considerations for various health and safety plans, risk assessment, incident reporting, training etc...	1
		Ocean Wise	Not mentioned	0
<b>ECONOMIC</b>				
Living and minimum wage	<b>Wages</b>	Organic	Not mentioned	0
		ASC	Minimum wage or more, but also considers working towards basic needs payment and transparency	1
		BAP	Generally clarification on legal compliance, but also for deducting wages and wage payment	0.75
		Ocean Wise	Not mentioned	0

	<b>Working hours and overtime</b>	Organic	Not mentioned	0
		ASC	Legal compliance + Overtime is limited, voluntary, paid at a premium rate and restricted to exceptional circumstances	0.75
		BAP	Legal compliance only	0.25
		Ocean Wise	Not mentioned	0
	<b>Employee benefits</b>	Organic	Not mentioned	0
		ASC	Not mentioned	0
		BAP	Benefits include beyond the basic needs to ensure clean potable water, health food, access to toilets and showers etc...	1
		Ocean Wise	Not mentioned	0
Impacts to coastal users	<b>Access to resources</b>	Organic	Not mentioned	0
		ASC	Assessment to monitor impact on access to resources	0.75
		BAP	Shall not block access to fishing grounds	0.5
		Ocean Wise	Encourages an area approach that is integrated with other industries to manage cumulative impacts	0.75
MANAGEMENT				
Legal Requirements	<b>Compliance with regulations</b>	Organic	Comply with local and national regulations. Emphasis on Permitted Substances Act	0.25
		ASC	Principle 1 : Presence of documents demonstrating compliance to regulations on land and water use, tax laws, labour laws, water quality impacts	1
		BAP	Criterion 1: Presence of documents demonstrating compliance to regulations on land and water use, labour laws, operating licenses, environmental regulations, indigenous laws. Producers should also be working towards and Area Management Agreement with biosecurity plans at least twice regulatory requirement	1
Monitoring and Environmental Assessment	<b>Evidence of ongoing monitoring efforts</b>	Ocean Wise	No evidence of illegal activities.	0.25
		Organic	No mention	0
		ASC	ABM scheme which has monitoring plan for disease, parasites, sea lice. Also must monitor P and N	1
		BAP	Monitoring for benthic quality, sediment and nutrient levels, coordinated within an ABM scheme and with other farms	1
		Ocean Wise	Public availability needed as part of data recording criterion, some indicators include monitoring	0.5
	<b>Provision of an Environmental Impact Assessment</b>	Organic	No mention	0
		ASC	Requirement for biodiversity-focused environmental assessment. Not legal assessment, only focuses on impacts to biodiversity	0.75
		BAP	Legal compliance. BAP provides audits to augment enforcement	0.25
		Ocean Wise	Mentioned as part of data recording for 'habitat'	0.25
Geographical Farm Location	<b>Considerations of the geographical location and placement</b>	Organic	Sited so that sediment build up does not exceed assimilation capacity of local environment [also needs a plan to show how measured]. Net pens shall be sited to minimize contamination and disease taking into account currents and seasonal changes	0.75
		ASC	Not directly mentioned but provides conditions for considering if farms are located in certain areas	0.5
		BAP	Not located in areas 'critically sensitive' or 'endangered' unless authorized and justified with an environmental impact assessment	0.75
		Ocean Wise	Siting required in-depth knowledge of environmental factors and local conditions. Should take an integrated ecosystem approach that also considers community impacts	1

Record keeping and traceability	<b>Records of operations</b>	Organic	Organic plan must outline record-keeping details. Records must enable tracing of origin, quantities and composition of products and feed	0.75
		ASC	Data criterion which assesses farm's availability of information from a combination of information available on : production, management, effluent, habitat, chemicals, feed, escapes, disease, source, predators/wildlife, introduced species, energy use	1
		BAP	Criterion 12 - Traceability: Outlines various requirements include that operators must have record keeping system that tracks each production cycle and includes records for treatment and drug use, feed quantities, transportation requirements	1
	<b>Preparation of specific farm-related management plans</b>	Ocean Wise	Records of all mortalities, greenhouse gases, escapes, energy use, accident reports, etc...	0.75
		Organic	Operators must have an Organic Plan denoting areas of processing, production and handling. Have a nutrient plan, plan for escapes, parasites and predator deterrence	0.75
		ASC	Involvement in an Area Based Management which requires some plans. Mentions a health management plan.	0.5
		BAP	Requires presence of multiple plans include a Fish Containment Plan, Wildlife Interaction Plan, Materials Storage, Handling and Waste Disposal Plan, Water Quality Management Plan, Fish Health Management Plan,	1
		Ocean Wise	No mention	0