# Exploring consumer-facing traceability as a risk mitigation strategy for seafood producers in Nova Scotia

By

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## Table of Contents

# List of Tables

# List of Figures

## Abstract

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Nova Scotian producers and consumers are continuously faced with the complexity of global seafood supply chains. Recent studies on seafood mislabeling, fraud, and the newly uncovered issue of slave labour, has led to increased information demands and a push for change in the way seafood supply chains operate by adopting new international regulations and initiatives. This naturally creates a risk to industry actors who fail to comply with these changes and new regulation standards. While seafood traceability has been present within the global food supply chain for decades, consumer-facing traceability has newly emerged as an innovative way to communicate provenance and distinguish brands within the market. This research aims to assess under what context and for which seafood sector consumer-facing traceability may be a feasible risk mitigation strategy for producers. This question is addressed through semi-structured interviews from a variety of actors along the supply chain within Nova Scotia, supply chain mapping of major species, and a simplified risk assessment. Results highlight the necessity for traceability to combat pressing issues such as mislabeling and illegal cash fisheries within the industry, as well as the willingness to engage if benefits outweigh costs. While consumer-facing traceability's role in mitigating risk for mainly small-scale producers was not evident and challenges, such as competition and lack of transparency inhibits consumer-facing traceability adoption, shellfish aquaculture producers are seen as the most prepared to take on consumer-facing traceability to mitigate risk and reap the most benefit by differentiating their product within the market. Finally, this study provides insights into the seafood supply chain in Nova Scotia and offers recommendations to shift toward a transparent seafood industry benefiting producers and consumers.

*Keywords*: seafood; consumer-facing traceability; Nova Scotia; producers; seafood supply chains; market; regulation; risk mitigation.

## Abbreviations

| | |
|---|---|
| ASC | Aquaculture Stewardship Council |
| BAP | Best Aquaculture Practices |
| CFIA | Canadian Food Inspection Agency |
| CFT | Consumer-facing traceability |
| COOL | Country of Origin Labelling |
| CSSP | Canadian Shellfish Sanitation Program |
| DFO | Department of Fisheries and Oceans Canada |
| EU | European Union |
| FIR | Fish Inspection Regulations |
| HACCP | Hazard Analysis Critical Control Point |
| IUU | Illegal, Unreported, Unregulated |
| MSC | Marine Stewardship Certification |
| NGO | Non-governmental organization |
| RFID | Radio Frequency Identification |
| QR | Quick reference |
| UK | United Kingdom |
| US | United States |

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# Chapter 1 – Introduction

Within the last two decades, seafood production from capture fisheries and aquaculture has steadily grown and has amounted to being the most traded food commodity in the world (Pardo et al., 2016). This rise in seafood globalization means that seafood supply chains are continuing to increase in complexity (Leal et al., 2015), where seafood supply chains encompass all activities in relation to the flow of seafood and seafood products from harvest to the end user, as well as the information that is associated with the product (Seuring & Mu, 2008). These chains are increasingly becoming complex, consisting of numerous actors and covering extensive geographical locations before the final product ends up in the hands, or mouths, of consumers (Future of Fish, 2015; Sterling et al., 2015). In fact, approximately 40% of all fishery production is traded internationally, and it is estimated that anywhere from 60% to 80% of this traded seafood currently ships to Japan, the European Union (EU) and the United States (US) (Jensen, 2006; Swartz et al., 2010). International trade increases the complexity within the seafood supply chain because less control exists over food handling, transportation, and packaging (Jensen, 2006). This increased complexity often leads to other issues that have negative consequences to the environment, the seafood industry, and consumers (Jacquet & Pauly, 2008; Leal et al., 2015).

In the past, concerns over seafood safety through production and distribution have dominated, whereby consumers were mainly concerned about safety and quality (Leal et al., 2015). However, additional concerns through the environmental and social dimensions have arisen more recently as a result of increased seafood supply chain complexity (Magera & Beaton, 2009; Olson et al., 2014; Parenreng et al., 2016). Global and national studies have revealed the widespread presence of seafood mislabelling and fraud, through efficient taxonomic methods such as DNA barcoding, in grocery stores, restaurants and local markets (Hanner et al., 2011; Jacquet & Pauly, 2008; Leal et al., 2015; Muñoz-Colmenero et al., 2016; Nagalakshmi et al., 2016; Oceana, 2013; Stawitz et al., 2016). While incorrect labelling of seafood may arise as a mistake or misunderstanding surrounding species names or origins, for example, it is also common that seafood is mislabelled for economic gain or to meet current demands by substituting cheaper, low value species for high value ones (Bailey et al., 2016; Khaksar et al., 2015; Stawitz et al., 2016). Both intentional and unintentional mislabelling of seafood products results in increased health risks for consumers and prevents consumers from making informed,

sustainable choices (Helyar et al., 2014). Additionally, the lack of enforcement and regulation surrounding the seafood industry, has encouraged illegal, unreported, and unregulated (IUU) fishing (Helyar et al., 2014). IUU fishing has been detected worldwide with the advancement of satellite tracking data and is estimated to account for approximately 25% of all commercial wild fishery catches (Burzigotti et al., 2012; Helyar et al., 2014). Both mislabelling and IUU fishing make fisheries stock assessments more difficult, causing concerns over seafood sustainability (Crona et al., 2015). Furthermore, the recent expose on slavery at sea and human trafficking within the industry, especially within Thailand amongst the offshore shrimp fisheries, has brought into question the labour conditions and well-being of fish harvesters supplying seafood products (Kittinger et al., 2017; Marschke & Vandergeest, 2016).

This highly complex and globalized seafood industry has led to elevated informational demands for supply chain actors within the industry (Bailey et al., 2016), mirroring general demands from consumers for more fully transparent food production systems for both safety and sustainability reasons (Mol, 2015). As a result, many of the voluntary increases in transparency have been operationalized by private industry actors and non-governmental organizations (Nunes et al., 2017). Furthermore, globally, but specifically in the US and the EU, regulatory import requirements are shifting towards the need to track seafood products along the supply chain and provide more detailed labelling on seafood products for consumers, as well as to combat IUU fishing and fraud (Magera & Beaton, 2009). These bylaws include the US Bioterrorism Act, US Country of Origin Legislation and the newest regulation set to initiate in January 2018, the US Seafood Import Monitoring Program (Magera & Beaton, 2009; NOAA, 2016). The EU has also introduced regulation over the past decade that has led to better labelling standards and traceability (Lewis & Boyle, 2017). These include stricter regulations and labelling outlining the requirement for more traceability within the EU, as well as import regulations that emerged as a result of high instances of IUU fishing and mislabelling (CFIA, 2015a).

Due to increased calls for transparency in light of seafood sustainability concerns, traceability has emerged as a tool that has the ability to satisfy these demands and combat the issues associated within the seafood today (Lewis & Boyle, 2017). Traceability comes in many shapes and dimensions, as it is simply the flow of information, but for it to fully resolve the current global problems and provide consumer confidence, consumer-facing traceability may be a necessity (Miller, 2014). Consumer-facing traceability (CFT), also known as “end-to-end”

traceability or "full chain" traceability, implies that a consumer is able to trace their seafood purchase back to its origin or point of harvest to obtain elaborate details on that product (Fishwise, 2017). While many companies are now publically committing to sourcing sustainable products or adopting sustainable practises, the next challenge is the ability to verify those claims and ensure consumers are able to trace merchandise back to their origins (Fishwise, 2017). Thus, consumer-facing traceability has newly emerged as a critical management tool for tracing product information from the "boat to plate," and therefore increasing and verifying transparency claims (Bailey et al., 2016).

While some benefits of CFT have been recognized throughout the seafood supply chain, its application within different regions and who benefits from this strategy is largely undetermined (Mai et al., 2010; Oceana, 2016; Sterling et al., 2015). It is evident that Canada's fisheries are environmentally, socially, and economically significant as they are among one of the more diverse and varied in the world with three oceans surrounding its land mass: the Atlantic, Pacific and Arctic (Agriculture and Agri-Food Canada, 2016). Canada is currently the eighth largest seafood exporter in the world and generating over $6.0 billion in exports in 2015 (Agriculture and Agri-Food Canada, 2016; Govender et al., 2016). The top species exported by value (in descending order) are: lobster (*Nephropidae*), Atlantic salmon (*Salmo salar*), snow/queen crab (*Chionoecetes opilio*), shrimp (*Pandalus borealis*), scallops (*Placopecten magellanicus* and *Argopecten irradians*) which are mainly exported the US, the EU, China, and Japan (DFO, 2017c).

The province of Nova Scotia significantly contributes to the overall production of seafood within Canada (Government of Canada, 2015). Nova Scotia contributes to over ¼ (31%) of Canadas seafood exports (by volume) and with prior plans to further increase export values by 86% from 2011-2015 (Government of Nova Scotia, 2016). Exports in 2015 accounted for about $1.68 billion dollars, with US accounting for $958 million dollars CAD, Asia for $407 million dollars CAD, EU for $249 million dollars CAD (Government of Nova Scotia, 2016). In the past, this production was primarily dominated by a variety of groundfish species, but is now largely dominated by shellfish including lobster, snow crab, scallops, and shrimp, which equate to roughly 80% of total landings by value (Government of Nova Scotia, 2013). Aquaculture in Nova Scotia has also steadily grown, and provides economic value to the province in the amount of $60 million in 2014, with Atlantic salmon comprising a large percentage of the species farmed

(Government of Nova Scotia, 2014). Nova Scotia's fishery is largely dominated by small-scale owner-operator fishers or family-owned businesses as compared to largely industrialized vessels and companies (Nikoloyuk & Adler, 2013). The province mainly comprises of small coastal communities that rely on fishing for their livelihoods (Nikoloyuk & Adler, 2013). In 2013, the seafood harvesting and processing industry employed 7,800 people directly (Government of Nova Scotia, 2013) and in 2014 aquaculture industry employed 606 people directly with 270 active sites today (Government of Nova Scotia, 2014). The large values in seafood exports and number of jobs created by the seafood industry illustrate that this industry and its economic benefits are important for the province (ACOA, 2004).

### 1.1 The management problem and rational for study

Despite the importance of the seafood industry in Nova Scotia, increasing regulatory and market demands mean these industries may not be prepared to satisfy these expectations as the current requirements of the Canadian government lag behind the requirements for other export market countries (Magera & Beaton, 2009). Currently, it is only necessary for some of the seafood industry in Nova Scotia to retain internal records of products sold, which may not meet standards for exportation in the future (Magera & Beaton, 2009). In fact, the Department of Fisheries and Oceans Canada (DFO) conducted a market risk analysis in 2008, concluding that Nova Scotia was one of the five provinces most at risk of losing its export market share (DFO, 2008). With the increased informational demands, but lack of involvement in emerging traceability systems with full chain transparency, a significant amount of risk is created for producers who are unable to meet regulatory and market demands (Sterling et al., 2015). Furthermore, the lack of involvement or implementation of CFT in Nova Scotia does not allow for consumers to make informed decisions to avoid seafood associated with fraud and IUU fishing, as well as ensure product safety (Iles, 2007).

While there is some recognition in the literature for the benefits of traceability, especially at the retail level, the benefits and risk mitigation for upstream actors, such as producers, is unclear. Many authors have recognized that the implementation of traceability is restricted in some ways due to the varying benefits and costs that exists within different supply chain actors ((Mai et al., 2010). With increases in regulations and changing markets, especially within

Canada's major export markets, it is important to understand current and future risks producers may face and whether implementation of CFT can benefit producers.

The previous discussion points to the potential benefits and risk mitigation potential that may exist for fishers and aquaculturists, collectively referred to as "producers" in this research paper, if they adopt or engage in CFT. Benefits may include increased accountability and decreased occurrence of fraud and the selling of IUU products (Sterling et al., 2015). Additionally, with increased consumer demand for CFT, producers may be able to engage in new emerging markets, verify their sustainability claims, and add value to their business (Sterling et al., 2015). Hence, engaging in traceability systems may set a successful fish harvester apart from one that does not partake in these strategies (Vallejo et al., 2009).

### 1.2 Research aims and question

This research aims to analyze the current state of traceability within Nova Scotia and provide a deeper understanding of the perception of regulatory and market risks for buyers and producers in Nova Scotia. This report also aims to identify where CFT is most necessary and feasible, by determining where higher risk exists and were implementation would be easiest. Lastly, it is also important to examine what the perceived challenges and benefits of traceability are, as well as how willing producers in Nova Scotia are to participating in CFT within their supply chains. This report takes on an inductive approach and aims to reach these goals through supply chain mapping and semi-structured interviews with mid-chain actors and producers in Nova Scotia seafood supply chains.

The research question asked is, under what context and for which Nova Scotia producers is CFT a feasible risk mitigation strategy?

The following sub-questions will be addressed:

1. To what extent is CFT present in Nova Scotia?
2. Which fisheries or aquaculture facilities are at most risk for mislabeled seafood and IUU fishing?
3. What forms of risk (regulatory and market risks) can CFT mitigate for producers?
4. How willing are producers to partake in this strategy?

### 1.3 Research paper organization

This paper is organized into six chapters. The first chapter provides an introduction and overview of the study, defining research objectives and questions. The second chapter provides a more detailed background on the topic of seafood traceability and gives context for this research study. Chapter three contains methodology for the study and chapter four provides results from interview data, supply chain mapping, and the risk assessment. Chapter five discusses findings with a focus on major themes discovered, and the final chapter provides recommendations and a conclusion of the study.

## Chapter 2 - Background and Context

### 2.1 Seafood traceability

#### 2.1.1 Defining traceability

A variety of definitions for traceability have been proposed within the literature, all with varying meanings and terminology, but for the purposes of this report, traceability is considered "the ability to access any or all information relating to that which is under consideration, throughout its entire life cycle, by means of recorded identification" (Olsen & Borit, 2013). Traceability itself is not the information being passed on, but the tool that is used to retain records of product movement so that it may be accessed at a later date or in a distant place (Bailey et al., 2016; Coff et al., 2008; Donnelly & Olsen, 2012). Additionally, traceability can be seen as a spectrum, moving from a business-to-business system where internal traceability exists by tracking products one step forward and one step back, all the way to a full chain consumer-facing traceability system where product information is communicated to the consumer (Bailey et al., 2016). Due to this inconsistency in traceability systems, the processes involved, functions, and benefits also vary.

Ideally, product can be traced along a supply chain both upstream and downstream (Magera & Beaton, 2009; Figure 1). Upstream refers to the producer end of the supply chain, where product is traced back to its origin, whereas downstream refers to the last point of consumption, where product is moving towards the consumer (Magera & Beaton, 2009; Figure 1).

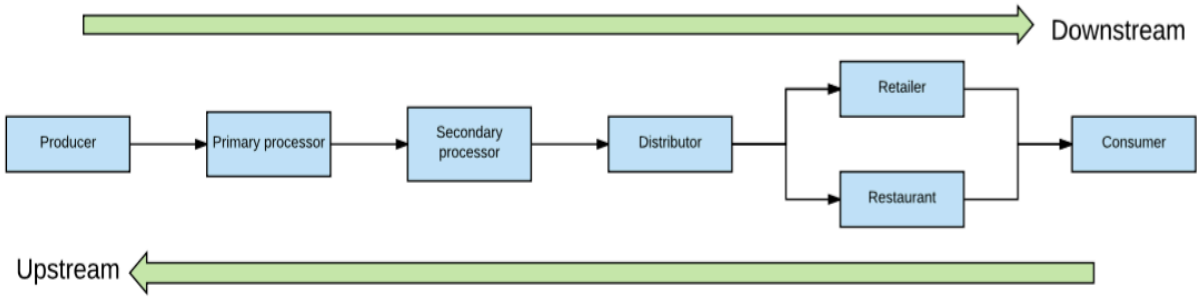



**Figure 1** A simplified example of a seafood supply chain with downstream and upstream ends identified.

2.1.2 Forms of traceability

Traceability in itself is not a new or advanced tool within the seafood industry (Magera & Beaton, 2009). In fact, it has been utilized for many years to aid in management practises and to ensure product safety within the supply chain (Magera & Beaton, 2009). The Canadian Food Inspection Agency (CFIA) for example has always required a basic level of traceability for seafood safety and product recalls (ACOA, 2004). However, current traceability initiatives and requirements can be seen in two forms, namely private and public, making it both a regulatory and non-regulatory system at times (Archipelago Marine Research Ltd, 2005; Bush et al, 2017). Some examples of regulatory requirements are those developed by the Canadian Food Inspection Agencies Program such as Hazard Analysis Critical Control Point (HACCP), as well as EU General Food Law Regulations, US Country of Origin Labelling (COOL), and the US Bioterrorism regulation (Archipelago Marine Research Ltd, 2005). On the other hand, consumer driven initiatives that have varying aspects of traceability and are adopted by industry and non-governmental organizations (NGO) are also present such as the Marine Stewardship Certification's (MSC) chain of custody, ThisFish, Can-Trace, TraceFish, BAP and many more (Archipelago Marine Research Ltd, 2005; Howard et al., 2012). Within these regulatory and non-regulatory requirements and initiatives traceability can exist within different forms along the spectrum mentioned above. It can be as simple as a paper-based system to record product information and attributes using shipping receipts, permits and invoices, to a complex chain of custody with technology such as Quick Reference (QR) codes and Radio Frequency Identification (RFID), to recall product information at any point within the supply chain right to

the consumer (Howard et al., 2012; Petersen & Green, 2004). Electronic systems are able to store larger amount of data and make it easier for information to be shared across databases and supply chain actors (Petersen & Green, 2004)

Generally, there are two types of traceability that exist today; internal and external. Internal systems involve retaining records for company use in order to keep track of inventory, purchasing, packaging, storage and transportation (Magera & Beaton, 2009). This type of system allows companies to understand what is occurring within their operations and serves a business management rationale (Magera & Beaton, 2009). On the other hand, external traceability allows for information to be shared among the supply chain and involves the ability to trace product once it is outside of the company's entity (Magera & Beaton, 2009).

It is important to note that within internal and external traceability systems there are differing levels of information and "externality" (Bailey et al., 2016). The most common type of traceability system existing worldwide is what is described as a "one-up-one-down" traceability system (Magera & Beaton, 2009). This system is often cited in the literature as both internal and external (Future of Fish, 2016; Magera & Beaton, 2009) and is a minimum requirement for many regulations worldwide such as the US Bioterrorism Act and the EU General Food Law (Archipelago Marine Research Ltd, 2005). Within these systems, the supply chain of information may be viewed as individual operations that are linked by the products supplied to companies to the products that are supplied to someone else (Magera & Beaton, 2009). In other words, information can be tracked from one step upstream (towards the producer) and one step downstream (towards the consumer) (Magera & Beaton, 2009). However, it is evident that these systems are not efficient for product recalls and communication of information to downstream actors (Magera & Beaton, 2009).

The most external type of traceability is referred to as CFT, full chain traceability or end-to-end traceability (Bailey et al., 2016; Future of Fish, 2016; Miller, 2014). This type of traceability involves the flow of information on products to consumers so that information such as species, location, method of catch or production, specific fishers or aquaculture facility is communicated to the end buyer (Bailey et al., 2016). CFT has not been implemented within regulation, but rather from NGO's to try and keep up with emerging demand (Bailey et al., 2016; Miller, 2014). This often involves first, second or third party verification and chain of custody to ensure claims are valid (Bailey et al., 2016). Eco-labels are often viewed as a form of CFT that

provides characteristics and qualities about a product such as MSC, ASC, BAP, and Dolphin Safe (Bailey et al., 2016; Wessells, 2002). However, while these eco-labels often have a form of traceability within them, they do not represent a full end-to-end traceability system (Bailey et al., 2016; Miller, 2014). CFT has also emerged from the seafood industry in a form that is web-based with coded products to properly communicate information about a particular product and allow consumers to trace back to its origin (Bailey et al., 2016). However, the level of information and type of information that is expressed can vary from one initiative to the other (Bailey et al., 2016; Miller, 2014). For example, some schemes will provide real-time data that traces back to the exact organism caught, while others are more "static" in that the information is traced back to an unchanging proprietary database (Bailey et al., 2016). To date there is no consensus on which type of traceability is truly essential to provide all benefits without extra work or cost (Bailey et al., 2016).

### 2.1.3 Functions of traceability

Traceability serves many functions and can provide myriad benefits, but benefits may differ depending on position along the supply chain or role (Magera & Beaton, 2009). Coff et al. (2008) has described these benefits by category, which are summarised below, including particular interest from stakeholders (Magera & Beaton, 2009; Table 1).

**Table 1** A summary of the benefits of traceability as described by Coff et al. (2008). Stakeholders that have been shown to experience these benefits is noted under the stakeholder interest column.

| **Benefit** | **Evidence** | **Stakeholder interest** |
|---|---|---|
| Risk Management and Safety | A central focus of traceability has been to improve overall safety through efficient recalls, process-based auditing, and food surveillance reducing any food safety implications (Coff et al., 2008; Mai et al., 2010). For example, if customers become ill from contaminated seafood, information on the product origin and pathway can be access quickly and easily to solve the incident | Producers<br>Processor<br>Distributors<br>Retailers |

| | | |
|---|---|---|
| | efficiently (Hall, 2010). This helps to reduce any liability risks that are often prevalent in food-related incidents, thus protecting reputation and brand (Mai et al., 2010). | |
| Control and verification | Traceability allows for the surveillance of other supply chain actors so that seafood fraud is deterred and sustainability claims made by sellers is verified (Coff et al., 2008). | Government<br>Consumers |
| Supply chain management and efficiency | Traceability has the ability to reduce costs and labor associated with the management of seafood products along the supply chain (Alfaro & Rabade, 2009; Coff et al., 2008; Mai et al., 2010). It has been seen to improve inventory management and internal company systems as well as promote efficient use of resources (Coff et al., 2008). | Producers<br>Processors<br>Distributors<br>Retailers |
| Provenance and quality assurance of products | Traceability allows for companies or producers to showcase their sustainability or ethical claims, ensure that it is authentic, and of top quality having potential to add value or increase market access (Coff et al., 2008; Magera & Beaton, 2009). This function increase overall credence qualities which would have otherwise been near impossible to determine without the correct verified information (Hall, 2010). | Producers<br>Processors<br>Distributors<br>Retailers |
| Information and communication to the consumer/buyer | This function promotes transparency in products sold allowing consumers or buyers to have access to information on the product and verification of its authenticity, quality and sustainability (Coff et al., 2008). It promotes informed decision making, public participation, and allows for consumers to have their | Processors<br>Consumers |

| | | |
|---|---|---|
| | demands and concerns satisfied Coff et al., 2008. This information can increase consumer confidence and trust in a product or brand (Alfaro & Rabade, 2009; Hall, 2010). While there is a spectrum of "faceability" systems that exists currently within the global seafood industry, consumer-facing traceability is important because it is often very difficult to determine information about a product unless consumers are buying directly from the source (Nunes et al., 2017). | |

Thus, Coff et al. (2008) interprets traceability as a management, governance and communication tool. Full chain traceability allows for these functions to be satisfied, while internal traceability only allows for traceability to be used as a management tool. The main component that seems to be missing within the majority of seafood supply chains, worldwide but particularly in Canada, is the consumer-facing aspect. However, there is little evidence if CFT can provide any additional benefits or reduce future risks for stakeholders within the seafood supply chain. It is evident from previous research that the benefits to downstream actors are clearly demonstrated, but uncertainty still exists whether upstream actors are provided with enough benefits to outweigh the costs (Bailey et al., 2016).

### 2.1.5 Outlook on the demand for, and barriers to, traceability

With the emergence of new regulation and market demands to combat issues such as the ones mentioned above, traceability may be used as the tool to accomplish much more than just seafood safety, as it has potential to reduce seafood fraud, IUU fishing and social issues as well as provide the much needed information consumers are demanding to make informative decisions (Alfaro & Rabade, 2009). With the more recent examples of fraud, mislabelling and seafood safety, the type of traceability is evolving (ACOA, 2004). Consumers are trying to gain more specific information regarding product labels such as origin, method of harvest, and eco-labeling (Jensen, 2006; Wessells, 2002). Additionally, increasing awareness of over-fishing and declining fish populations has led to a demand for verifiable sustainable seafood and a general increase in informational demands about seafood provenance (Wessells, 2002). Lastly, this

demand has also been fueled by increases in consumer income and the greater overall access to information that exists within the scientific world today (Jensen, 2006). In fact, a survey from Greenpeace Canada (2004) that was conducted by Legar Marketing revealed that 7 out of 10 Canadians felt they did not have adequate information from their grocery stores about harvest methods of seafood products. Furthermore, 74% of respondents indicated that if there was adequate information conveyed they would make the more sustainable choice (Greenpeace Canada, 2008). This demand has also increased the use of traceability technology to increase their effectiveness. Allied Market Research predicts that the global market for traceable food technology will steadily grow by 8.7 percent per year, reaching a revenue of $14.1 billion by 2020 (Allied Market Research, 2014). Thus, the implementation of traceability systems within the seafood industry is driven by two types of factors: compliance-driven factors which are the regulatory requirements that arise as a result of consumer demand for change and increased informational requirements, and value-driven factors which arises from industry working to improve the efficiency of business and promote better quality, safer and branded products (Archipelago Marine Research Ltd, 2005).

*Challenges to traceability*

While benefits are recognized there still remains issues and challenges with the adoption and practise of CFT within the seafood industry today. Some of these barriers to the implementation of traceability were described by Future of Fish in their report "Getting here from there: A guide for companies implementing seafood supply-chain traceability technology" (Table 2).

**Table 2** A summary of the challenges in implementing traceability as described by Future of Fish (2014).

| **Challenge** | **Evidence** |
|---|---|
| Data security and sharing | Data security is a large issue within the seafood industry because revealing too much information about a company has potential to lead to a loss of competitive advantage, and showcase private information. While internal traceability is generally of no concern, any other information is often not exposed if it is not a government requirement. Furthermore, it can be difficult to share and verify data across the full chain of custody |

| | |
|---|---|
| | because each of the producers, processors, and distributors have their own individual system with information contained within it, but that does not reach the buyers or customers. This lack of data sharing is a main driver that inhibits full chain traceability. |
| Competition | Adding on to the previous drawback, competition and the nature of the seafood industry prevent many stakeholders from revealing to much or engaging in new technologies that may threaten small family businesses. |
| Lack of evidence for a return on investment | While some evidence showcases that there are inherent benefits in terms of profit, these are still in development and may not be worth a producer or company's resources without a promised incentive. |
| Future of Fish describes as a "Mid-chain black hole" | While data is often captured at the point of harvest this information can be easily lost by the time it has gone through to the processor and on to the buyer or distributor. This may occur when batches are combined together mixing up any effort of separating product or when larger fish are filleted, but information is not re-attached to the transformed product. |
| Lack of uniform standards for traceability | Currently there are various techniques for capturing product information, sharing, and differences in what is even required to pass along the supply chain. This has made it difficult to implement on a larger scale. It is evident that finding one solution is not feasible given the vast nature of the seafood industry globally. |
| Uncertainties in future regulations and markets | Concerns over the changing future of regulations and markets can lead some stakeholders to be reluctant in engaging in something that may not be wanted or even a step backwards. This can be seen as a consequence of government regulations not taking on this action itself, but leaving it up to private industry decisions. |

### 2.1.6 International efforts for increased traceability

Focusing on the three largest export markets for Canada, namely the EU, the US and Asia, a brief outline of their efforts in enacting traceability legislation and regulation is explained below.

*European Union requirements for seafood traceability*

The EU has led the way in implementing and promoting regulation that increases seafood traceability and delivering more comprehensive labels on seafood products (Roebuck et al., 2017). The regulating body, the EU Common Organization of the Markets, has set in place labelling requirements to ensure that sufficient information is kept internally through the one-up one-down system and is displayed on seafood products sold on the market (Roebuck et al., 2017; Seafish, 2016). Seafood products are required to be placed in lots before first sale and the information contained in these lots must be visible along the supply chain (Seafish, 2016). Required information to be passed along includes: lot or batch number, supplier name and address, fishing vessel or aquaculture unit, sate of harvest, quantity, area where product was caught or farmed, category of fishing gear used, commercial designation and scientific names, and the correct alpha-3 code (a species code developed by the FAO) (Seafish, 2016). Additionally the following six components are currently required on labels of products to be sold to consumers: common name, scientific name, production method (farmed or wild), harvest method, geographic origin, and country of last major transformation/processing (Roebuck et al., 2017). Finally, under the General Food Law No. 178/2002 and more specifically the regulation (EC) No. 1005/2008, the EU requires countries exporting to the EU to provide a detailed catch certificate to ensure products do not originate from IUU fisheries (CFIA, 2015). In doing so, buyers and sellers within the supply chain have more assurance in the product, ensuring it is not associated with IUU fishing or slave labour (Roebuck et al., 2017).

*United States requirements for seafood traceability*

While the US still lags behind the more comprehensive requirements of the EU, they do have stronger labelling requirements than Canada. Under the "Country of Origin Labelling" (COOL) regulation, it is required that industry provide the common name, production method, and country of last major transformation/processing on consumer labels (Roebuck et al., 2017). Additionally, the "US Bioterrorism Act" introduced a mandatory requirement to trace product internally, thus businesses must have one-up-one-down traceability (Magera & Beaton, 2009). The US has recently introduced a new Seafood Import Monitoring Program, set to be in effect January, 2018, that was implemented by NOAA fisheries and has arisen as a way to combat IUU fishing and seafood fraud (NOAA, 2016). The purpose of the program is to implement a well-

managed system to track seafood from point of harvest to entry into US commerce (NOAA, 2015). They require electronic reporting through their International Trade Data System, while keeping any previous entry filings the same (NOAA, 2015). NOAA fisheries will issue an International Fisheries Trade Permit that is required for all importers and these importers will be responsible for obtaining all required information about the product (NOAA, 2015). Specific information required is outlined in Table 3.

**Table 3** Information that will be collected for the identified priority species* for entry into the US (NOAA, 2015).

| **Information type** | **What is included** |
|---|---|
| **Harvesting and Producing** | • Name and flag state of harvesting vessel<br>• Evidence of authorization to fish (permit or license number)<br>• Unique vessel identifier (when available)<br>• Types of fishing gear used<br>• Name of farm or aquaculture facility |
| **Seafood Product** | • Species of fish – Scientific name/acceptable market name, ASFIS number<br>• Harvest date<br>• Product form at time of landing including quantity and weight if product<br>• Area of wild capture or aquaculture harvest<br>• Point of first landing<br>• Name of entity to which the fish was landed or delivered.<br>• Importer of Record<br>• Name, affiliation and contact information<br>• NOAA fisheries issued international fisheries trade permit (IFTP) number<br>• Importer of record is responsible for keeping records regarding the chain of custody<br>• Information on any transshipment of product<br>• Records on processing, re-processing, and commingling of product. |
| *Priority species include: Abalone, Atlantic cod, Blue crab (Atlantic), Dolphinfish (Mahi Mahi), Grouper, King crab (red), Pacific cod, Red snapper, Sea cucumber, Sharks, Shrimp, Swordfish, Albacore, bigeye, skipjack, and yellowfin tuna, Bluefin tuna. | |

*Japan and China requirements for seafood traceability*

The largest Asian export markets Canada, which are Japan and China, are lacking in terms of specific regulations for increased seafood traceability. Japan does not currently have any specific regulation to seafood however, under the "Food Sanitation Law" (Law No. 55 of 2003), labelling requirements for food product recalls when imported are: product name, name and address of processor, lot identification, import date, import notice, ingredients and food additives, and inspection records (Petersen, & Green, n.d.). Similarly, China does not have very specific traceability requirements for seafood, though in 2003 they enforced the "Chinese Regulations on Inspection and Quarantine of Import and Export Aquatic Products," which applies to seafood (Magera & Beaton, 2009). It is required that products have the following clearly labelled: common name, scientific name, product specification, date of production, batch code/lot number, preservation requirements, processing establishment, and country of destination (Magera & Beaton, 2009).

**2.2 Traceability's role in risk mitigation**

With the sizable amount of international trade and increasing requirements for seafood traceability, particularly in the EU and US, Canadian producers must begin to adopt these traceability systems to comply with demand. This inherently creates a risk if they do not. Risk is often described as a product of probability and consequence, where probability describes the likelihood of an event occurring and consequence is the severity of adverse effects if that event were to occur (Aven, 2011). Risk within this report is identified as the likelihood of fishers and aquaculturists to be faced with new forms of regulation and market demands, as a result of trying to reduce mislabelling and fraud. With the increasing regulatory and market demands, but lack of involvement in emerging traceability systems with full chain transparency, workers in the industry could lose market share, money, and not be able to show accountability or compliance (Sterling et al., 2015).

Traceability has been seen as a tool to reduce risk within the seafood supply chain in the past and present (Parenreng et al., 2016). Parenreng et al. (2016) analyzed risk mitigation on tuna supply, revealing that the development of traceability was a key component to risk management since it encompasses information along the entire supply chain. They concluded it has potential to mitigate product safety risks in relation to the production of goods because traceability system

help to avoid unwanted events and can be used as a tool to quickly handle incidents (Parenreng et al., 2016).

Additionally, some studies have examined fisher's perception of risk, with a focus on safety risks, food safety, economic driven behaviour, uncertainty with science and management, and ecosystem related risks (Tingley et al., 2010). Edvardsson et al., 2011 examined risk perception amongst fishers in three different European countries: Iceland, the Faroe Islands and the United Kingdom (UK). From examining the case studies, they concluded that the most common risks that were cited by fishers were related to policy, management, conflict within the industry, or with other stakeholders and control (Edvardsson et al., 2011). Other risks identified were also related to economic changes, trade and market issues, working environment, as well as the impact fishing has on the surrounding environment (Edvardsson et al., 2011). Fishers often rated poor policy and management of the seafood industry and depletion of fish stocks as the highest risk (Edvardsson et al., 2011). Tingley et al. (2010), who also examined a number of case studies, discovered that economic and policy/management factors were perceived as the highest risk areas. However, that risk can vary between locations and between different people because risk is subjective to the individual's perception (Tingley et al., 2010). Nonetheless, examination of risk perception may be important and useful for managers to build a knowledge base on key issues relevant to stakeholders in order to manage resources efficiently and effectively.

### 2.3 Seafood industry in Canada and Nova Scotia

The seafood industry, and the value that it brings through imports and exports, is important for Canada generally, and for Atlantic Canada specifically. In 2014, Canada as a whole was the seventh largest seafood exporter in the world (Govender et al., 2016), with 17,910 registered fishing vessels, with a total landed volume of 845,602 (metric tonnes), and a landed value of $3.3 million CAD (DFO, 2017b). Sea fisheries account for 837,746 (metric tonnes) and $3.2 million in value (DFO, 2017d, 2017e) while aquaculture has a total of 882 establishments, producing 187,374 (volume) and a total value of almost $1 million (DFO, 2017a). Canada exports much of their total production, with 639,466 in volume (metric tonnes) and 6,551,382 in CAD value ($000) (DFO, 2017b). The highest value of exports goes to the US, the EU, China, and Japan (DFO, 2017c; Table 4). Specifically, the province of Nova Scotia contributes greatly to the overall seafood production within Canada in both the sea fishery and growing aquaculture

with lobster, snow crab, scallops, shrimp and Atlantic salmon dominating sector (Government of Nova Scotia, 2014; Government of Nova Scotia, 2013; Table 5).

**Table 4** Canada's top four export markets in 2016 by volume (metric tonnes) and value (CAD $000) (DFO, 2017c).

| **Market** | **Volume (metric tonnes)** | **Value (CAD $000)** |
|---|---|---|
| US | 344,591 | 4,280,156 |
| China | 104,744 | 763,837 |
| EU | 56,422 | 515,374 |
| Japan | 28,773 | 309,138 |

**Table 5** Summary of volume (metric tonnes) and value (CAD $000) produced in Nova Scotia's fishery and aquaculture sector in 2015 (DFO, 2017a, 2017d, 2017e).

| **Nova Scotia** | **Volume (metric tonnes)** | **Value (CAD $000)** |
|---|---|---|
| **Sea Fishery** | | |
| Groundfish | 43,611 | 91,461 |
| Pelagic and other | 50,560 | 57,022 |
| Shellfish | 163,113 | 1,063,048 |
| Other | 794 | 16 |
| Total | 263,078 | 1,211,547 |
| **Aquaculture** | | |
| Finfish | 6,058 | 53,580 |
| Shellfish | 1,109 | 2,395 |
| Total | 7,167 | 55,975 |

2.3.1 Traceability in Canada and Nova Scotia

Traceability of seafood is developed and enforced by the Canadian Food Inspection Agency, but as it begins out at sea or within an inland water body, traceability also falls under the regulatory jurisdictions of the DFO (Howard et al., 2012). Currently, within Canada, there are no enforced traceability requirements for the seafood industry (Magera & Beaton, 2009).

However, there are many programs and regulations that have aspects of traceability and labelling within them and will be discussed further to provide a basis for analysis.

Efforts within Canada begin with the Dockside Monitoring Program that the DFO introduced as a way to ensure third party verification on fish landings, although at this point information about the seafood product is not collected, only the amount and verification of licensed vessels (Howard et al., 2012; DFO, 2015). Fish and seafood products are then subject to the CFIA's Fish Inspection Regulations (FIR) and several packing and labelling requirements under the Food and Drugs Act, the Consumer Packing and Labeling Act, and the Fish Inspection Act (Howard et al., 2012). The labelling requirements under FIR apply to any fish product including finfish, shellfish, and any marine animal as well as any fish product or by-product that are processed within a federally-registered facility or imported products (CFIA, 2017). Mandatory labelling requirements on any fish product is the common name, which the CFIA has developed a list of acceptable common names to place on a label (CFIA, 2017). Additionally, the CFIA requires that any imported seafood displays a "country of origin" label, which is the country of last major processing and often does not indicate where the seafood was actually harvested (Roebuck et al., 2017). It is important to note however that domestic product does not require country of origin, providing this information is voluntary (CFIA, 2017). Other information that is to be included with prepackaged fish is the net quantity unless specified that the product will be weighed at the time of retail sale (CFIA, 2017). Additional information is required for live and raw molluscan shellfish, in that it is mandatory that the product labels include the date of processing and location of harvest, as well as a best before date (CFIA, 2017). Additionally, when seafood contained in labelled retail packages is shipped within Canada the following are required for the label: the common name, the establishment, day, month and year of processing, and harvest location (for molluscans only) (CFIA, 2017).

While not required, internal traceability is present within some supply chains in the form of one-up-one-down traceability to comply with other measures such as the Quality Management Program (QMP), HACCP, and Canadian Shellfish Sanitation (CSSP) (Magera & Beaton, 2009). All establishments that process seafood for export or inter-provincial trade must be federally registered and must operate under the QMP (CFIA, 2015b). The QMP applies the principles laid out in the HACCP that ensure the production of safety food product (CFIA, 2015b). Data that are collected under this regulation and the need for product to be effectively recalled, means that

internal traceability is often present within these facilities (CFIA, 2015b). Furthermore, the CSSP is required by all shellfish producers and allows for product to be traced back to the source for the purpose of detecting any contaminated product (CFIA, 2016). It is required for shellfish producers to attached tags to each shipping unit which can be a box, crate, or bag (CFIA, 2016). Finally, all exports from Canada must comply with Canadian labelling requirements as well as any additional requirements by the country the product is being exported to, which may require internal traceability such as the EU (CFIA, 2017). While these requirements are for Canada as a nation, it is important to note that there are no specific regulations for traceability for the province of Nova Scotia specifically.

While traceability within Canada's regulations is generally lacking, some industry and NGO led initiatives provide differing levels of traceability along the supply chain. Can-Trace was developed as a traceability initiative that is managed by Agriculture and Agri-Food Canada, and they help to develop and promote traceability within Canada as a voluntary standard (Magera & Beaton, 2009). Additionally, systems that have been created to allow for companies to trace their product have been created in Canada, for example TraceTracker (Magera & Beaton, 2009). ThisFish a CFT system from Ecotrust Canada which provides QR codes or alpha-numeric codes on tagged product to be entered into their website to allow consumers to gain information about their purchase, and has grown in popularity among Canada, as it began on the west coast in 2014, but also expanded out to Nova Scotia (Naaum & Hanner, 2016). Finally, certification schemes, most notably MSC, although not CFT, does have aspects of traceability associated with it (MSC, 2016). The MSC Chain of Custody standard was developed to ensure that as MSC certified product is passed along the supply chain and all actors have sufficient traceability systems in place (MSC, 2016). The MSC also requires DNA audits to ensure information is correct (MSC, 2016).

## Chapter 3 – Methodology

To determine under what context and for which producers CFT is a feasible risk mitigation strategy in Nova Scotia, three main methodologies were used: key informant interviews, supply chain mapping, and a simplified risk assessment.

### 3.1 Key informant interviews

Semi-structured key informant interviews (approved by the Dalhousie University Research Ethics Board #2017-4150), were performed with two main classes of informants being targeted. Firstly, potential mid-supply chain actors, those that are buying and selling seafood in Nova Scotia, were identified. These included stakeholders from small and large retailers, distributors, processors or wholesalers, exporters or importers. These interviews served three purposes. The first was to gain an understanding of where seafood product is coming from and going to in Nova Scotia. This served as the data for mapping out the specific supply chains related to the participants (see 3.2). Secondly, these interviews were also used as a way to gain information from stakeholders who were not producers, but knowledgeable about the overall supply chain within Nova Scotia. This was critical for analysis because it was recognized that producers may not have a clear sense of the risk for mislabelling and fraud within the seafood sector and in some cases have little to no control over this process once their seafood products are sold. Additionally, Parenreng et al. (2016) noted that the perception of risk within supply chains varies with the amount of integration and the ways supply chains interact. Mid-chain actors that buy and sell seafood often are more integrated into the supply chain and have more control over seafood products, and thus can play a key role in mitigating regulatory and market risks for producers. Lastly, key informant interviews served to identify the set of producers that would be interviewed. Mid-supply chain actors were asked at the end of the interview to identify 4-5 of their suppliers so that they could be recruited into the study. If participants identified other mid-chain actors, those people were contacted and interviews proceeded until producers were identified, otherwise producers were contacted directly.

The semi-structured interviews conducted were divided into three sections, namely background and actions, knowledge, and perceptions. The first portion of the interview aided in understanding the business and gaining information of the products purchased and sold as well as any internal traceability that the business may have had. The second portion of the interview focused on knowledge about the current seafood industry, globally and within Nova Scotia. The third and last portion of the interview focused on the perception that the participants had on CFT, its benefits, challenges, and feasibility of implementation. The mid-chain actor's interview questions can be found in Appendix A.

The semi-structured interviews with producers were of similar structure to the mid-supply chain actors with the same three broad categories. These interviews served as important for insights into the producer's perception of the risks they were facing in the industry currently as well as to assess willingness to participate in CFT. Thus, modifications to the questions posed during the interview were made to tailor the interview targeting these topics. The producer's interview questions can be found in Appendix A.

In total, 18 semi-structured interviews were conducted from June to September, 2017. Out of the 18 interviews, 12 individuals were classified as mid-chain actors and 6 were classified as producers.

#### 3.1.1 Coding analysis

To analyze collected data, all interviews were coded using the statistical and qualitative data analysis software "NVivo." Analysis began by identifying words or small phrases that were expected to be common amongst the interviews. These where pre-set codes that were used to initiate the coding process, whereby interviews were read and sections of the responses were coded based on their content. Analysis also allowed for emergent codes to be used as well, which were those that emerged from the data one analysis had begun. Once all interviews were coded, codes were arranged under categories. From that key themes that emerged from the interviews were examined to identify and analyze commonalities among responses and infer conclusions about the perception of risk and willingness to participate in CFT, and how that perception of risk aligns with the literature on risk in seafood supply chains.

### 3.2 Supply chain mapping

To analyze current seafood supply chains existing within Nova Scotia today, supply chain information was mapped out using the software, "Lucidchart." All information collected during individual interviews was mapped out as a large network in a single document to gain an idea of the composition and complexity of seafood supply chains within Nova Scotia (see Figure 3). Supply chains were divided into species/product type to establish generalities of where supply chains offer CFT feasibility and risk mitigation potential. Supply chains were divided into lobster, oysters, scallops, sea urchin, finfish, crab, shrimp, and mussels. These were chosen based on the types and amount of information obtained from the interviews, as well as considering

which species are significant exports by value for the province of Nova Scotia. All supply chains focused on a specific species except for finfish which were lumped together in one category since information on specific finfish species was not available from interviews conducted.

### 3.3 Simplified risk assessment

Using interview information and the **"**The Five Core Functions of Robust End-to-end Traceability," each supply chain was assessed to examine if the species supply chain satisfied the core functions or not. It is theorised that when supply chains are not in accordance with the five core functions, they are thus susceptible to a higher risk of mislabelling or fraud, or IUU fishing. This was then used to compare the feasibility of CFT and potential risk of mislabelling or fraud.

#### 3.3.1 Five Core Functions Framework

Five core functions for robust end to end traceability has been established by Future of Fish and is the framework used in this study for assessing adoption of CFT within Nova Scotia (Figure 2). These five core functions are hypothesized to reduce risk of mislabelled and IUU fishing by ensuring product and information is captured from point of origin, information is retained throughout the supply chain, information is visible both within the supply chain and to consumers, and the information attached to the product is verified on a regular basis to ensure it accuracy. An overview of the framework is described below.

*Vessel-dock capture*

Data must be captured at the point of harvest or with the first receiver. Information containing the species, location, type of harvest or methods, etc. should be paired with the product and uploaded to a database (Future of Fish, 2016). When data are captured at the vessel or farm, detailed and verified data about the product is known to supply chain actors. This results in many benefits to fisher's who want to sell differentiated catch, for mid-chain actors who want to ensure that the information received is verifiable and accurate and for consumers who want the story behind their seafood (Future of Fish, 2016). Vessel-dock capture may be able to eliminate the issue of data being lost or never captured at the beginning that is associated with complex and long supply chains and distant origins.

*Product-data pairing*

Once the data is uploaded and captured at the source, products must be paired with the physical attachment of the information to ensure integrity of the data (Future of Fish, 2016). This label, code, or chip should remain with the product until sold to the consumer at the end of the supply chain (Future of Fish, 2016). Product-data pairing allows for improved inventory and quality control, can help to identify and prevent IUU fishing and mislabelling, aid with recalls, and ensure that information about the product is carried throughout the supply chain (Future of Fish, 2016). This reduces the probability that any information about origin, species, or production remains unchanged and accurate through the supply chain, limiting the risk for fraud (Future of Fish, 2016). This information is conveyed to the supply chain actors, including the consumer and can ensure reputation of stakeholders is upheld as well as increase market share.

*Internal traceability*

Internal traceability is common for most business to have since it embodies basic product management and is often required for food safety compliance (Future of Fish, 2016). It is often referred to one-up, one-down as the supplier has a record and documentation of buying and selling the seafood (Boyle, 2012). Internal traceability helps to ensure efficient supply chain management, inventory control, improve operations, and ensure health and safety compliance (Future of Fish, 2016). Adapting an internal traceability system that is efficient can reduce costs of production and reduce labour.

*Supply chain visibility*

This function consists of information about the businesses products and ensures that this information is visible to their buyers and/or customers (Future of Fish, 2016). This may include where the business is located, what they do, how do they do it, health and safety standard and more (Future of Fish, 2016). This function provides proof of compliance, sustainability claims, and any regulatory requirements as well as improving risk management (Petersen, & Green, 2004).

*Data verification*

This is the ability for the business to cross check their product for information at any point along the supply chain (Future of Fish, 2016). This help to prove legitimacy and compliance when any recalls occur and makes the process less costly. Additionally, data verification aids in ensuring quality control, identifying fraud, and aiding with consumer acquisition (Future of Fish, 2016).

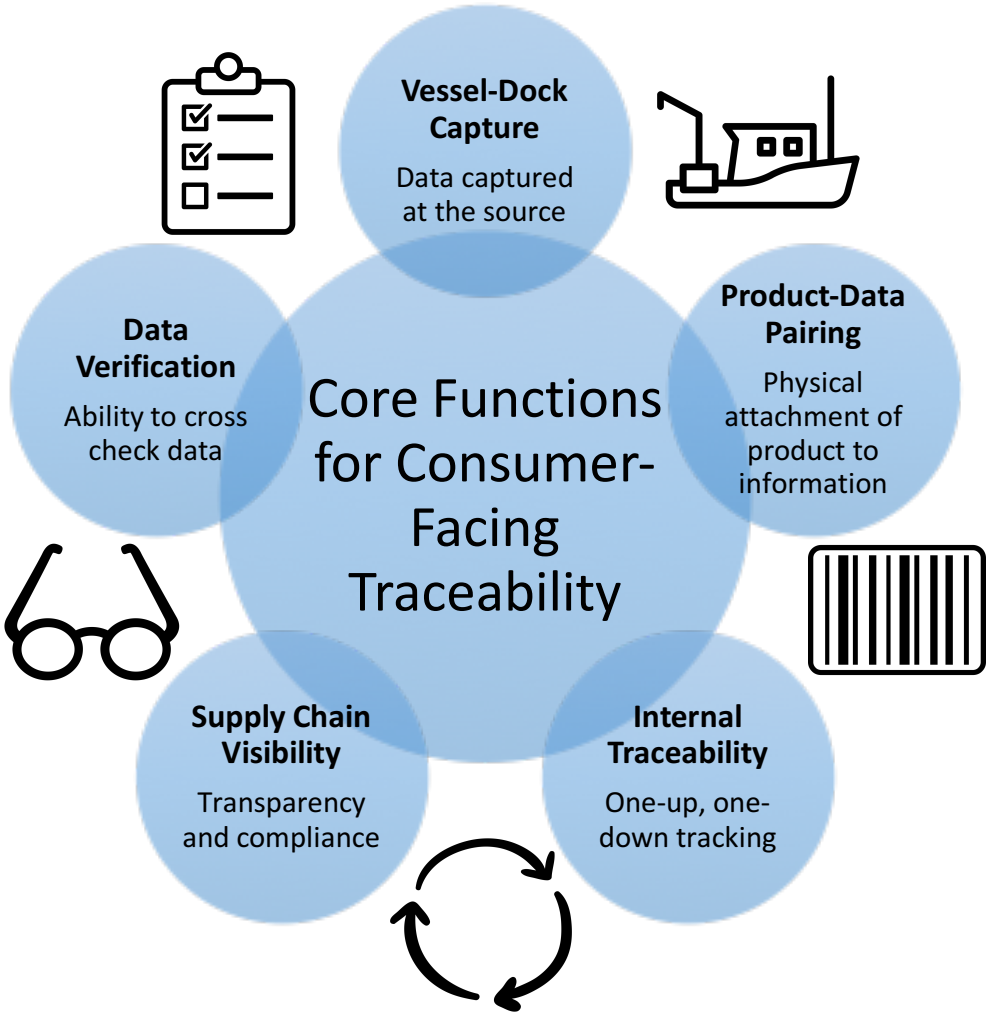



**Figure 2** "The Five Core Functions of Robust End-to-end Traceability," development by Future of Fish (Future of Fish, 2016).

# Chapter 4 – Results

To review, this study is focused on answering under what context and for which Nova Scotia producers is CFT a feasible risk mitigation strategy? Specifically asking to what extent is CFT present in Nova Scotia, which fisheries or aquaculture facilities are at most risk for mislabeled seafood and IUU fishing, what forms of risk can CFT mitigate for producers and how willing are producers to partake in this strategy? The results section is organized in relation to these questions, whereby informant opinions on the extent of the issues facing the industry and the presence and perception of CFT is displayed. Secondly, supply chain maps are displayed with their corresponding checklists and supporting information from interviews to determine which sector or species is most at risk for mislabelling and IUU fishing. Finally, risks identified by informants, CFT's potential in risk mitigation, its benefit and challenges, and the willingness of producers to participate is described.

## 4.1 Overview of seafood industry and CFT in Nova Scotia

### 4.1.1 Mislabeling and IUU fishing

Interviews highlighted the extent to which mislabelling, fraud and IUU fishing are present in Nova Scotia. Fifteen of the eighteen respondents agreed that mislabelling of seafood is a significant issue within Nova Scotia, while the other three, all of which were producers, were unaware of the issue. It was expressed by the majority that this is issue is as widespread in Nova Scotia as it is in others places around the world. Generally, respondents attributed mislabelling to the misidentification of a species, for example substituting a lower value species for a higher value species in the marketplace and in restaurants. However, some did mention that among shellfish such as lobster, oysters, mussels, and scallops, the location of harvest may also be mislabelled. This could be locally, in which the location an oyster was substituted for another location or on a larger scale, in which lobster originating from Canada is sold as Maine lobster. One respondent noted that motivations to label product as being harvested or captured in a sustainable way as compared to an unsustainable practise was also prevalent. The participant provided an example of a time where this occurred, *"I have had people tell me 'I will tell you it is harpoon caught, they will put a hole in its head if you want'"* (04 small retailer/wholesaler/processor). Furthermore, there were a couple mentions of deceiving a consumer through adding weight or other additives to products so that the product becomes

heavier and more expensive. Finally, it was noted by many respondents that while some mislabelling is intentional, often in retail settings with young workers and lack of experience identifying product, mislabelling may be an accident.

When asked about IUU fishing, eleven respondents agreed this was also a significant issue in Nova Scotia, compared to five respondents that believed it was somewhat of an issue or were unsure of its presence in Nova Scotia. The remaining two respondents did not directly address the issue of IUU fishing during their interview. It was recognized that illegal and unregulated fishing, such as those who are fishing without licences or when the season is closed, is less common due to strict regulations and monitoring by the government, however unreported fishing has increasingly been recognized as a major concern. This was due to the "cash fishery" that exists within Nova Scotia. This activity occurs when producers decide to sell their product for cash, often on the side of the road, but there is a large uncertainty if any of this product is officially recorded. It was explained that, *"the tuna and the scallop fishery in the Northumberland Strait, its 100 percent a cash fishery, that doesn't go to any legitimate processor, so anybody can say they caught whatever, whether it goes into the quota or not… who knows and we actually think we have quite a robust cash fishery in Nova Scotia"* (04 small retailer/wholesaler/processor).

It is evident that unreported fishing and mislabeling are pressing issues within Nova Scotia, but only some respondents made the connection that traceability could prevent this issue. One respondent explained they believed traceability was necessary as, *"so much of this fraud and mislabeling and ambiguity in terms of where the product comes from leads to corrosion of trust overall in the industry and erosion in value" (02 small retailer).* In addition to traceability, it was pointed out by four respondents that appropriate licensing for harvesters and processing plants was critical. This was expressed by a large retailer in saying, *"federally licensed facilities are responsible and audited against that type of buying so if you're buying through a federally licensed facility you're pretty well assured that you're getting product that is caught legally and is from a quota"* (02 large retailer).

### 4.1.2 Changing regulation and market environment

In addition to the issues mentioned above, questions surrounding the changing regulations and evolving markets were posed to the interviewees to gain insight into their

knowledge and perception of the issue in Nova Scotia. Five respondents were aware of regulatory changes (all mid-chain actors), four were somewhat aware and nine were unaware (four of which were producers). Those that were unaware, were either uninterested as it did not impact their business or were more focused on their immediate business such as day to day sales. Those that were aware of changes in regulation in other areas of the world, were often more heavily involved with exporting product to the EU and the US. It was highlighted by many respondents, that regulations imposed on the industry are continually increasing in Nova Scotia. However, there was conflicting opinions on where Canada sits in terms of advancing traceability within the country. Some agreed that Canada is lagging, while others believed regulations were similar to the US for example. Regulations were viewed as important, but overregulation was viewed as a potential burden especially to producers or small businesses. While there was this recognition among some respondents, their perception towards the changes was generally passive. When asked about future changes in regulation it was said that, *"we have been regulated to hell since day one so whatever they bring on we deal with it"* (09 oyster producer). Only a select few, who were mid-chain actors, recognized traceability as a way to get ahead of the market and regulation, that is, as a way to be prepared.

### 4.1.3 Presence of CFT in Nova Scotia

When examining responses from all informants, it is evident that true CFT is relatively non-existent within Nova Scotia. When asked about the presence of CFT in Nova Scotia today, the CFT initiative, ThisFish, was mentioned by most informants. Although the program is largely not active as it was explained that, *"we had a traceability program, ThisFish, at one point which was customer-facing and they were from the West Coast I believe we set up in Ontario and Atlantic Canada" (02 large retailer).* ThisFish began as a pilot project program within mainly the lobster, haddock and halibut fishery in Nova Scotia. Although some tagged product is still within the supply chain today, the program failed to gain a lot of traction within Nova Scotia and thus is relatively inactive as of today. Other mentions of traceability were local and community supported initiatives from smaller retailers in Halifax who provide more transparent sustainability information to their customers, or companies that have begun to adopt electronic systems, such as QR codes, to allow for end users to assess information about their product. However, these programs are still in their early stages. There were three respondents who also

mentioned MSC certified product within their company attributing it to traceability as the certification with the Chain of Custody requires product to be traced one-up one-down. Although only mentioned by one respondent, the government of Nova Scotia through the Department of Agriculture introduced a traceability pilot program, which was meant to encourage new technologies and systems to increase traceability specifically within crop or aquaculture industries (Government of Nova Scotia, n.d.). While this is not considered to satisfy the requirement for CFT in this report, it is important to note that this is still seen as a traceability initiative to respondents.

*Awareness of traceability*

During the interviews, the awareness of traceability and CFT was posed as a straight forward question being, *"are you aware of seafood traceability? And are you aware of CFT?"* The majority of the participants were aware of CFT or traceability in general, with eleven respondents saying yes, six respondents expressed somewhat of an understanding and only one respondent not understanding what traceability entailed. It is evident however that producers were less educated on traceability compared to the mid-chain actors, as three producers expressed somewhat of an understanding and one producer had no understanding of traceability.

*Current labelling or recording*

While CFT may not be present extensively within Nova Scotia, interviews served as a good way to understand what type of product tracking and labelling of product exists so that a feasibility analysis could be performed. When discussing the ways in which product inventory is managed, generally only larger businesses use technologies to keep a record of product flows. This is in the form of codes such as UPC that is put on boxes of product, PO numbers, item or article numbers assigned to product, or simply the name of the product. Wholesalers and distributors use both paper and electronic databases to track product coming in and out of their facilities, although one respondent revealed they keep track of everything manually. Codes are used to match information to the product such as size, date, and origin. Smaller retailers will do physical counts and use excel sheets to keep track of product. Thus, inventory tracking is largely both paper and electronic based within Nova Scotia. Finally, mid-chain actors were aware of the labelling requirements that exists within Canada and that audits are preformed from time to time.

Producers, excluding shellfish producers, expressed that the only recording they currently did was filling out logbooks of their catch as required. Shellfish producers abide by the regulations set out by the CFIA, in which they are required to have a tag with the harvest date, processing date, lease area, and size. One oyster producer was also providing extra information on their product due to the demand from their customers in the US. *"In the US we put the same tag in the box, the US we also have an oysterology tag that tells a little story about our oysters, that goes in every box"* (09 oyster producer). It is also evident that shellfish producers require more paperwork and ability to trace product as the CSSP and HACCP required products to be recalled at any point.

### 4.1.4 Perceptions towards traceability

When examining respondents' reactions and feedback about CFT and traceability in general, eleven had a positive outlook on its use in the seafood industry, while the seven others were skeptical about its application, however no one was outright negative towards the idea. CFT was viewed by six of the respondents as an initiative that was a novelty to consumers or directed towards the small niche market that exist in Nova Scotia and internationally. Reflecting on the CFT trials taking place within a large retailer, the respondent explains that *"you get these peaks where you did a big ad and everything was traceable, but how many times am I going to tell them it's good after I told him the first time? That was attitude we were getting after a while, it was a novelty thing they appreciated being able to know, but they weren't always taking advantage of it"* (02 large retailer). Products that have CFT were also compared to products that claim they are organic, where only a select number of the population appreciate or demands it.

*Perception of consumer demand for traceability*

During the interviews, questions about the amount of consumer demand for CFT was posed. Five respondents agreed there was increased consumer demand, seven felt there was only some demand, and one respondent believed there was no demand coming from consumers at all. It is evident that general awareness from consumers about their food products is increasing, but specifics about what information is of value to consumers is lacking and largely undetermined. It was explained that, *"in Canada, from our customer conversations that we've had it's not that they don't care, people seem to have more trust in the government in the way that they set the quotas"* (02 large retailer). This quote shows that some consumers in Canada have more trust in

the government to set regulations and ensure their food products are safe and sustainable rather than leaving the decision making up to them. Within Nova Scotia and more specifically Halifax, there is a smaller percentage of like-minded customers who are asking questions about where their seafood comes from and are willing to pay a little extra money for this information whether it be verbally, or on the label. However, it was highlighted that, *"people are motivated and interested and if it is there and it costs the same people don't mind, but I think when it comes to who will be willing to pay the price for the costs of the programming, it is going to shrink the number of people who would be so interested to want to have something that has consumer-facing traceability"* (04 smaller retailer/wholesaler/processor). Concerns of consumers from the perspective of some of the mid-chain actors was that they wanted product to be sustainable, but that would happen through certification schemes like MSC, whereas traceability focuses more on quality and food safety from a consumer perspective. Another observation made by a few respondents was the lack of general awareness from consumers about seafood products, their origins and method of production.

### 4.2 State of seafood supply chains in Nova Scotia

This section focuses on the characterization of seafood supply chains in Nova Scotia, the risks for mislabeling and IUU fishing and species-specific feasibility. Seafood supply chains examined for this research are complex with differing characteristics and structures (Figure 3). Figure 3 demonstrates this complexity and also highlights the interconnectedness among some supply chain actors. The species or product groups that are analyzed are: oyster, lobster, mussel, sea urchin, scallop, finfish, shrimp, crab.

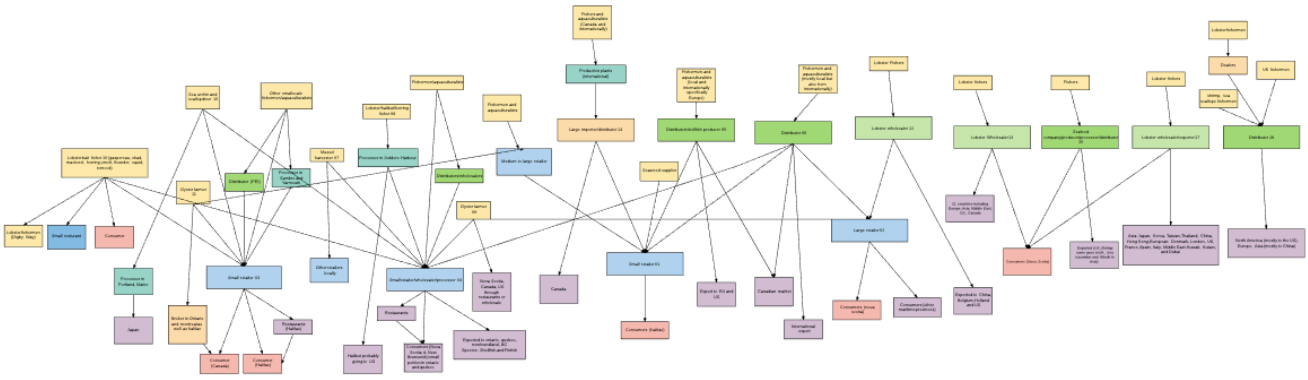


**Figure 3** Overview of seafood supply chains examined in this report based on information from interviews conducted. Diagram colour legend provided in Table 6.

All of the following seafood supply chains illustrated in the results section were created with the following attributes in Table 6 below.

**Table 6** A legend for all seafood supply chains examined within this paper.

| **Characterization** | **Description** |
|---|---|
| **Solid line** | Represents certainty that product is going from one actor to the other |
| **Dashed line** | represents certainty that product goes to identified actor/place but any additional places it goes in between is unknown |
| **Smaller dashed line** | represents areas where cash fishery was described, thus it is assumed that product is going straight to consumer, but this is still uncertain |
| **Thick line around actor** | Interviewed |
| **Blue-green circle** | represents product that is within Nova Scotia. |
| **Yellow** | Producer |
| **Orange** | Broker/dealer |
| **Green** | Distributor |
| **Light green** | Wholesaler or exporter |
| **Turquoise** | Processor |
| **Dark blue** | Restaurant |
| **Light blue** | Retailer |
| **Pink** | Consumer |
| **Purple** | Export countries |
| Note: some actors can be classified as more that one of the above, in most cases this is indicated OR main role was assigned. Additionally, within supply chain maps there is both plural and singular names, plural means there is a variety of companies or people within them, singular means information from interview indicated only one company or person. Where there is a thicker box around a plural actor, it means that one or two of the interviews fall in that category, but may also include others not interviewed. | |

*Oyster supply chain*

Oysters produced within Nova Scotia are often sold locally, as well as internationally to Europe, the US and the rest of Canada via the producer themselves or through other wholesalers or brokers (Figure 4). While oysters are often not mislabeled in terms of the species because they are obvious in both appearance and taste, their origin may be mislabeled. An oyster producer explained that, *"I have gone to Yarmouth and we sell to Sobeys and have seen my oysters there and I said to the person behind the desk, where are those oysters from, and she said I think they are from PEI"* (09 oyster producer). It was also noted within interviews that risk is increased in retail stores because oysters are often displayed outside of their packaging on an ice covered counter without a label on the product, making feasibility for CFT a challenge in this situation. Finally, IUU activities were not as commonly mentioned within oyster supply chains, however it was noted that there are harvesters who sell product within Nova Scotia that are not federally registered which increase the risk for food safety and compliance with rules and regulations. Oyster supply chains satisfy 2 of the 5 core functions, namely vessel-dock (farm-dock) capture and internal traceability, and somewhat satisfy product-data capture and supply chain visibility, but fail to meet the data verification function (Table 7).

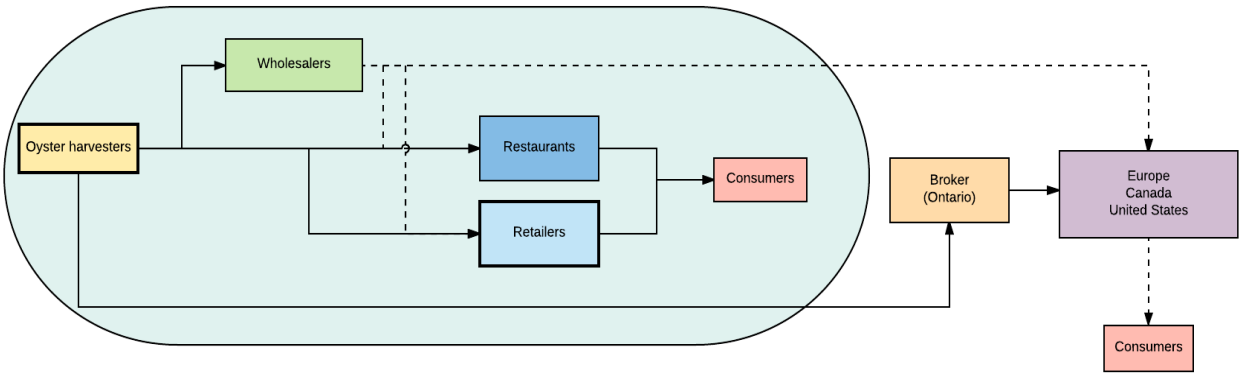
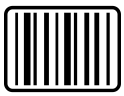
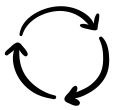



**Figure 4** Oyster supply chain in Nova Scotia based on information from interviewees.

**Table 7** A comparison of the oyster supply chain in Nova Scotia to the five core functions for robust end-to-end traceability.

| **Checklist - Oyster** | |
|---|---|
|  | Yes – Generally, all oyster harvesting occurs within one lease area, so tagging the location of harvest is much more feasible as oppose to wild capture fisheries. Information is collected at the site of harvest, where processing (usually) also takes place, which ensures that data is captured at the source. |
|  | Somewhat – Since each individual oyster is not tagged, when oysters are removed from the box or bag and placed at a retailer counter or restaurant display, they are at risk of being mislabelled. |
|  | Yes – The oyster supply chain generally has a good amount of internal traceability (if federally registered) as they are required to abide by HACCP and CSSP regulations, where they must recall product in case of illness of a consumer. Additionally, these products that are sent out internationally to the EU and US, they must abide by their regulations for internal traceability. |
|  | Somewhat - Oysters producers are required to provide more detailed information such as common name, location of harvest, name of establishment, date of processing which attached on the box or packaging that product is sent out in, thus they have more visibility with their product that others, however they are not fully transparent. |
|  | No - Regular audits are performed for safety purposes, but not for traceability. |

*Lobster*

The lobster industry was recognized as a very important industry to Nova Scotia, as it is often considered one of the best provinces for fresh lobster. It is evident from the mapped out supply chains that the lobster industry can be complex, whereby product is transported to multiple actors and even traded back and forth between buyers within and outside of Nova Scotia (Figure 5). Data from interviews conducted showed that even with requirements from the EU for catch certificates, product mislabelling may still be evident as the certificates are not always filled out truthfully. One respondent explained, *"I can tell you that not one person in Canada has ever followed correctly what they are asking us to do because it is impossible so every business, all they do is just take a guess of which boat they have that they are buying from and they just mark it on a page and then after a few weeks switch boats"* (17 lobster wholesaler/exporter). This lack of truthfulness in recording catch data is often due to the sheer amount of product these companies are bringing in and the fact that they have to be stored live (at lobster pounds). Live lobster should be separated at the lobster pounds to maintain traceability, but this is not done. For example, the same respondent explained that "*in one night I will easily buy 150 thousand pounds, everything gets shipped to my plant, we have high school workers, we have regular workers, we have everything and these kids grate it out and then they put it into little individual cells that we put per tubing so we winterize them basically live and then we wait until the shitty weather comes in and then we release them from the cages and then we ship them live"* (17 lobster wholesaler/exporter).

Risk for mislabelling of lobster was not attributed to species as most respondents agreed that it is difficult to mislabel as another species, however the location of where the lobster was coming from was more of a concern for mislabelling, *"I was lobster fishing for 20 years and we sold our lobsters to the US and every lobster was sold as a Maine lobster to wherever they sold it, so not much traceability there"* (09 oyster producer). Lobster was also recognised as a high value species thus risk for species mislabelling is low. However, there may be significant risk of unreported catches in the lobster industry as respondents did recognize that it is apparent (in line with earlier discussions about cash economy).

A variety of challenges to the feasibility of tagging lobsters were recognized for example, a producer expressed the lack of feasibility if tagging lobsters took longer to complete, *"we put in a lot of long hours so if it was anything that was going to take more than a split second it*

*would really add to your day like we haul 250 traps a day and they are all on one buoy and one line so it usually takes 14 to 16 hours getting them back, at the start of the season every day so if it took, say it took a minute to do every trap that's an extra 250 minutes, or 4 hours on your day you just couldn't do it."* It was also evident that trials in the past as a part of ThisFish on the lobster industry were only somewhat successful because the bands with codes could be easily placed on the lobster, as the bands would be placed on the lobster either way. However, challenges still existed as it was explained *"even tagging the lobster was a real challenge they came up with bands that had tags on them, but the bands would fall off in the tank so then you'd end up with tanks with bands and lobsters that has nothing on them so really that was a fail"* (02 large retailer). On the other hand, it was recognized that *"because of the nature of the process like processing them into a consumer good, so for example lobsters are generally sold individually and you can tag them relatively easily and they don't go through a lot of processing" (18 distributor).* Currently, lobster supply chains satisfy 1 of the 5 core functions, namely internal traceability, and somewhat satisfy vessel-dock capture, product-data capture and data verification, but fail to meet the supply chain visibility function (Table 8).

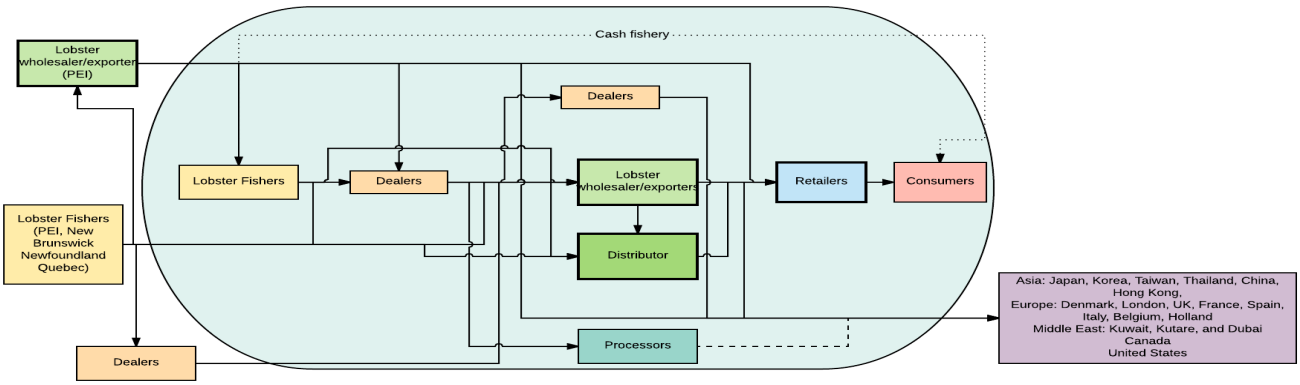



**Figure 5** Lobster supply chain in Nova Scotia based on information from interviewees.

**Table 8** A comparison of the lobster supply chain in Nova Scotia to the five core functions for robust end-to-end traceability.

| **Checklist - Lobster** | |
|---|---|
| | Somewhat – It was noted that the lobster industry has been involved in the program ThisFish, and while some lobsters are still banded with codes that link to the ThisFish website, the codes are inactive and not being updated once they reach the wholesaler or distributor. In some cases, information about the product is being captured at the dock, but there are also vessels within Nova Scotia that are not involved in this initiative. Otherwise, product is generally aggregated at a port with information such as size, date, and origin. |
| | Somewhat – Any product that is connected with ThisFish would have codes of the bands of lobster that attached the information to the product. In some cases, codes assigned to grated lots for facility storage, but after that codes are not maintained downstream. |
| | Yes – Generally, the lobster industry does have internal traceability within their own facility where product is sorted according to size, date, and origin and especially because the inshore and offshore fleets in Nova Scotia are MSC certified. Those that are involved with the MSC Chain of Custody are required to maintain internal records and traceability one-up one-down in the supply chain. Small amounts of lobster remain in Nova Scotia and the rest is exported to US (large portion), EU, Asia, Middle East, and the rest of Canada. Thus, exporters must abide by the regulations set out by those countries. |
| | No - Information to clients or consumers is not evident as they often receive more general information such as product of Canada. |
| | Somewhat - The CFIA performs audits each year, but audits are not linked to traceability, they are not making sure that the information provided to clients is correct, however MSC certified fisheries will conduct audits for certified product to ensure compliance. |

*Mussel*

Information collected about the mussel supply chain was limited and thus results show product that is produced and remains within Nova Scotia only. Mussels are usually directly sold to retailers and restaurants; thus the supply chain is relatively simple in this case (Figure 6). Potential risk for mislabeling within retail settings was identified as it was explained that, *"we used to sell mussels into retail in 25-pound bags and they just dump them on the ice and you do still see that and the next bag would come in and get dumped on top and didn't matter where it came from and they would all get mixed together and you see a lot less of that today"* (07 mussel producer). Retailers will sometimes keep the product within the bag because mussels release a lot of water which decreases the weight so instead of the 25-pound bag that was poured into ice, when repackaged it would have weighed only 21 pounds. It is important to note, that similarly to oysters, there may be difficulties in tagging the individual mussel instead of the bag. The risk for mislabelling and fraud, while present, is low as there is little to no chance that a mussel would be labelled as a different species because it is obvious in both appearance and taste. However, it is clear that the mislabelling of where mussels are coming from or how they were produced is likely to occur within Nova Scotia. Feasibility for CFT of mussels was viewed as mostly feasible as long as packaging allowed for information to remain on the product, instead of it being removed and placed on ice. The mussel supply chain satisfies 2 of the 5 core functions, namely vessel-dock capture and internal traceability, and somewhat satisfy product-data capture and supply chain visibility, but fail to meet the data verification function (Table 9).

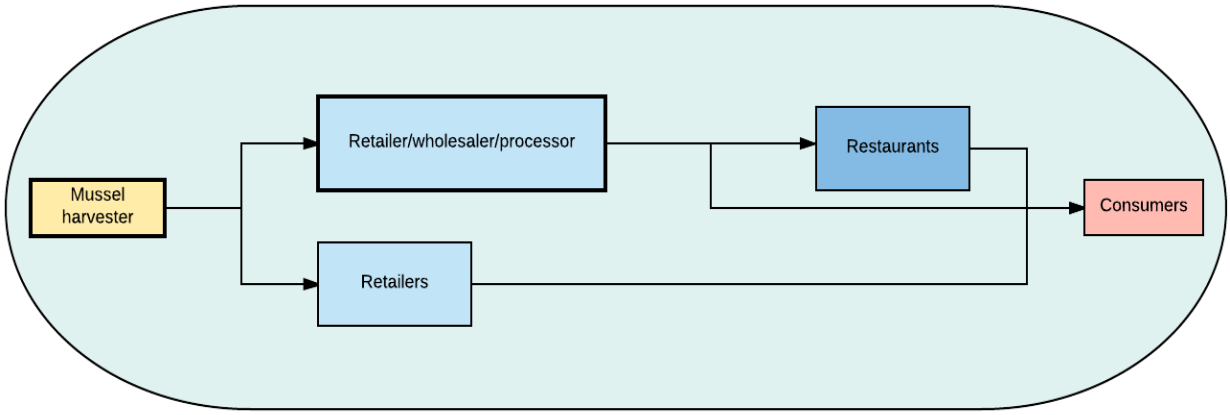



**Figure 6** Mussel supply chain in Nova Scotia based on information from interviewees.

**Table 9** A comparison of the mussel supply chain in Nova Scotia to the five core functions for robust end-to-end traceability.

| **Checklist - Mussel** | |
|---|---|
| | Yes - Mussel harvesting occurs in one area so tagging the location of harvest is much more feasible as oppose to wild capture fisheries. Information is collected at the site of harvest, where processing (usually) also takes place, which ensures that data is captured at the source. |
| | Somewhat - Mussels are often sold within a package or bag, and when sold like this directly to a consumer, little risk for mislabeling or fraud is apparent because of the requirements for the label on the product. However, when this product ends up at the retail or restaurant level, the risk is elevated because the information is no longer attached to the product. |
| | Yes - The mussel supply chain generally has a good amount of internal traceability (if federally registered) as they are required to abide by HACCP and CSSP regulations, where they must recall product in case of illness of consumer. |
| | Somewhat - Mussel producers are required provide more detailed information such as common name, location of harvest, name of establishment, date of processing which attached on the box or packaging that product is sent out in, thus they have more visibility with their product than others, however they are not fully transparent. |
| | No - Regular audits are performed by the CFIA for safety purposes, but not for traceability. |

*Sea Urchin*

Based on interviews in this study, all of the sea urchins harvested are exported to the US, then shipped to Japan where there is a higher demand for the product (Figure 7). Risk for mislabelling was not discussed within the interviews pertaining to this supply chain, however in examining the 5 core functions it is visible that the risk may be relatively high. The sea urchin supply chain only somewhat satisfies product-data capture and internal traceability, but fails to meet the vessel-dock capture, supply chain visibility and data verification functions (Table 10). Additionally, when discussing IUU fishing with the sea urchin producer, they explained that they knew someone who was using someone else's vessel number to get product across the border,*"there was an incident where somebody, I am not going to mention any names, I think I know who it was, was caught by doing that with the sea urchins, I think the company was fined a couple million dollars or something, that was a few years ago so that's about all I know about it, but it has happened I guess"* (16 sea urchin/sea scallop diver).

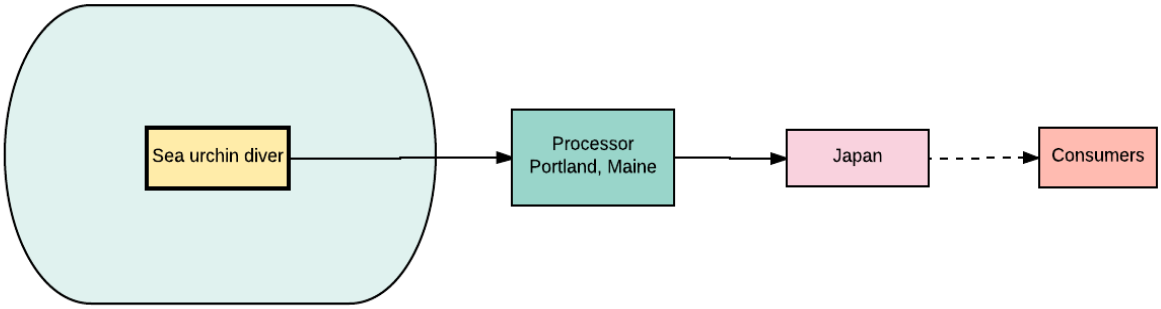
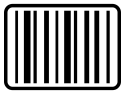
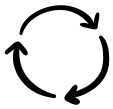



**Figure 7** Sea urchin supply chain in Nova Scotia based on information from interviewees.

**Table 10** A comparison of the sea urchin supply chain in Nova Scotia to the five core functions for robust end-to-end traceability.

| **Checklist – Sea Urchin** | |
|---|---|
|  | No – Producers are required to log their catch and every box sent out is tagged with a number which is associated with the vessel. However, any other information recorded is unknown, thus it is likely to be just the common name and the country of origin. |
|  | Somewhat - every box sent out is tagged with a number which is associated with the vessel. It is plausible that risk for mislabelling is increased once product is removed from box. |
|  | Somewhat – As the product is sent out to the US, internal traceability would exist once it is in the US. |
|  | No - It is plausible that information carried on along the supply chain is not visible to consumers in Japan. Without supply chain visibility product attributes cannot be determined. |
|  | No - There is likely no verification of the data associated with the product, which presents a final risk for mislabelling or IUU fishing. |

*Scallop*

The scallop industry, largely composed of sea scallops and bay scallops, are harvested within Nova Scotia as well as other areas which were identified during interviews such as Argentina and the UK (Figure 8). A small amount of product remains in Nova Scotia or is exported out to the rest of Canada, Europe, US, and China (Figure 8). Cautions over the sustainability and the need for traceability was highlighted as both dragger-caught scallops and more sustainable methods of capture are both MSC certified which can deceive the consumer. Additionally, there is evidence of the cash fishery being present for this species as well. It was described that the, *"same thing with the scallops the sea scallops… it's not legal and people just try to sell them all over the place, that was the one thing that DFO asked about was, who was the diver because there's only one person who has a license so you can only say that one name or you're in trouble, so it must be a problem if DFO is coming around once in a while seeing what you have"* (01 small retailer). Furthermore, risk for mislabeling the type of scallop may exist on the market as explained that, *"bay scallops and sea scallops, big one there I think I would look at a bay scallop and I think I probably have a good eye because of the size of the scallop because it's a bay scallop, does somebody in Ontario know that, does somebody in Illinois know that because they don't actually know what a scallop is, I don't know and a bay scallop is probably a lot cheaper than a 22 dollar pound sea scallop"* (07 mussel producer). Risk for mislabelling and IUU fishing (due to presence of cash fishery) is relatively high as the scallop supply chain only satisfies somewhat 3 of the 5 core functions, namely internal traceability, supply chain visibility and data verification and fails to meet the vessel-dock capture and product-data pairing functions (Table 11).

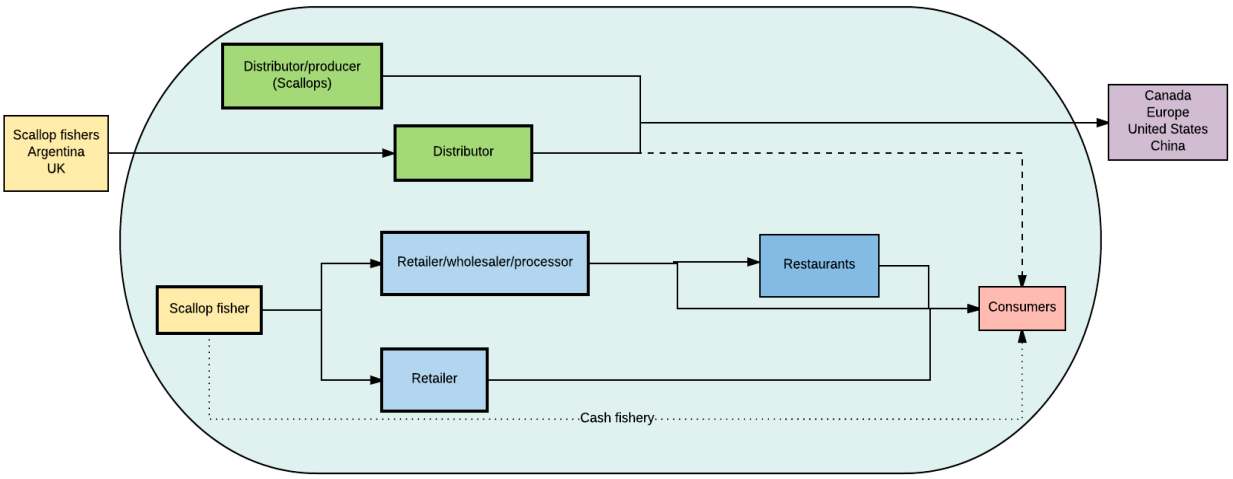



**Figure 8** Scallop supply chain in Nova Scotia based on information from interviewees.

**Table 11** A comparison of the scallop supply chain in Nova Scotia to the five core functions for robust end-to-end traceability.

| **Checklist - Scallop** | |
|---|---|
| | No – Lack of evidence to be certain, however it is likely that information about the product is not collected at the vessel within Nova Scotia. |
| | No – Lack of evidence to be certain, however it is likely there is no attachment of product to data. |
| | Somewhat – Product coming from Europe would have one-up one-down traceability, and when it is imported the name of the establishment where the fish or seafood was sourced from would be included. Those that are involved with the MSC Chain of Custody are required to maintain internal records and traceability one-up one-down in the supply chain. Exporters to EU and US must abide by the regulations set out by those countries, specifically, the EU has catch certificates that are required to be filled out. |
| | Somewhat – Within Nova Scotia, there were efforts to develop a diver caught scallop fishery that was approved by the DFO recently. In this case, because the product is highly sought after, labels within restaurants or retailers will say “diver caught scallop” as a way to appeal to consumers for this rare product. However other than the country of origin and common name, there are no other requirements for labelling. |
| | Somewhat – Due to the fact that some scallop inshore and offshore fleets are MSC certified, MSC audits would be performed. |

*Finfish*

The finfish supply chain, as it is a broad category made up of both wild capture and aquacultured species, is complex and variable. While some product remains within Nova Scotia where it is sold to distributers, retailers, restaurants and other lobster fishers for bait, much of the product is exported to Europe, the US and the rest of Canada (Figure 9). Mislabeling was recognized as being quite high for finfish from many of the respondents. The most common instance of mislabeling that was recognized was identified in species that looked the same, for example any of the whitefish such as halibut, haddock, hake, cod, cusk, and pollock. The groundfish and other species such as ocean perch and mentioned above are also at an increased risk as some are a lower value species. Furthermore, there was a large distinction between farmed and wild-caught finfish and its risk for mislabelling. It was thought that farmed fish would be mislabelled more often than wild-caught because of the demand for wild-caught and perception toward farmed product.

Risk for IUU fishing is also noted to be higher within finfish. The cash fishery was recognized as present within Nova Scotia and a concern for sustainability. It was highlighted that *"There are pretty well documented cases on the south shore on the halibut fishery being illegal"* (04 small retailer/wholesaler/processor). Additionally, some of the finfish caught in Nova Scotia and exported to the US are at risk of being more stringent for labelling in the US Import Monitoring program which includes swordfish, Albacore, bigeye, and yellowfin tuna, Bluefin tuna.

Feasibility for traceability within finfish varies depending on the species. In terms of tagging finfish, the ease of it largely depends on the size of the species. Reflecting on trials for the halibut and haddock fisheries it was explain that, *"you can't do that with haddock, we catch 50-60,000 lb of haddock and they're little fish there not 40, 50, 60 lbs halibut, so the expectation couldn't be the same on a haddock fishery as it was on their fishery"* (02 large retailer). It was recognized that larger fish such as halibut, were more feasible because they are a large fish so the time it took to tag a few halibut was reasonable. Additionally, for sustainability purposes, it was mentioned that it is important to know how halibut was caught because it could be from a small-scale producer on a day boat or by a large longliner who was out at sea for two weeks. However, two respondents did recognize that it was relatively feasible to tag the fins of fish for traceability purposes. It should be noted that while CFT is more feasible for whole fish when

tagged, once product is filleted, the risk for mislabeling increases if individual tags are not placed on the fillet (i.e., if data-product pairing is not maintained when processing). Risk for mislabelling and IUU fishing (due to presence of cash fishery) is relatively high as the finfish supply chain only somewhat satisfies 2 of the 5 core functions, namely internal traceability, and data verification and fails to meet the vessel-dock capture, product-data pairing and supply-chain visibility functions (Table 12).

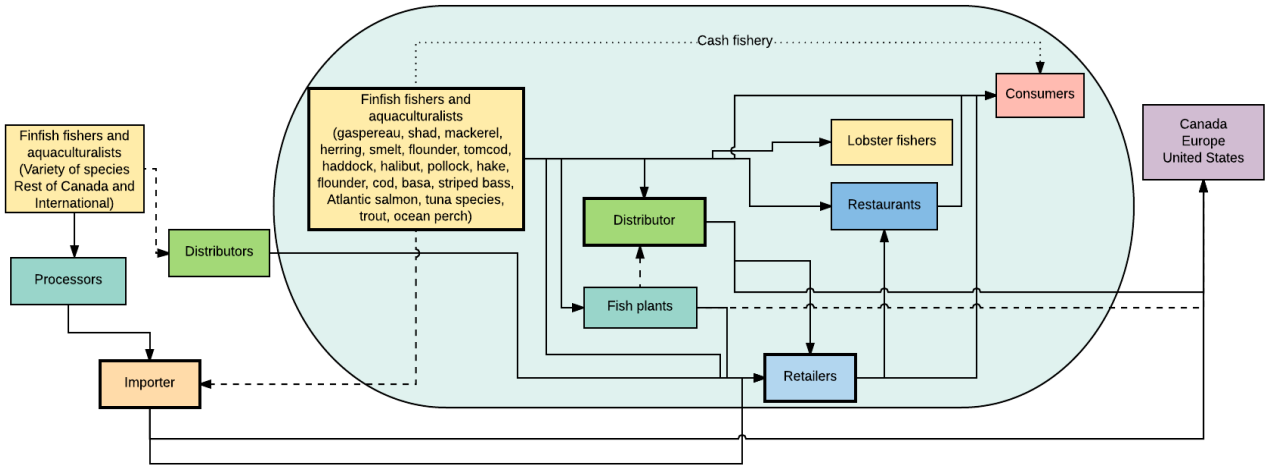
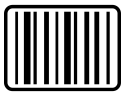
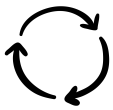



**Figure 9** Finfish supply chain in Nova Scotia based on information from interviewees.

**Table 12** A comparison of the finfish supply chain in Nova Scotia to the five core functions for robust end-to-end traceability.

| **Checklist - Finfish** | |
|---|---|
|  | No - Lack of evidence to be certain, however it is likely that information about the product is not collected at the vessel within Nova Scotia. |
|  | No - Lack of evidence to be certain, however it is likely there is no attachment of product to data. |
|  | Somewhat - Some products within the industry are MSC certified such as some halibut, herring, and haddock fisheries thus internal traceability would be present in these cases. Exporters to EU and US must abide by the regulations set out by those countries, specifically, the EU has catch certificates that are required to be filled out. |
|  | No – information about the business or producer is often not conveyed, only the common name and country of origin is required in Canada and finfish are subject to any EU and US labelling requirements. |
|  | Somewhat – Within the fleets that are MSC certified, MSC audits would be performed. |

*Shrimp*

Some of the shrimp within Nova Scotia is processed and consumed here, while others are imported in from other areas internationally and sold to export markets such as the rest of Canada, Europe, US, and Asia (Figure 10). Shrimp product originating from Nova Scotia and exported largely to the US is at risk of lack of adherence to the US Import Monitoring Program as it is one of the priority species. It was recognized that aggregation of shrimp products would result in difficulty in implementing traceability. It was explained that *"not so with shrimp, for example, so a cold water shrimp harvested by a small boat in Newfoundland comes to shore and offloads it's catch along with 5 or 6 of his friends, all of that catch goes into one or two days of production on a shore side plant, all of those shrimp get sorted by size, you have many boats to many outputs and while we of course can keep track of well all of these vessels contributed to the packing of all these goods, we cannot pick up one shrimp or one bag of shrimp and say this bag came from this harvester" (18 distributor).* Risk for mislabelling and IUU fishing is relatively high as the shrimp supply chain only supply chain satisfies 2 of the 5 core functions, namely internal traceability and data verification and fails to meet the vessel-dock capture, product-data pairing, and supply-chain visibility functions (Table 13).

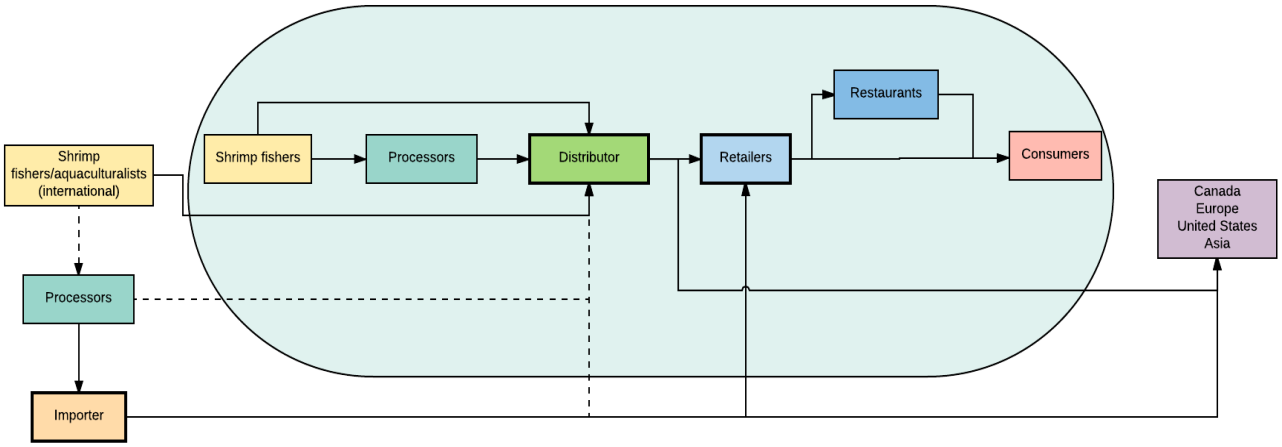



**Figure 10** Shrimp supply chain in Nova Scotia based on information from interviewees.

**Table 13** A comparison of the shrimp supply chain in Nova Scotia to the five core functions for robust end-to-end traceability.

| **Checklist - Shrimp** | |
|---|---|
| | No - Lack of evidence to be certain, however it is likely that information about the product is not collected at the vessel within Nova Scotia. |
| | No - Lack of evidence to be certain, however it is likely there is no attachment of product to data. |
| | Somewhat – Only the northern shrimp fishery in Nova Scotia is MSC certified thus internal traceability would be present in these cases. Exporters to EU and US must abide by the regulations set out by those countries, specifically, the EU has catch certificates that are required to be filled out. |
| | No – information about the business or producer is often not conveyed, only the common name and country of origin is required in Canada and shrimp are subject to any EU and US labelling requirements. |
| | Somewhat – Within the fleets that are MSC certified, MSC audits would be performed. |

*Crab*

Several species of crab are harvested in Nova Scotia, including brown crab, rock crab, and snow crab. Specifically, the snow crab industry is very high value, thus risk for mislabelling of species was recognized as low. It is plausible that other crab species could be mislabelled as snow crab, however, evidence from this study does not show any proof of this occurring. Product is caught within Nova Scotia and sold to processors and distributors, where a small percentage is sold within Nova Scotia and a large percentage is exported to Europe, the US, Asia and the rest of Canada (Figure 11). Examination of the five core functions suggests that the crab supply chain is at a relatively high risk for mislabelling as only 2 of the 5 core functions are satisfied, namely internal traceability and data verification and fails to meet the vessel-dock capture, product-data pairing functions, and supply-chain visibility (Table 14).

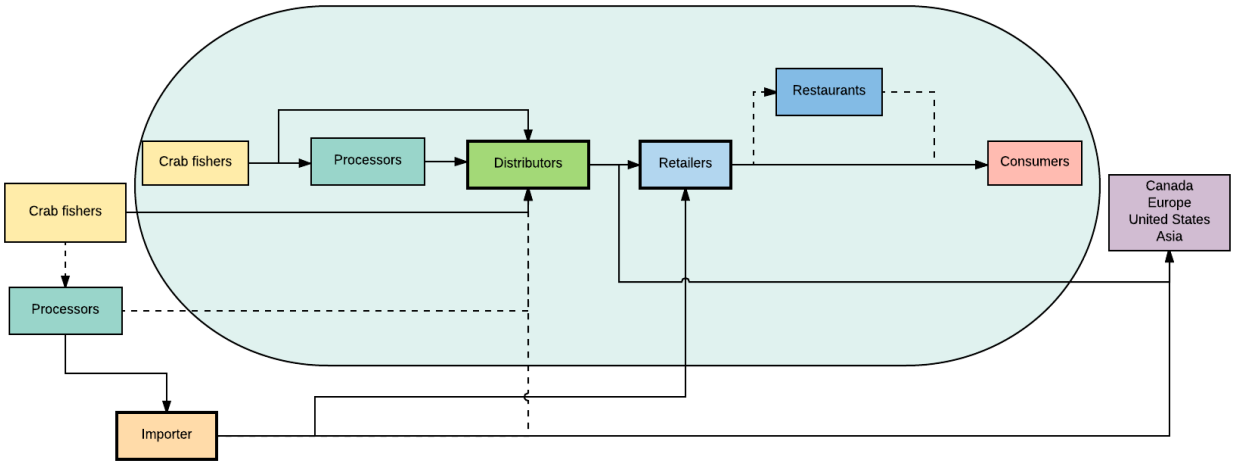
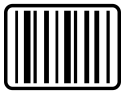



**Figure 11** Crab supply chain in Nova Scotia based on information from interviewees.

**Table 14** A comparison of the crab supply chain in Nova Scotia to the five core functions for robust end-to-end traceability.

| **Checklist - Crab** | |
|---|---|
|  | No - Lack of evidence to be certain, however it is likely that information about the product is not collected at the vessel within Nova Scotia. |
|  | No - Lack of evidence to be certain, however it is likely there is no attachment of product to data. |
|  | Somewhat - Crab trap fisheries on the Scotian Shelf and the Gulf of St. Lawrence MSC certified thus internal traceability would be present in these cases. Exporters to EU and US must abide by the regulations set out by those countries, specifically, the EU has catch certificates that are required to be filled out. |
|  | No – information about the business or producer is often not conveyed, only the common name and country of origin is required in Canada and crab are subject to any EU and US labelling requirements. |
|  | Somewhat – Within the fleets that are MSC certified, MSC audits would be performed. |

A summary table is identified below to aggregate all of the supply chains and provide an overview of compliance with the five core functions. It is evident that the industry as a whole is satisfying or partially satisfying the function of internal traceability with the highest score of 5.5 (Table 15). However, all others are generally lacking with vessel-dock capture scoring a 2.5, product-data paring scoring a 2, supply chain visibility scoring the lowest at 1.5 and data verification scoring a 2.5 (Table 15). The supply chain visibility function is lacking the most within the industry, thus further highlighting that CFT is not apparent within Nova Scotia as supply chain visibility is the key component of this form of traceability.

**Table 15** A summary table displaying all supply chains analyzed and to what extent they satisfy the five core functions for end-to-end traceability. A solid circle means yes (1 point), a half filled circle means somewhat (0.5 points), and an empty circle means no (0 points).

| | Vessel-dock capture | Product-data Pairing | Internal Traceability | Supply Chain Visibility | Data Verification | Score |
|---|---|---|---|---|---|---|
| **Oyster** | ● | ◒ | ● | ◒ | ○ | 3 |
| **Lobster** | ◒ | ◒ | ● | ○ | ◒ | 2.5 |
| **Mussel** | ● | ◒ | ● | ◒ | ○ | 3 |
| **Sea Urchin** | ○ | ◒ | ◒ | ○ | ○ | 1 |
| **Scallop** | ○ | ○ | ◒ | ◒ | ◒ | 1.5 |
| **Finfish** | ○ | ○ | ◒ | ○ | ◒ | 1 |
| **Shrimp** | ○ | ○ | ◒ | ○ | ◒ | 1 |
| **Crab** | ○ | ○ | ◒ | ○ | ◒ | 1 |
| **Score** | 2.5 | 2 | 5.5 | 1.5 | 2.5 | |

### 4.3 Risks identified and potential for risk mitigation via CFT

During the interviews, both mid-chain actors and producers were asked about the risks producers are facing within the industry today, and specifically questions concerning increased regulation and changing markets were probed. Eight mid-chain actors recognized the potential risk of not complying with regulations or market demands. It was noted that increased regulations enforced on individuals poses a risk if they are unable to change and adopt necessary components of their business. A lobster wholesaler explained that, *"from what I understand some of the new measures coming especially from the US will make it much more tedious, there will be much more paperwork and not a lot of companies in our type of business are.. there is a lot of us, there is not a lot of really big ones so it is not like we are all Clearwater so we can just add a department for that"* (12 lobster wholesaler). While not keeping up with regulation was a risk, increases in regulation in itself is viewed as a risk for some companies and producers who are unable to keep up. One respondent expressed the amount of regulations already imposed on the industry *"we have transport Canada, we have CFIA, we have federal department of fisheries and oceans, the provincial department of fisheries and aquaculture, we have European catch certificate procedure, we have 8 or 10 regulatory agencies that somehow monitor what we are doing."* (13 lobster wholesaler). They also explained "*I knew one company that sold out of the fish business because they just got tired of the paperwork, I kind of feel their pain, so we will see what develops*." (13 lobster wholesaler). The potential for CFT to mitigate the risks as a result of increased regulation or market demands is therefore only applicable when producers or other supply chain actors are able to put forth the resources to adopt these new systems. CFT will likely not help to mitigate risk for those who are already faced with the burden of changing regulations or who are struggling to keep up.

While increased regulations made up the majority of risks identified, other risks were also a concern to the industry as a whole. Risk in sourcing product that was mislabelled or unethical and unsustainable for retailers was a concern, as well as the risk for liability surrounding food safety and compliance. It was explained that *"to have a little bit more traceability would give me more confidence and peace of mind and searching out new product because I would assume only legitimate places would get that traceability"* (01 small retailer). Additionally, for any business exporting product, a concern was noted about any future tariffs on seafood exports that would dramatically impact their business. It was noted that, "I*f (US President) Trump put a tariff on*

*seafood like he is doing on softwood, that is going to change everything"* (03 small retailer). Finally, for producers, it was identified that there is some inherent risk when relying on one buyer for all product sold. It was noted that if dramatic changes in the market occur, producers who sell to only one buyer could potentially be at a loss. It was highlighted that the need to outsource to other avenues to sell product is critical given that, *"they are on the edge, especially for producers that are relying on the buyers for everything, if something shifts on the buyer end in terms of price of fuel or the Boston prices or whatever, the buyer continues to price or just stop buying entirely"* (03 smaller retailer). Finally, natural risks, such as population levels of species and storms, that may affect the frequency and amount of product was a concern in terms of ensuring product was available.

On the other hand, a smaller percentage of mid-chain actors had a different view expressing that producers are not at risk because the market is largely saturated in Nova Scotia and product will always be in demand. It was noted that this pressure for ensuring compliance and market competitiveness falls on the mid-chain actors, such as the processors, not the producers. A seafood company that acts as a process and distributor explains that *"I think it is more so on us, because usually it is not the harvester or the license holders that are importing… their job is to catch it, land it and then we take over from there and there is a possibility that transporting it, processing it, packaging it and then shipping it."* (15 seafood company/producer/processor/distributor).

Producers were generally less aware of their risk in relation of changing regulations and markets. Two producers did recognize that changing regulations would pose a risk if they were unable to keep up. A producer noted that as *"more and more industries are burdened with more and more regulations and things that they need to do, the last big wave was all of this certification and some of it has stuck and a lot of it has gone by the wayside with a huge expense to the industry"* (05 mussel producer). When asked how CFT might mitigate this risk, it was identified from the mussel producer that it may not make a large difference due to the fact that the industry is staying up to date with what is required now. They explained that *"If we didn't keep up with their requirements and their certifications, then we were at risk of losing them, I think most of what we are doing right now, if we keep up with what is required for our federal legislation we seem to check most of the boxes for our customers"* (05 mussel producer). This was a common view among some producers who felt as though keeping up with regulations as

they come was appropriate for ensuring they stayed within the market. Other risks identified had to do with the risk of safety while on board fishing vessels and increase regulations surrounding that as well as for shellfish aquaculture producers the risk of food safety and being liable for any product recalls was a significant risk. One producer also mentioned the risk of tariffs for exports as their product would be directly impacted. Finally, one producer was largely uncertain about the risks that they faced within the industry today.

**4.4 Potential benefits of traceability**

A variety of benefits of traceability and CFT were recognized by respondents. The most common benefits that were mentioned were: branding, food safety, and accountability (Table 16). Branding was strongly viewed as a benefit of CFT, and was particularly important to aquaculture shellfish producers, who sensed that CFT would allow for them to distinguish their product in the marketplace. Food safety was another common benefit of traceability, for benefits to be experienced, it was noted that CFT isn't always a necessity. Instead, internal traceability is recognized as critical for food safety and ensuring efficient product recalls. Many respondents agreed that CFT has the ability to increase the accountability of producers in supplying product that is credible and of high quality. On the other hand, the few respondents that rejected this idea felt as those they were already accountable due to the current regulations imposed on them.

Education and long-term sustainability were the other benefits that were more common in respondents' answers. It was explained that, *"if traceability is inherent in seafood, if we know where it comes from and who is doing the harvesting and who is doing the processing, where the processing is taking place, I think that part of the story has required a lot consumers to do work on their own and I think it lays it right out there"* (02 small retailer). With a consumer-facing label it was believed that consumer education would increase, however this is not a direct benefit to the producer. Respondents also spoke to the benefits of long-term sustainability when traceability is implemented, however, this may not be attributed to true CFT but rather eco-labels.

There was the most negative perception was towards the potential benefit of value added to the product and increased market access. While some respondents thought there could be an increase in value when product contained CFT, others explained that this often does not add value in such a way that the producer benefits. *"What traceability can do, one the small scale*

*folks they can kind of break out of that, we call it the commodity curse, break away from that Boston kind of commodity market and one of the tools they could use is traceability if their product is branded and tagged, they can set their own price"* (02 small retailer). Others disagreed, *"no, see we were involved in that and we couldn't get more for something that was tagged, there would have to be a distinct difference and you know there would have to be a lot of branding around that"* (12 lobster wholesaler).

A majority of respondents felt as though CFT would not increase market access for producers, or only felt it would make a small difference. A reason for this was that the industry in Nova Scotia is mostly saturated, meaning producers or sellers are able to find a place to sell their product without having to adopt initiatives such as CFT. It was highlighted that market access is potentially more viable in Canada's export market compared to Nova Scotia. *"I think less so local because it just isn't here it would really have to be raised up from where it is now in order to make a difference, International I mean I think a lot of them were already looking at some type of that because to get into the UK to export to some of these other countries the ones that are doing it are getting the business"* (02 small retailer). Finally, it was recognized that the market has been good within the past few years, so initiatives to sell more product or at a higher price is not as urgent.

**Table 16** A summary table outlining mid-chain actors and producers perceived benefits of adopting CFT.

| Benefit | Description | Yes | Somewhat | No |
|---|---|---|---|---|
| Accountability | Increased accountability in providing product that meets its claims. | 5 | 2 | 2 |
| Branding | Increased recognition for product in market. | 7 | 1 | 1 |
| Compliance | Increased compliance and adherence to rules in place. | 2 | 0 | 1 |
| Connection | Consumer having a greater connection to the food, as they are aware of its origin. | 3 | 0 | 0 |
| Consumer confidence | Increased confidence in validity of product claims. | 2 | 2 | 0 |
| Education | Increased awareness and education about seafood and its production. | 4 | 1 | 1 |
| Food safety | Increased food safety measures in product and handling. | 6 | 0 | 0 |
| Inventory management | Businesses are better able to management inventory internally. | 2 | 0 | 0 |
| Long-term sustainability | Sustainability was associated with CFT as it can allow for consumers to make more sustainable decisions and protect the industry for future generations. | 4 | 1 | 0 |
| Market access | Increase access to new markets within Nova Scotia or internationally. | 3 | 6 | 7 |
| Product recalls | Ease and efficiency in ability to recall products in an emergency. | 4 | 1 | 0 |
| Quality of product | Increase quality of product. | 1 | 1 | 0 |
| Value added | A monetary value that is added when CFT is present. | 2 | 1 | 4 |
| Verification | Ability of verify if product is meeting its claims. | 1 | 1 | 1 |

### 4.5 Potential challenges for traceability

While benefits clearly exist, there are also many obstacles and challenges the seafood industry in Nova Scotia faces due its nature and characteristics (Table 17). The extra resources and cost required for the adoption of CFT was notably the most common challenge identified among respondents. It was identified that there was push back from producers for initiatives such as ThisFish when the program cost money to be involved. It was also recognized that adopting more robust traceability would put pressure on companies who would need to hire more employees to take on the extra work that is required to keep the system going. This was apparent within mid-chain actor companies, but also applied to shellfish aquaculture producers who harvest and process their own product. When reflecting on the challenge of implementation it was noted that *"I think there is cost and it is probably going to take time and it is going to take proper planning and really good thinking about how do we implement this without tying up the existing operations without slowing things down because loss in productivity."* (15 seafood company/producer/processor/distributor). It is clearly important to the industry that existing operations are not at a loss due to implementation of new systems.

Other challenges identified by the respondents related to the nature of the industry in Nova Scotia. It is evident that Nova Scotia is comprised of many small-scale fishing communities that are largely traditional with their fishing practices. This poses two challenges. Firstly, it creates a burden that is imposed on the industry when new regulations are introduced for the producers or other supply chain actors who cannot keep up. It was explained that, *"I have sat around lots of tables with small-scale producers who are.. they don't have big offices with lots of overhead, they have one or two people who are usually the owner who is doing all the paperwork in order to get their product out the door and all these additional requirements makes it very difficult for them to operate"* (18 distributor). Furthermore, when reflecting on the challenges to keep up with new sustainability initiatives it was recognized that, *"generally the producers bear the brunt of the traceability programs and if the cost is prohibited for small-scale producers, that is the issue with the MSC is there are small guys that can't afford it, so if that sort of thing happens with traceability than it is not fair, they are at risk of being excluded."* (02 small retailer). Additionally, the industry today is widely paper-based especially towards the upstream end of the supply chain. Mid-chain actors and producers both recognized that new technologies are generally not being introduced within the seafood industry. One of the

producers explained that *"we have to fill out a log book but that's pretty much it, if you had to enter something in a computer that would be a hard thing to do, most fishermen know how to put in for unemployment and I think that's about it with a computer"* (08 halibut/herring/lobster producer). Thus, the lack of technology use poses a challenge for the industry to adopt traceability initiatives or keep up with regulation as these systems often require the use of technology for tracking and tracing product.

The final challenge that was common among respondents was the competition that exists and thus lack of transparency that supply chain actors are willing to provide to others in the industry as well as consumers. It is evident that the seafood industry is competitive as actors work hard to forage relationships to buy and sell product. So even if consumers are demanding information, it is often in the best interest of the company to keep information private. It was noted that *"the challenge of traceability is that you are opening your books to give the end consumer and all the intermediaries, and of course all your competitors, access to all the information on who supplies the product and what that means it that's now accessing you're basically giving them a leg up after you have done all of the work to get to a certain point and developed those relationships"* (05 distributor/shellfish producer). However, it is important to note that this is not so much of an issue for producers unless they sell their own product, thus producers who are just selling to a processor or distributor are not as concerned with the competition aspect. Fishers are often more private about where they find their fish, good fishing spots, mainly activities that occur on the water. This idea of competition then led many respondents to discuss the large amount of information that is required to be provided within a CFT system and it was noted that this hindered the willingness of particularly mid-chain actors to participate. These concerns were largely centered around information that would inversely turn the consumer off to buying the product. This was highlighted within the lobster industry where it was explained that *"there is not a lot of fishing that happens in the summer and there is basically no hard shell lobster that is caught in the summer and so our hard shell lobster that we are selling now was actually caught in May, sometimes in August the consumer doesn't want to know that the.. that's not fresh to them but they don't know that it is in our tanks and you know that that is normal in this business, however to a consumer that is not a very… I don't think most consumers know how long it actually does take for their product, fresh fish to get to them"* (12 lobster wholesaler). As a result of a lack of consumer awareness, traceability may hinder sales or

lead to decreased profits. Specific information such as traceability all the way back to the boat was another factor that hindered business for mid-chain actors as it gives away the connections to producer and thus supply. An interviewee explained that, *"if there is traceability back to the producer, a lot of my clients are going to start calling them directly, and trying to buy that lobsters, so it ruins my... you know and we put 100 grand a year invested into travelling the world and trying to develop new markets so I don't want to promote the other guy, so yes traceability is good to some extent but traceability on the industry is good, traceability all the way back to the boat, that is no good"* (17 lobster wholesaler/exporter). The only concerns over a producer exposing themselves by providing where their product comes from as well as many other details was an oyster producer who was concerned about the lack of knowledge about how oysters are produced and that consumers would be less likely to consume the product if they were aware of all the details. When asked about what would be reasonable to label on a product, majority agreed that harvester or processor with federally registered plant, location or catch area, method of capture or harvest were useful.

**Table 17** A summary table outlining mid-chain actors and producers perceived challenges to the implementation of CFT.

| **Challenges** | **Description** | **Yes** | **Somewhat** | **No** |
|---|---|---|---|---|
| Competition | Competition exists among players within the industry which leads to reluctance to participate in CFT. | 6 | 0 | 0 |
| Lack of producer control | Producers often have a lack of control over where their product goes and how much they are paid for the product. | 2 | 0 | 1 |
| Inconsistency | Supply chains within different species differ and leads to inconsistent use of CFT. | 1 | 0 | 0 |
| Lack of technology use | Nova Scotia seafood industry is comprised of many producers who are not well equipped with traceability technology. | 4 | 0 | 0 |
| Low margin | Margins are low within the seafood industry, there is no extra money to put towards CFT. | 3 | 0 | 0 |
| Small-scale producers/businesses | Nova Scotia is characterized by many small-scale producers and companies that do not have the capacity to adopt initiatives like CFT or keep up with emerging regulation. | 8 | 0 | 0 |
| Strong relationships | Producers often have strong relationships with buyers and are unwilling to explore opportunities for new marketing. | 3 | 0 | 0 |
| Supply chain blindness | Supply chains are complex and information about where products is difficult to map. | 4 | 1 | 0 |
| Extra resources required | Extra workers and cost is associated with the adoption of CFT. | 10 | 3 | 1 |
| Lack of willingness to provide fully transparent product | Industry is not willing to disclose all information about their products as it can hurt the business and rid of competitive advantages. | 5 | 0 | 0 |

### 4.6 Willingness to participate in CFT

Willingness to participate in CFT systems among producers was generally positive. Three producers (two of which were oyster producers) expressed definite interest in participating in such an initiative. A halibut/herring/lobster producer explained his willingness to participate in CFT by saying *"I am sure it is not going to be that hard or time consuming so probably not a bad thing and it would be low impact for us and not much for us to worry about so why not fire it in there, can't hurt" (08 halibut, herring and lobster producer).* For shellfish producers, willingness to participate in CFT was largely attributed to product recognition and branding. When asked why CFT was important it was explained by an oyster producer, *"just so that the people who eat my oysters know that they are eating my oysters, I have worked for three years to grow these oysters and sometimes people go to a bar and get a dozen oysters and have no idea where it came from or what they ate so it would be nice to be recognized as the oyster man" (09 oyster producer).* None of the other three producers provided an outright no to their willingness, but expressed their willingness would depend on the situation and if benefits could outweigh the costs. *"I have to see a real cost benefit analysis and you know a need for this, and depending on how something rolled out if it just involved another thing on a tag for our distributor or something then that's not a big deal, if it involves another staff person doing more paper work its really got to be sold to me"* (07 mussel producer). Among those that were on the fence, willingness was dependent on what benefits existed, whether there was actually any demand for the initiative and how the costs would compare to the benefits was a common response among participants.

It is also important to note that some of the mid-chain actors mentioned the willingness from producers that they had experienced through traceability trials. The majority recognized that willingness is really cost dependent, meaning many producers would be upset when they had to buy into these schemes, but did not get a return on investment. However, if the process was relatively simple, many producers had no problem with engaging at all. While willingness to participate in CFT was not posed for mid-chain suppliers during the interview, some mid-chain actors admitted that their willingness was lower. It was evident that mid-chain suppliers have more control and more competition for selling product than producers do, so their willingness to provide all information is lower.

# Chapter 5 – Discussion

The purpose of this research was to determine for which supply chains and under what context would CFT be a risk mitigation strategy for producers in Nova Scotia. By interviewing various actors along the supply chain, including producers, feasibility was determined for specific supply chains as well as perceptions toward CFT. This discussion is split up into three sections where supply chains are discussed, either individually or grouped based on their similarities, then commonalities and differences are discussed across supply chains, and finally synthesis of themes that emerged and their context within Nova Scotia is discussed.

## 5.1 Individual supply chain synthesis

### 5.1.1 Shellfish aquaculture (mussels and oysters)

Conclusions for the oyster and mussel supply chain are combined due to their similarities in characteristics and results from data analysis. Shellfish aquaculture is unique in that the producers within this system are often also processors, thus they sell their own product. The potential for CFT to help with branding and differentiating it within the market was important to these producers. Oysters specifically also fit within the niche market that was described as being directed towards with products that were involved with CFT. Oysters are generally not an everyday food in Nova Scotia, but often a delicacy that consumers purchase during a special occasion, thus CFT may be more fitting for this supply chain. Due to the fact that shellfish aquaculture products are satisfying more traceability regulations than other supply chains, the potential for risk mitigation for upcoming regulatory risks is relatively low, and adoption of more robust system may be more feasible. Food safety was also a prominent concern that was discussed within these supply chains, and robust traceability was viewed as critical for quality management. Results show that adopting CFT would definitely help to ensure better compliance, increase product recalls, and keep track of inventory. Thus, all of the five core functions in this case would aim to help reduce risks identified by shellfish aquaculturists. The challenge this industry faces is the feasibility in tagging product, since it still may be difficult and time consuming if each individual oyster or mussel was tagged. Willingness among this supply was relatively high, as the potential to increase branding was important, however it was still identified that a cost benefit analysis is necessary.

### 5.1.2 Lobster fishery

When examining the lobster supply chain, risks identified and feasibility of implementation, it can be concluded that the lobster industry is somewhat prepared to adopt CFT, but push back from industry especially among mid-chain actors was high. The lobster industry is quite complex with a variety of actors involved before it reaches the consumer, thus lobster fishers have less control over their catches. In this industry, more of the regulatory risk falls on the distributors and exporters as their job is to buy, trade and export product that is accepted into the market. However, the importance of adopting increased traceability was highlighted due to the presence of the cash fishery, lack of verification that information filled out on catch certificates is correct, and high risk of mislabeling the origin. While there is recognition that traceability is feasible for lobsters, there were also many challenges identified from previous trials through ThisFish such as the volume of catch and resistance to provide full transparency.

### 5.1.3 Scallop, shrimp and crab fisheries

As scallop, shrimp and crab fisheries scored similarly for the five core functions checklist, they will be analyzed together. It is evident that these fisheries are of high value due to their export potential and demand internationally. However, all are at high risk of mislabeling and IUU fishing as there is a significant lack of traceability within the supply chains. Additionally, it should be recognized that the scallop fishery scored slightly higher due to the presence of diver caught scallops within Halifax that was started locally and has spread to other areas in Canada. Supply chain visibility is thus evident on this product by providing transparency on how the product was handled. However, the cash fishery was identified as prevalent within the scallop fishery, thus it remains at a high risk. No producers within these fisheries were interviewed and thus it is difficult to conclude whether CFT would reduce any risk for them. However, it can be hypothesized that adopting more robust traceability for these species is beneficial as they are of high value and largely exported (DFO, 2017e). Specifically, for shrimp producers may reduce risk as it is a priority species for the US Import Monitoring Program (NOAA, 2015).

### 5.1.4 Sea urchin fishery

Although there is a lack of information collected on the sea urchin supply chain, it is found to satisfy the least amount of the five core functions and thus risk for mislabeling and IUU fishing is the highest. This was also supported by mentions of illegal activity such as using different vessel numbers to export catch that may have not been allowed into the US. Furthermore, due to the fact that product is immediately sold to processors in the US, the producers within this supply chain have little control over the products end point and may not be at risk for any future regulatory requirements as sea urchins are not a priority species for the US at this time. If regulation did pose a risk, it would likely fall more on to the processor.

### 5.1.5 Finfish fisheries

This supply chain, including both aquacultured and wild-caught finfish, is complex with a variety of actors involved before it reaches the end consumer. Risk for mislabelling and IUU fishing aligns with conclusions from the comparison of the five core functions as mislabelling was recognized as being very common among finfish, IUU fishing is present due to cash fishery within Nova Scotia, and this supply chain does not satisfy many of the five core functions. Risk mitigation among fishers from adopting CFT is not evident as results show they are more concerned with the risk of safety on board. However, aquaculture finfish businesses may be able to mitigate risk of increased regulation when product is exported as it is hypothesized they would have more control over this because they are involved with processing and exporting product. Additionally, adopting CFT was recognized as somewhat feasible for some species, but not all. For example, larger species such as halibut may be easily tagged, compared to smaller species such as herring.

## 5.2 Supply chain synthesis

It is evident that seafood supply chains are complex and can be largely unique depending on species, thus it is recognized that risk mitigation for producers and overall feasibility of adopting CFT cannot be examined as a one-size-fits-all approach (Lewis & Boyle, 2017). From analysis, shellfish aquaculture is most prepared to take on CFT as they satisfied the five core functions the best compared to the other supply chains. Additionally, due to the recognition and desire for better branding, they may benefit the most from adopting this system. The sea

urchin fishery was found to satisfy the five core functions the least. When examining all of the supply chains within Nova Scotia, the importance of CFT in benefiting the industry as a whole and aiming to reduce the issues that were addressed during the interviews should not be overlooked. It is clear that Nova Scotia's seafood industry is at risk of mislabeling and fraud most notably with the presence of the cash fishery, particularly within the finfish, lobster and scallop fisheries, that undermines the efforts of the government and responsible actors within the industry. While all supply chains were seen to be at risk for mislabeling or fraud, mislabeling of common name or harvest method was most prevalent within the finfish industry, while other fisheries the origin was more commonly mislabeled. Additionally, risk is particularly higher for the priority species under the US Seafood Import Monitoring Program that are harvested in Nova Scotia, such as shrimp, tuna species, Atlantic cod, and swordfish (DFO, 2017b; NOAA, 2015).

Overall, it was determined that producers within these supply chains are still subject to the regulatory risk or rather burden imposed on them. However, CFT as a way to mitigate this risk successfully remains unclear. Their risk within the industry is different from mid-chain suppliers or those that have more control over product sales and thus adopting CFT may be more effective for risk mitigation of mid-chain suppliers. This is a theme that is also recognized by others where the more risk there is for actors within the supply chain, the more significant traceability becomes (SeaWeb, 2016). This can also be related to product safety, whereby those actors within the supply chain that have more responsibility over the quality of the product and ensuring it is handle safety, benefits the most when adopting traceability that aims to solve these issues.

### 5.3 Small-scale versus large scale businesses and implications for transparency

The small-scale nature of the Nova Scotia's seafood industry places producers at a disadvantage when trying to compete or comply within the industry. Many respondents came to the consensus that not keeping up with regulation puts you at a disadvantage and using innovation to drive business ahead of others within the industry is a good business strategy, but with this also comes with other potential risks. Given the small-scale nature of the industry in Nova Scotia there was no significant consensus that CFT is able to mitigate this risk as it may be too much of a burden to bear. Thus, CFT may be an appropriate strategy for larger companies, but this may be at the expense of small-scale producers who make up a lot of Nova Scotia's

seafood industry. This is a trend that is also discussed by Mol (2015) and Bush et al. (2013) whereby, transparency within the supply chains is often easier to achieve by larger actors who are more profitable and more developed than smaller companies in poorer states, who have trouble fulfilling transparency requirements. This notion is apparent because large institutions have the resources to invest in traceability systems or infrastructure to advance themselves within the market and/or ensure they are up to date on regulations imposed on them (Mol, 2015). In contrast, smaller companies or producers who are aiming to keep up may reduce their productivity when trying to adopt certain transparency measures or lack the capacity to adopt traceability at all. It is noted that this trend is also further exaggerated when there are also restrictions on market access (Mol, 2015). This criticism towards the adoption of traceability, leads to the question of whether traceability puts too much pressure on producers, when they are limited in how much power they have over the supply chain.

### 5.4 Proactive versus reactive actors within the industry

An interesting characterisation of the seafood industry within Nova Scotia was discovered through this research, which is that most actors within the industry take on a more reactive approach to new regulations and rules imposed on them. The common view held among actors is that they deal with the increases in regulations as they come, with only a few that actively search to adopt new systems to drive their business ahead. Due to the fact that majority of respondents took on this reactive approach, it can be concluded that the risk for losing market share may be greater for Nova Scotia, further showing that changes must occur to reduce this risk. An analysis of British Columbia's seafood industry found similar results, as the processing industry was seen to react to changes in regulation or consumer demand as they emerged, thus continuously meeting minimum requirements, but never recognizing the proactive approach (Archipelago Marine Research Ltd., 2005). A plausible explanation to this trend may be the fast paced nature and low margins identified as challenges that inhibit the industry from setting aside extra resources for advancing innovative solutions such as traceability. Individuals within the supply chain are more focused on their day to day tasks and often do not set aside more time and effort to address underlying issues. Unfortunately, when taking on this reactive approach, these problems will never fully be addressed, which is a fundamental issue and may inhibit industry in the future.

### 5.5 Necessity of CFT and the five core functions

The five core functions developed by Future of Fish was developed as a way to address the environmental and social issues that the seafood industry faces today (Future of Fish, 2016). They argue that all functions must be in place to fully solve these issues (Future of Fish, 2016). This framework presents the industry with the opportunity to gain benefits, environmentally, socially and economically, and should be continuing to strive to meet these functions in the future. CFT presents the industry with a potential opportunity for innovation and compliance while securing market value for future generations. However, currently it is evident that Nova Scotia is immensely lagging behind and it may not be realistic for industry to adopt all functions immediately. Results highlight the extent of the issue for the seafood industry in Nova Scotia, as most of the functions were only partially or not satisfied in the industry. Internal traceability was the function that was most present within the industry, which is not surprising given this is a common practice among industry for compliance of domestic and international regulations (Magera & Beaton, 2009). Given that supply chain visibility was lacking the most of all the functions and the opposition towards increasing transparency by some industry actors, it is evident that the industry is not ready to satisfy this function. Dramatic changes in regulation and market demand may be the only avenue to move towards increase visibility of product information as many industry actors are cautious towards providing the information on their own. Vessel-dock capture and data-product pairing were also relatively lacking, except in the case for shellfish aquaculture producers. These initial steps of ensuring information about the product is captured from the beginning and that the information remains along the supply chain attached to the original product is an obvious challenge to the industry where species are aggregated at docks, filleted once they reach the processor or retailer, or simply because many fishers are not tagging and recording product information. Data verification was also only somewhat present within the industry as a result of MSC audits occasionally (MSC, 2016). While this function may be overlooked, it is critical for ensuring that the claims made are correct and the system is operating flawlessly. Lastly, as highlighted in the results, if benefits outweigh costs and concerns are met over the adoption of CFT, the industry was relatively willing to engage in such systems, which shows potential for the satisfaction of the functions in the future.

# Chapter 6 – Conclusion

## 6.1 Management considerations and recommendations

This paper discusses the extent in which CFT may help producers in Nova Scotia mitigate risks of increasing regulation relating to addressing IUU fishing and mislabelling and fraud. While it is not clear that CFT is able to reduce this risk for all producers within Nova Scotia, some suggestions and recommendations for researchers and decision-makers are proposed below in considering moving forward with traceability and transparency within the seafood industry based on what has been learned through this research.

*Recommendation 1: Determine how much transparency is necessary*

While benefits of CFT are recognized within this report, it was evident that many actors felt as though CFT was too much information to be communicated when consumer demand for all of this information is still unclear. This results in the question of, what should really be communicated to the consumer to create benefits exhibited in this report, but without providing information that is not appreciated by the buyer or consumer as practical? This challenge has arisen within many traceability feasibility studies and research on this topic is continuing to evolved (Archipelago Marine Research Ltd, 2005; Magera & Beaton, 2009). Since the industry is so private and generally unwilling to expose all information and practices related to a certain product, determining what information can be communicated is important moving forward with the implementation of traceability. Verbeke (2005) explains that too much information to the consumer can result in overwhelm and can lead to potential disinterest. It is important for future studies to determine what the consumer is able to digest when making a decision to purchase (Verbeke, 2005).

Since Canada only requires common name and country of origin currently, it is plausible to suggest that there is room to introduce new information to labels. Additionally, Verbeke (2005) notes that increase information disclosed is important, but it is essentially useless if the verification of the claims is not there to back it up. Thus, it is suggested that future efforts in the adoption of traceability should recognize this challenge of transparency and focus on research that gains a good understanding of what consumers are demanding on labels and what is optimal for the industry in terms of feasibility and reduction of risk.

*Recommendation 2: Traceability should be regulated (or pre-competitive)*

A central question that has emerged as a result of this research is whether traceability is more beneficial to the industry as a system that is industry led or that is drawn from regulation and is required by the whole industry. Both have pros and cons, which are discussed below.

If CFT is a voluntary initiative this would then result in traceability being a tool that provides a competitive advantage to the purveyor (Golan et al., 2001). Traceability would then have the potential to differentiate product in the market and increase product sales (Miller, 2014). However, this is assuming that consumers are willing to pay more or purchase this product attribute more often. This would likely not reduce risk of compliance with increased regulation, but would provide benefits mainly to sellers of product, which would include any producer that sells their own product on the market by making their product stand out. In this case, traceability makes good business sense (Bailey et al., 2016), however, since markets within Nova Scotia are relatively saturated this benefit may only be applicable for export market where there is room to enter new markets.

If CFT is a mandatory requirement through regulation this would result in traceability becoming pre-competitive, whereby no one has an advantage for adopting such systems over the other, then a variety of outcomes is predicted. Golan et al. (2001), describes mandatory food labelling schemes as an effective way to correct issues within the market and ensure compliance. Thus, traceability in this case would have potential to solve pressing issues such as IUU fishing and mislabelling, increase sustainability, and ensure product safety within the market (Bailey et al., 2016). Producers, if able to keep up with the market, would reduce their risk of not being able to comply with regulations, being blamed for fraud, and enhance food safety to farmed products. As a result, it is recommended that traceability move towards being regulated and pre-competitive due to its clear benefits to the overall seafood supply chain. However, the way this recommendation is implemented must be considered to reduce the negative effects and challenges imposed on the industry. If producers cannot keep up and there is no governmental support, would not lead to a reduction of risk but cause risk in that smaller companies or producers would be phased out of the market (as shown results from this report). It should also be noted that from the results of this report, risk in this case may still be reduced for primarily mid-chin actors or those more heavily involved in the supply chain, as opposed to fishers. \

*Recommendation 3: Begin with adoption of more robust internal traceability and labelling*

The seafood industry in Nova Scotia is presented with the opportunity to advance seafood traceability in order to comply with international regulation and increase market access. However, the adoption of traceability is a large undertaking given the small-scale nature of the industry and its lack of traceability as of today. It should also be recognized that supply chains within Nova Scotia vary greatly, thus in considering how to move forward with advancing seafood traceability options and flexibility should be provided to companies and businesses to comply in their own way. However, given the numerous benefits and potential to combat pressing issues within the seafood industry, a small step forward in the right direction, can dramatically transform the future of the industry. It is recommended that the industry begin to adopt stronger internal traceability systems to maximize benefits to their business, ensure compliance with current international regulations, and begin the process towards full traceability, while regulatory bodies begin to require better labelling standards similar to that of the EU. If internal traceability and clear labelling is fully developed in a way that links all actors through the supply chain, it has the potential to benefits all stakeholders, even producers by ensure they are accountable and compliant. This is a system that can be adopted easily and within businesses giving them the ability to adapt systems to their unique supply chain, but not lead to the negative affects noted such as extra resources, costs, and too much transparency to consumers outside of the industry.

## 6.2 Limitations of the study and future application

A variety of limitations are recognized within this research. Firstly, there were difficulties in reaching participants to be interviewed as many individuals declined to answer their phones or emails. Recruitment was especially difficult when there was no primary or secondary connection to the potential participant. Many of the cold-call attempts were not successful or individuals were less willingness to participate. This highlights an additional characteristic of the seafood industry where pre-existing relationships can be of an advantage. A second limitation that may have hindered the amount of detailed information required for this study and also speaks to the competitive nature of the industry was that many participants where not comfortable giving away all information especially pertaining to who their suppliers were. This inhibited the ability to create an even more detailed supply chains, but also limited the number of producers that the

researcher was able to reach out to. It is also important to recognize that only a small section of the supply chain within Nova Scotia was analyzed for this report as the scope was limited. Data may not be representative of all of Nova Scotia due to this smaller sample size. Additionally, results may be slightly skewed as many of the smaller retailers interviewed cared more about sustainability of the industry as opposed to larger companies that may have not been as interested in the study. It should be recognized that the willingness to participate and provide information about the supply chain was more evident in the more sustainably focused companies and individuals as opposed to the larger companies, even those who were not interviewed. The last limitation to note for the results of this paper is the uneven amounts of information collected within each supply chain. Many actors within the lobster industry were interviewed, however only one representative from the sea urchin fishery was interviewed thus lobster data may be more accurate than those that were not as data rich.

This research into CFT within Nova Scotia, its feasibility and potential to mitigate regulation and market risks for producers may help to advance overall traceability and transparency within the seafood industry. This research highlights the complexity of the seafood supply chains within Nova Scotia, and the challenges that the industry faces today. CFT was seen to potentially provide some benefits to the industry, specifically to those who are more involved with the processing and selling of product and fit within niche markets such as oyster producers, and willingness to engage in traceability systems was relatively high suggesting potential for further research and development into this initiative. While it is evident that a variety of risks are faced within the industry today, CFT may reduce risk for those that have more involvement in the supply chain. This research highlights the importance of traceability within the seafood industry and its role in being an effective tool to solve pressing issues in the industry. However, as demonstrated throughout this report, how the tool is used and implemented varies greatly. Whether there may not be a right or wrong answer in how traceability should be implemented, this report shows that through analysis into supply chains can help to clarify a path for implementation by understanding the unique characteristics and stakeholder opinions within the area of study.

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# Appendix

## A – Interview questions

### Mid-chain Supplier Interview Questions

**Actions**

How would you characterize your business? What is its vision?

What are the main products you buy and sell?

Of those products who are your most important suppliers?

What is proportion of products you source that are local (Nova Scotia) compared to imported?

How do the products you sell vary from season to season?

Do any of the products you buy get exported outside of Nova Scotia?

How does your business keep track of inventory? Electronic or paper or both? Use of any technology such as barcodes, QR code, RFID?

**Knowledge**

Are you aware of seafood traceability? What about consumer-facing traceability?

What do you know about the presence of seafood traceability in Nova Scotia.

What do you know about the presence of mislabeling and fraud in the seafood industry?

What do you know about illegal, unreported and unregulated fishing and its impacts to seafood industry? Does it lead to mislabeling? Why or why not?

What do you know about the new regulations for increased traceability in the US and EU?

Are you aware of any increase in demand from your consumers for more information about where their seafood comes from or validation? Why or why not?

**Perceptions**

Within the different supply chains you source from and sell to, what amount of risk are producers facing? (specific to regulatory or market risks)

How do you feel about the new regulations for increased traceability in the US ad EU? Would engaging in a consumer-facing traceability help reduce risk for producers? Why or why not?

Would engaging in consumer-facing traceability open up new markets for these producers? Why or why not?
How could consumer-facing traceability impact the supply chain and producers engaged in it? Could it limit any risks you identified earlier?
Is consumer-facing traceability feasible to implement within the supply chains you source from and sell to? Is it costly? Extra work?
What challenges would you expect for implementation of consumer-facing traceability?
Where do you go from here? What does the business have planned for the future?

**Producer identification**

Asked participant if they were willing to provide contacts to some of their suppliers.
Any final comments?

**Producer Interview Questions**

**Background and Actions**

How long have you been working in the industry?
How did you get into this industry?
What products do you harvest or farm?
Who do you sell these products to?
Where and how do you sell this product?
What regulations and rules do you follow with respect to labelling of your products?

**Knowledge**

Are you aware of seafood traceability? What about consumer-facing traceability?
What do you know about the presence of mislabeling and fraud in the seafood industry?
What do you know about illegal, unreported and unregulated fishing and its impacts to seafood industry? Does it lead to mislabeling? Why or why not?
Are you aware of the new regulations for increased traceability in the US and EU?

**Perceptions**

What do you think about consumer-facing traceability?

How do you feel about the new regulations for increased traceability in the US ad EU? Would engaging in a consumer-facing traceability help reduce risk? Why or why not?

What regulatory and market risks do you face or may face in the future as markets change?

Would engaging in consumer-facing traceability open up new markets for you?

Are there any other ways the consumer-facing traceability may benefit you?

Does consumer facing traceability mean extra work for you? why or why not?

Would consumer facing traceability make you more accountable for your catch or product? Why or why not?

Do you think would reduce the risk of being blamed for fraud? Why or why not?

Would you join this initiative? Why or why not?

Any final comments?