'Reeling in' Fish Fraud: Identifying the Stage where Seafood Mislabelling Occurs in Canada's Supply Chain and Solving it

European Success Adapted to Canada

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Contents

1. Abstract

In Canada, there exists an epidemic of seafood fraud ad counteracting this requires an understanding of which actors are creating this issue. To do this, I created a model and used variables, including likelihood to be caught, the costs of being caught both in terms of reputational costs and fines levied by the government, to determine which stage of the supply chain has the greatest incentive. I found that various stages had some incentive however, the value-add and processing stage had the greatest benefit and lowest likelihood of being caught. I then put forward some policy suggestions, based off Europe's success in addressing fraud, and adapted them to the Canadian situation. The literature and information in this area has proven there are ways of combatting seafood fraud in Canada and this paper hopes to over a meaningful way of addressing the perpetrators of it and an efficient solution to discouraging it.

2. Introduction

2.1 Problem Statement

In North America, there has been an epidemic of fraud that is costing consumers, according to some estimates, the same as the illicit drug industry (CBC, 2018). Seafood fraud, through mislabeling, is an economic epidemic. The actions of unscrupulous actors, which are an asymmetric advantage and their comprehension of a complex system, is resulting in fraudulent profits at the expense of consumers. Seafood fraud has continued to thrive in Canada while NGO campaigns, news stories and public outcry against the fraud are prevalent. To combat the epidemic, I delve into the issue and then offer solutions, based on a successful system used in European, which has driven mislabelling rates to the lowest globally.

In 2016 Seafood exports from Canada accounted for over 6.5 billion CAD exchanged in 2016, while imports represented just under 3.8 billion CAD (Fisheries and Oceans Canada, 2017). Further, the 10 billion CAD which changes hands over seafood each year helps maintain 72,000 jobs and represents 1.5% of total exports in Canada (Fisheries and Oceans Canada, 2017; Statistics Canada, 2018). Seafood, therefore, represents one of Canada's most important industries, yet startlingly little is known about the origins and supply chain custody of the product received by Canadian consumers. Recent studies suggest that mislabelling rates range from 21% to as high as 77% in North American Seafood (Willette et al., 2017). Of the 1034 samples tested across these studies spanning 9 years, 358 were mislabelled, for an average of 41% of samples being fraudulently or incorrectly labelled (Willette et al., 2017)[1]. Due to the complex nature of the seafood supply chain, tracing these mislabelled products back to the perpetrator is extremely difficult and costly. A systemic approach is need to address the stage mislabelling is most incentivized and to determine the firms involved.

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[1] This figure was generated by averaging the rates across the study

2.2 Methodology

The aim of this paper is to build on research and literature that has identified seafood mislabelling in the supply chain of North America and determine the stage in the supply chain mislabelling is most likely to occur. Only recently has there been enough evidence to identify the extent to which mislabelling is occurring in North America, and specifically Canada. I review how mislabelled seafood is currently addressed will be evaluated and potential solutions, from adapting the European model, will be offered.

The paper will use an economic model to look at the various stages of the seafood supply chain and attempt to create an economic rationale for government to intervene and deal with mislabelling, without having to oversee all transactions at each stage of the supply chain. Due to the global interconnectedness of the seafood supply chain there are logistical issues in identifying what issues arise and where.

This paper investigates the five stages of the supply chain: inputs and technology, harvester/producer to first production stage, first production stage to value add, value add to retail and lastly retail to consumer. For the purpose of this paper, there is no reason to test inputs and technology in the model, as I argue that they do not contribute to seafood fraud in the supply chain.

Using the results and inferences from the model, I will be able to identify where mislabelling is most likely to occur. This allows the governing body could allocate resources most efficiently and effectively to reduce mislabelling. However, this is only one side of the problem. Since nearly one third of the domestic consumption of seafood, in monetary terms, is from imported products, there must be a solution for the imported products as well. Due to the global market for seafood I provide a potential solution, through adapting the areas that Europe used to minimize seafood fraud, to Canada.

2.3 How Europe Solved Fraud

The European Union previously had rates of mislabelling in seafood comparable to North America's current rates. A study conducted in Ireland in 2010 showed rates of Cod and Haddock mislabelling at 25% (Miller and Mariani, 2010). When testing smoked products, the

authors found mislabelling rates of 82.4% (Miller and Mariani, 2010). Since the release of that study, the EU government has implemented strict regulations on product labelling and created a government program LABELFISH, which is the Atlantic Network on Genetic Control of Fish and Seafood Labelling and Traceability (Labelfish). These programs successfully decreased mislabelling rates in Western Europe to less than 10% for all Western European countries (ranging from 2.7% to 8.9%). (Mariani et al., 2015).
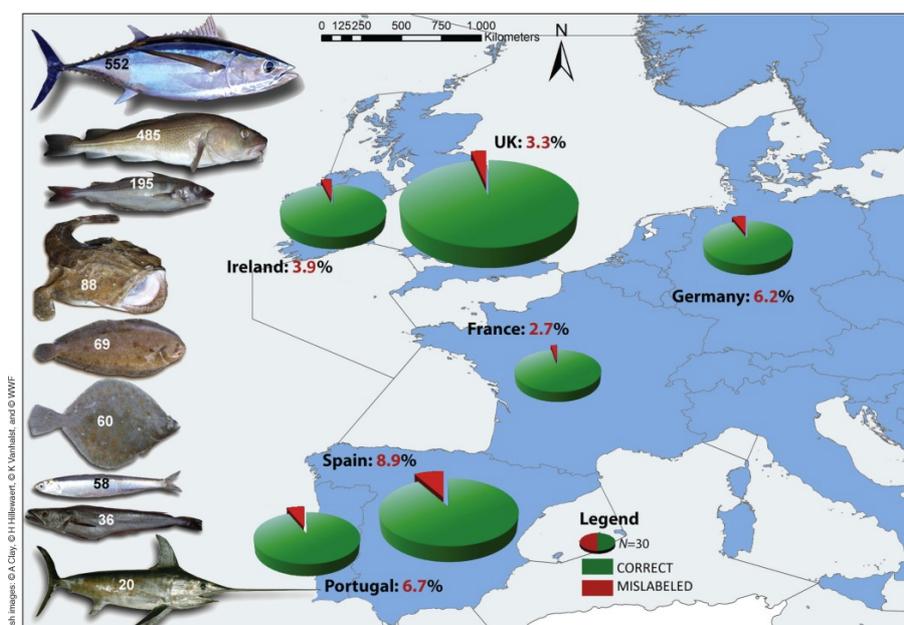
Figure 1.1: Seafood Mislabelling rates in Western Europe (Mariani et al. 2015)

These successes have been attained in various methods, which will be explored later in the paper. For Canada to succeed it will have to deal with the mislabelling problem in a similar manner to the EU.

2.4 Canada's Current Framework

Correctly labelled seafood, according to Canadian Food Inspection Agency ("CFIA") regulation, has the net weight of the product, the country of origin, the country and time of processing (if processed), list of ingredients principal place of business and the common name of the main product (Canadian Food Inspection Agency, 2017). Mislabelling of a product may involve the violation of one or more of these areas, however, many are tested for by CFIA. Products are weighed, visual checks done to make sure seals are maintained and the origins of the product are back checked. However, the products are not DNA tested to ensure that they

are correct species listed on the documentation. Products shipped across the national and provincial borders are subject to the random inspections, but species identification relies on checking the product visually. CFIA regulation does not require information on country of origin or harvest method, meaning that once a product is harvested and has passed through at least one additional country before entering Canada, it can be mislabelled and all history before this country could be erased or changed.

The current situation for seafood consumers in Canada is that nearly half of the products they are consuming are either fraudulently or unintentionally mislabelled. When products are mislabelled, that can result in illness and in extreme cases, death. For example, Escolar (*Lepidocybium flavobrunneum*) is one of the species often substituted for Albacore tuna; this same product is also poses a large health risk to consumers (Ling et al., 2008). It has indigestible wax esters which can cause diarrhea, acute gastrointestinal issues and in the case of pregnant women, can cause risks to the individual and child (Ling et al., 2008). This is not the only incidence where a mislabelled product presents a health risk. There are other losses associated with mislabelling such as consumer trust, ecological risks and economic losses to consumers, fishers and business (Stawitz et al., 2017).

A leading researcher from the University of British Columbia on seafood mislabelling states that, "once the head and skin of a fish have been removed it can be difficult for consumers and professionals to tell the difference... [he often tries to] buy the whole fish, scales and all, because then it's harder to mislabel the product" (Dimoff, 2018). Without DNA testing, processed products and in some cases, non-processed products, can be mislabelled and consumers face adverse health risks, over paying for lower value products and an overall sense of distrust in the market.

CFIA has not responded to the studies showing seafood fraud and has not published any warnings or offered any solutions. However, in 2014 CFIA ensured the Canadian populous it would change regulations on Halal products to ensure that mislabelling would not occur. CFIA stated, "This change will also provide consistency for the industry and help prevent mislabelling practices and claims regarding halal food products" (Canada Food Inspection Agency, 2014). If the Canadian government is willing to put the time and effort into ensuring halal products are properly labelled, for both the domestic and imported products, then there should be no reason they would not commit the same to seafood products. The reasoning

behind this is unknown and presents a compelling reason to try and show where mislabelling is occurring potential solutions CFIA can put forward to combat it.

2.5 Canadian Solutions and Conclusions

To address the situation listed above, I believe that Canada must tailor the solutions Europe utilized to the Canadian political landscape. This includes stricter and improved labeling standards, genetic auditing and levying strong punishments for actors that do not abide by the legislations. These solutions should push mislabelling rates down substantially, save consumers money and prevent potential health issues from arising. These are necessary steps and how Europe applied them will be analyzed and adapted to Canada later in the paper.

2.6 Outline

The paper will begin by giving an understanding of the seafood supply chain and how the intricacies of it can be utilized by firms to intentionally mislabel products. I will then go into depth giving an understanding of what mislabelling is, how it occurs and what the implications of it are and who bears the various costs of these actions. Then I will review the current literature on the topic, focusing on the broad topic of seafood mislabelling initially then focusing on Europe and North America specifically, finally highlighting where this paper fits. I then begin to show the model used and outline the variable values and what they mean. It is applied to the stages of the supply chain outlined earlier in the paper and results analyzed. The ending of the paper focuses on what is currently happening in North America, what Europe did well to combat mislabelling and how Canada can adapt the European solution to fit their system of governance. Once these are offered, I give a set of actions that must be undertaken immediately by Canada, an order that is based on the return on investment, then I offer subsequent solutions that will continue to drive down mislabelling rates. I conclude that there must be action by CFIA and the government of Canada, the extent to which is negligible based on the value of fraud (which is currently unknown), but that legislation must be changed immediately and research into this issue needs to be undertaken immediately.

3. Background on Supply Chain & Mislabelling

What is seafood mislabelling? Why does it occur? What are the implications? These three questions are dominant themes that must be explored and answered before delving deeply into this issue. First, what is seafood mislabelling in the context of this paper, it is, "when a product labelled as one species is in fact actually a different species, and can be a result of intentional product substitution, or can occur by accident" (Bailey, 2017). There are two major implications that arise from this definition, the first being that there is not a distinction between intentional and unintentional mislabelling. While the second implication is about the identification of one species is labelled as another species, not by a pseudonym or marketing term. The implications differ when considering if mislabelling is done intentionally or unintentionally and to better understand mislabelling, and the distinction between intentional and unintentional mislabelling, the seafood supply chain must first be examined.

To understand the issue of mislabelling one first must understand the process a seafood product takes from origin to consumption. The intricacies of the supply chain allow for mislabelling to exist, thus in introducing these two topics I begin by giving an introduction into the seafood supply chain on a domestic level and international level. Following that, I explain what mislabelling is and how, using the complex supply chain, it has been able to thrive. Once these issues are understood, they can be used to show which actors are likely perpetuating seafood fraud and how.

3.1 Global Supply Chain
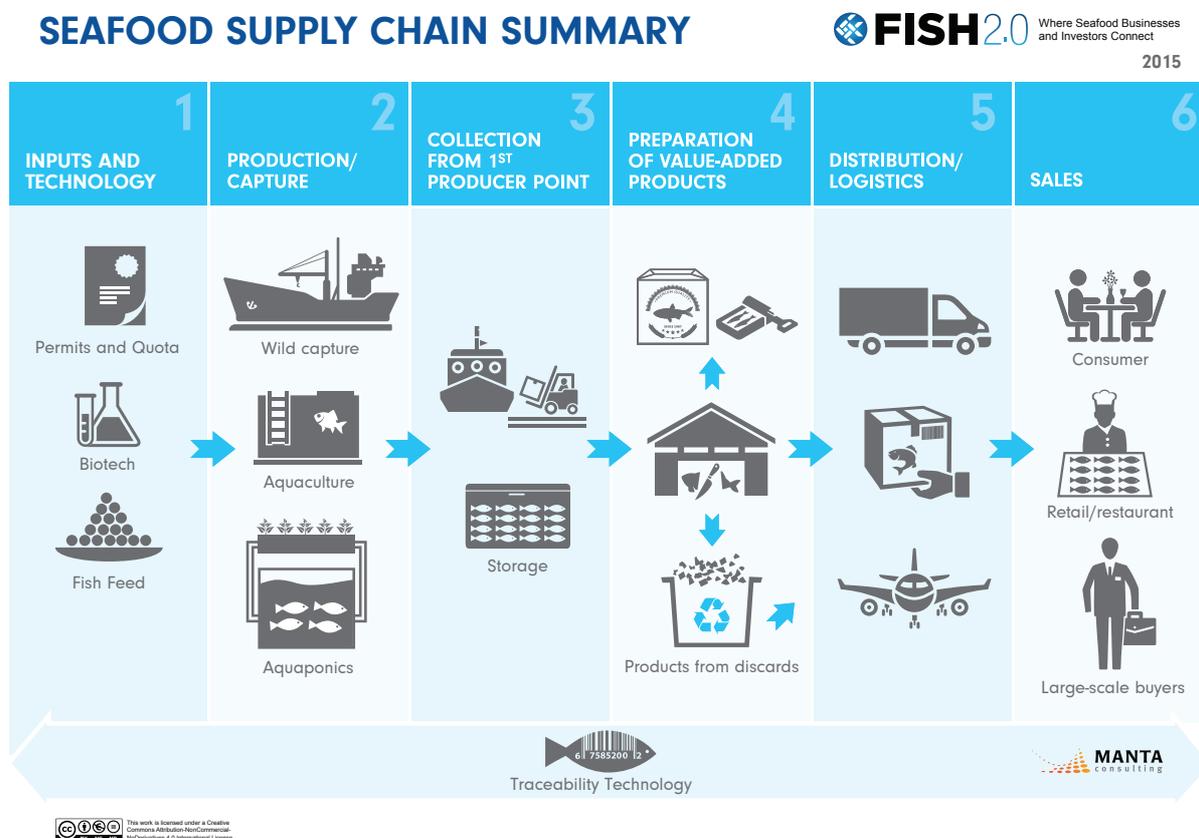
Figure 2.2: Seafood Supply Chain (Manta Consulting 2015)

This diagram highlights the main processes in the seafood supply chain. There are numerous players and processes that are required to occur for a consumer to receive a seafood product. This paper attempts to highlight where in this chain mislabelling occurs to the greatest extent. This supply chain is the same for a product that is domestic or one that takes an international route. To understand how it effects the Canadian market, this supply chain model will be applied to Canada in the following section, giving an in-depth understanding of the process of both domestic and imported products. To understand where mislabelling occurs, it is imperative to understand how products can be mislabeled, and to do that the supply chain intricacies must be understood.

3.2 Canadian Seafood Supply Chain

Breaking down each stage of the supply chain, the inputs and technology section refers to the permits and quotas for the harvest of fish, biotechnology and fish feed. For the purposes of this paper biotechnology will not be incorporated, as it does not play a major role in seafood mislabelling. Fish feed will be grouped with permits and quotas as the marine based inputs used in fish feed require a license or quota to harvest. Permits and quotas are given by domestic governments and determine who can harvest what product and how much. The issues that arises from this section regarding mislabelling are from products that are caught without a permit or quota, known as Illegal, Unreported and Unregulated ("IUU") Fishing. The Food and Agriculture Organization of the United Nations states IUU fishing includes:

> "Fishing activities conducted in contravention of national, regional and international laws. Non-reporting, misreport or under-reporting of information on fishing operation and their catches. Fishing by "Stateless" vessels. Fishing in convention areas of Regional Fisheries Management Organizations (RMFOs) by non-party vessels. Fishing Activities which are not regulated by States and cannot be easily monitored and accounted for." (FAO, 2016)

The only way for IUU fish to enter the supply chain is through mislabelling, as these products cannot be accounted for in the correct functioning supply chain model. The rationale behind this is that in a supply chain where mislabelling is eliminated, the origins of the product can be traced back to the point of harvest. When the point of harvest is identified and the producer, whether aquaculture or wild caught, can show the proper license and quota can be checked and the product can be identified as non-IUU. Therefore, solving for the mislabelling of seafood products produced and imported into Canada, would eliminate the ability of IUU products to enter the domestic consumer market.

The second stage of the supply chain is the harvest and production stage, where the fish are either harvested from wild capture, produced by aquaculture or used in Aquaponics (the combination of traditional aquaculture and hydroponics in one integrated system). In this stage, the issues are largely the same as the previous section, regarding IUU products. For domestic production, IUU fisheries in Canada are not a large threat. In 2005, the Government of Canada's Department of Fisheries and Oceans ("DFO") created the National Plan of Action to Prevent, Deter, and Eliminate Illegal, Unreported and Unregulated Fishing (Department of Fisheries and Oceans 2005). There were, however, previous overfishing concerns in Canada

where poor monitoring led to ineffective stock management, causing the 1990s collapse of the Atlantic Cod fishery in Eastern Canada (Myers, 1997).

This led DFO to begin major stock assessments, both on Pacific and Atlantic species, and to implement stronger stock management. Two main management types for fisheries are currently used, Enterprise Allocations ("EA") and Individual Transferable Quotas ("ITQ"). These market-based instruments are voted in by the members of the fishery and the governing body, in this case DFO (Le Gallic, 2003).

An Enterprise allocation system is where a fisher is granted a license to take part in a fishery with a total allowable catch ("TAC") of a species, or multiple species. The group of these fishers can harvest as much of the TAC as possible, reporting their harvest figures daily (Emery, 1993). Once the TAC is reached by the combined individuals in the fleet, or the harvest season ends, the fishery closes (Emery 1993). The TAC of a species is based upon various factors including stock assessments, catch record and developments in stock improvements (such as hatchery fish) (Emery, 1993).

The ITQ system involves taking the TAC and giving each enterprise, or fisher, an individual share of the TAC. This system differs from open access by giving small portions of the TAC to each member of the fishery and they have the right to harvest, lease or sell their share of the catch (Buck, 1995). It establishes rights to a privileged share of the catch, as a percentage of the TAC in either pounds or individual pieces. Since it is done as a percentage of TAC, the annual harvestable quantity may not be the same (Buck 1995).

By 2003 DFO had implemented ITQ management systems in fisheries that represented 50% of the landed value of all seafood in Canada (Le Gallic, 2003). These systems require stringent oversight with strong wording in the licensing agreement, daily logbook requirements and reporting, gear tags, at-sea observing, dockside third-party catch verification and other verification measures (Department of Fisheries and Oceans, 2017). This oversight, and the use of market based approaches, has stabilized the management of domestic fisheries.

Domestic Aquaculture and Aquaponics have strong oversight in their production, with strict monitoring by DFO and CFIA. This makes mislabelling of product challenging in the domestic market. Moreover, aquaculture producers most frequently sell their product to distributors or processors (or act as processors themselves). This pushes their product on to the next stage of the supply chain, which will be addressed further on in the analysis.

The third stage of the supply chain is the collection from the harvesters and aquaculture suppliers. As this is an intermittent logistical stage, it will be combined with the following stage, since this aspect of the supply chain is usually undertaken by the businesses transacting.

The next stage is the most likely point of mislabelling, according to the author, the value-added preparations stage (which also encompasses seafood importing). This is where a product is transformed from a whole fish, to various forms including, but not limited it, fillets, portions, smoked products, ground products and dried goods. When products are transformed their distinct morphological characteristics, in this case skin (or scales), fins and head, are often removed and all that is left is flesh. This is the most likely stage of mislabelling because when distinguishing characteristics of a product are removed, without DNA testing it is nearly impossible to prove that a product is labelled correct. There is not mandatory genetic testing at any stage throughout the supply chain in Canada currently, thus, once a product is processed, it becomes whatever the processor identifies it as. The University of Guelph has one of the most extensive DNA barcoding databanks of seafood products and has done much of the research for the various studies in Canada on mislabelling (Naaum & Hanner, 2015). Hanner, and colleagues from the University of Guelph have created Tru-Id, a certification program where a business can undergo an audit and prove, using their DNA database, the genetic make-up of their product, proving it is correctly labelled (Tru-id). In a sense, this is the private business version of the EU's Labelfish program, and is meant to help identify the same issues, however, adoption in the industry has not been widespread, with only one seafood supplier currently undertaking this process (Tru-id).

In Canada, seafood importing, processing, preparation and packaging was a 4.28 billion CAD business in 2012; however, there are only 722 registered businesses that operate in this segment (Agriculture and Agri-Food Canada, 2016). It is highly unlikely that these businesses are of equal size, as many of these 722 businesses may be small local processing plants, with a few entities that control much of production and importing. Regardless, the average will be used, which is equal to 5,927,977.84 CAD per year per business for processing or importing value[2]. This shows a high incentive to cheat. As mentioned earlier, CFIA and DFO have not openly acknowledged the reports on mislabelling, therefore, without any risk of punishment,

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[2] Figure is calculated using the total value of seafood processing divided by the number of businesses operating to get an average, though likely this is not the case it gives an idea of scale

the incentive to mislabel a cheaper product for a more valuable product comes without major punishment or risk.

Imported Seafood is scrutinised by CFIA, with various regulations on the product (Appendix 1). CFIA requires 19 protocols to be fulfilled, including listing the company the product was imported from, the product name, the Canadian name and genius; however, nowhere in the document or on the CFIA compliance website is genetic verification listed (Canadian Food Inspection Agency 2017). Therefore, for visibly wrong product, CFIA can punish the importer, but for products that need to be genetically proven to be mislabelled there exists no oversight. Moreover, there are no requirements for the product to be labelled as wild or farmed, or to list where it originated. This means that the importer relies on the word of the exporter. Thus, either the importer can be privy to this information, and choose to act fraudulently, or can be naive and be acting fraudulently by accident. In either case, there is no way, without genetic verification, to prove either case.

Regarding the next, and final step in the supply chain, the distribution and logistics sector, there exists numerous entities and types of businesses that operate in this segment. In this paper, this section will be referred to as the retail section. Retail refers to the sale to consumers either through markets, such as grocery stores, farmer's markets and direct from fishers, it will also include restaurants, catering and other food service industry. This step of the supply chain faces the greatest scrutiny for mislabelling from provincial governments and local health authorities. The testing that has identified mislabelling, has largely been done at this stage in the supply chain (except for Tru-id and Labelfish).

At this stage of the supply chain, CFIA steps back from the process and hands the governing of the health of patrons, sanitation and product quality checks to provincial entities and health authorities (Canadian Food Inspection Agency, 2017). The scrutiny faced by the businesses at this stage of the supply chain is quite extensive, with strict procedural guidelines and sanitation standards. Moreover, as consumer advocacy groups, such as Oceana and SeaChoice, take samples from these groups and find instances of mislabelling they have the means to expose which businesses are involved in seafood fraud. While there exists no legislation on seafood mislabelling for these parties in Canada, exposing them threatens their business. Moreover, as solutions are presented later, the EU has punished suppliers and parties with fines and pending fines, while also harmonizing all consumer labels into a government standard (Office Controls and Enforcement 2018). For these reasons, and economic reasons that will be explained later,

there exists an incentive to mislabel (the increased profits from selling lower value products as higher value products) however, there are risks to the businesses reputation and even operations, from the policing by health authorities, the provincial governments and seafood advocacy groups.

3.3 Mislabelling – What is it?

Mislabelling has various forms within seafood, as mentioned earlier the definition this paper will use is when a species is incorrectly, or intentionally, mislabelled as another species. Another example of this incorrect labelling, which will not be analyzed in this paper, involves the "marketing" of a product under another name. Oceana's study on mislabelling highlighted this in Canada where, in various retail locations including restaurants and grocery stores, Atlantic Salmon (*Salmo Salar*) was sold as Pacific Salmon, a species that does not exist (Oceana, 2017). There are various types of Pacific Salmon, such as Coho, Chinook, Pink and Sockeye; however, there is no actual species known as Pacific Salmon.

This type of mislabelling confuses consumers on the nature of their product by choosing names that are not identified by the governing body as the correct name. The reason this is done is to give consumers a name that is more appealing or recognizable. An example of this is Patagonian Toothfish (*Dissostichus eleginoides*), a name which few consumers would every recognize; however, most people who eat seafood have tried this product (Diaz, 2003). To consumers, this product is known as Chilean Seabass; though technically correct, the true species name is Patagonian Toothfish and the adapted name was to make the product more appealing (Diaz, 2003).

CFIA has specific names that must be used for products, allowing consumers to understand what they are purchasing; however, there is little enforcement of this. The most identifiable case of this occurring was in 2014 when the Quebec Ministry of Agriculture found 32% of tested seafood samples and fined those who were identified as fraudulently marketing their products (CBC, 2014). This type of mislabelling happens at the retail stage of the supply chain, and would be considered fraudulent marketing. For the purposes of this paper, fraudulent marketing does not contribute the greatest risk to the seafood supply chain. This paper will focus on the mislabelling that occurs when seafood is sold as different species (with the purpose of increasing profit), not products that are sold under a different branded product.

Seafood fraud is economically motivated, but which stage of the supply chain has firms that are the most motived has not been identified. If mislabelling rates were extremely low it could be argued that some products were accidentally mixed up as other similar products; however, Europe addressed seafood fraud showing, that it is not always an accident. There are incentives, but the incentives and punishments at each stage of the supply chain differ. For example, the incentive for a fisherman selling to a fish plant to mislabel is relatively high, he can try to get more money for the fish he has caught. There are also many factors that discourage him including government oversight, risk of losing the buyer if he is caught lying, potential fines or punishments and more. Therefore, although an incentive exists, there are reasons for this actor not to do this. This paper will use try to look at each supply chain stage through an economic model and identify which stage has the greatest incentives to act fraudulently, what motivates them to do so, what other factors affect their decision and, finally, this paper will try to offer ways they can be dissuaded from fraud.

As this paper is not addressing marketing issues, they will largely not be addressed in the solutions. The solutions to marketing practices fall on CFIA to find a solution with local health authorities and provincial governments. CFIA has a mandated list of names for products and they must ensure these are used throughout the supply chain, not only when product crosses some sort of border. Since this issue is technically addressed (though not dealt with in practice) the model will not address it. But, by implementing some random audits on genetic testing, actors that are found to be using names that do not match the Genius can be punished as a fraudulent actor. This helps address the issue, but the real solution to this issue requires CFIA to act on its mandate and punish those parties that are not using correct names.

4.   Literature Review

The literature that exists on seafood fraud can be broken into two main topics, proving the existence of seafood fraud in various markets and potential solutions to mislabelling. I am not aware of any research that identifies exactly where mislabelling occurs or how to effectively combat it at the given stage. This paper is attempting to bridge the two bodies of work to create a better understanding of the issues and offer a meaningful way to use government and industries limited resources to effectively combat them. Without this bridging, problems will continue to exist and solutions will be nothing more than theoretical options. The goal of this undertaking is to show there exists one area where mislabelling is most incentivized and offer some suggestions on how it can be dealt with in a cost-effective manner.

Literature on European seafood fraud effectively pushed government to intervene. This decreased the rates of mislabelling to the lowest in the world and is an example of what can be accomplished when government intervenes. These solutions have been suggested for Canada by academic and NGOs, but there has been little action by any governing body to make progress in this area. This paper will try to solve for this, and the literature reviewed below will be the basis for the discussion on the issues and solutions.

4.1 Seafood Fraud Work

In 1998, a paper presented at the Technology Society of Americas would be the first step in identifying a food safety and economic fraud epidemic on a global scale. This paper, which collected data from 1988 to 1997, highlighted how the FDA in the United States tested seafood products and found that 37% of fish and 13% of shellfish and other bivalves were mislabelled (Tennyson et al., 1997). The Global Food and Agricultural Organization ("FAO") had been trying to create regulation on the seafood supply chain through global labelling requirements. Due to backlash from countries, including Peru and the European Union it was unlikely this global standard would exist. When compounded with domestic issues in the United States, the goal of a global labelling standard was dropped.

In the United States, companies were fighting against the Country of Origin Label ("COOL") requirement, a standard set out by the United States government (Jacquet and Pauly, 2008). The only option for the FAO was to require that a single location for country of origin existed,

which for unprocessed product was the country of harvest and for processed products, the country of processing. This was much less than the FAO originally had hoped for, and this even took 4 year to be finalized (Alimentarius, 1999). This solution by the FAO created even greater issues in the future, as illegal fish could be caught in one country, processed in another and then sold as legal fish in a third, with the governing bodies inability to identify where it had originated, as per FAO regulation. Countries created their own legislation on labelling, scientific name, origin, harvest method and more, using the FAO requirement as a minimum standard (Moretti et al., 2003). The papers that followed would deal with regional or country based fraud as addressing this issue on a global scale was too great an issue.

The above information existed for nearly half a decade before a ground-breaking article in Marine Policy, that has since been cited just under three hundred times, was featured. The article, *Trade Secrets: Renaming and mislabelling of seafood*, compiled a global data set on mislabelling rates. The article then went on to identify how countries and international governing bodies perpetuated the issues. They present a compelling case and concluded that the newly created Marine Stewardship Council ("MSC") should become the global standard on supply chain custody via their audit and certification system (Pauly and Jacquet, 2008). Critics have argued that the pay-for-usage model MSC uses compromises their legitimacy as they are incentivized to label more products as MSC certified to generate greater revenue (Zwerdling and Williams, 2013). Others argue that MSC has lowered their bar for standardization and finally, MSC may be too big to properly certify small artisanal fisheries and is slow changing their ratings (Zwerdling and Williams, 2013).

4.2 Dealing with Fraud in Europe

Inaction by the European Governing bodies on the issue of mislabelling drove scientists to show the extent of this issue. A paper published in 2010 highlighted that 25% of Cod and Haddock products were mislabelled and that 82.4% of the smoked products tested were mislabelled in the EU (Miller and Mariani, 2010). The project was undertaken to highlight that correct labelling can encourage sustainable fisheries, as consumers desire this product and will actively seek out correctly labelled products (Miller and Mariani, 2010). However, in trying to do that the authors discovered a fraud epidemic. It was felt that until mislabelling was dealt with there would be no recovery in cod stocks as fishers would be incentivized to harvest the depleted stocks, have them processed elsewhere, mislabel them as other products, and allow

them to enter the supply chain, causing both economic and environmental issues (Miller and Mariani, 2010). This paper showed the ineffectiveness of the EU's preventative legislation for mislabelling and showed that consumers were still were being deceived and were facing both an economic and welfare loss, even with groups like MSC existing. Moreover, they highlighted how some of these products could be coming from IUU fisheries or depleted stocks, further exacerbating issues. Overall, Miller and Mariana's (2010) article highlighted the costs of seafood mislabelling to the fisheries industry, on the environment and that consumers were funding this.

In 2015, Mariani and another team wrote a follow-up article on how mislabelling rates had declined in Europe (Mariani et al., 2015). In this article, as well as Helyar's article on fish product mislabelling, the findings were much more positive than the previous article. Mislabelling rates were down to single digits, in the Helyar article rates of mislabelling were 5.5% and in the Mariani article they were 4.93% (Helyar et al., 2014; Mariani et al., 2015). This immense drop in the mislabelling rates was consistent with other papers findings, and a list of contributing factors was compiled which included media coverage, improved and binding labeling regulations and a notice that consumers have influenced the change (Mariani et al., 2015).

These papers did identify one trend that continued to be an issue, mislabelling was most frequent in processed products (Helyar et al., 2014). These products were mislabelled at twice the average rate of other products (13.6% compared to 5.5% and 4.93%) (Helyar et al., 2014; Mariani et al., 2015). According to the European Market Observatory for Fisheries and Aquaculture products, 68% of seafood products are totally or partially processed, making up a majority of the market (Marine Affairs and Fisheries – EU, 2016).

The European solution of putting binding regulation on labelling where products have come from, how they were harvested and what is included in the product, has proven effective. However, to apply this to other countries is difficult, the United States populous is much less receptive to strong government intervention and would prefer market factors deal with issues rather than government intervention. In Canada, the problem of various governing bodies having overlapping jurisdictions creates controversy about which body is to deal with each specific issue. Had the papers helped to show the economic incentives of mislabelling as well as the most important areas to police, there may have been more value.

The papers on the European solution to seafood fraud ignore a very important piece of information – why – why would there be mislabelling, what punishments do they face for mislabelling, how much benefits do they receive from acting fraudulently. These papers all show mislabelling is present and that it has negative implications, both on consumers and the seafood industry, however, no costs are ever accounted for and who bears the brunt of these issues is never addressed. These papers do not look at the externalities of this mislabelling, such as loss of consumer trust, economic losses to consumers and how much revenue is generated from product fraud. The key though that all literature on the European sector is missing is where does mislabelling occur in the supply chain. Europe has seemingly solved the issue better than any other nations; however, they have not put forward any information on where mislabelling occurs most frequently and who needs to be policed most strongly.

4.3 Fraud in North America

With a grasp of the literature on seafood fraud in general and how Europe used academic literature to guide policy, it is imperative to understand the literature from North America. It shares many parallels; however, it has not had the same impact on policy or regulation.

The Jacquet and Pauly article blew open the doors, showing the extent of North American seafood fraud. Since then there has been substantial work done by others. In that same year, there was a solution proposed: DNA barcoding to identify mislabelling (Wong and Hanner 2008). The technique was successful in 90 out of 91 samples and presented a cost-effective way to identify when products were mislabelled (Wong and Hanner, 2008). The article showed how consumers were attempting to purchase products that were from healthy stocks, therefore doing the right thing for the environment and industry; however, in 25% of these cases the products were mislabelled and often were endangered or threatened species instead of the sustainable option they were seeking (Wong and Hanner, 2008). Moreover, they found some species were very frequently mislabelled, such as red snapper (*Pristipomoides sieboldii*) which in three quarters of cases were mislabelled according to this study and previous others (Wong and Hanner 2008). This paper even goes as far as to touch on the potential economic implication of these issues, acknowledging this to be a key contributing factor to the issue (Wong and Hanner, 2008).

Many of the scientific papers that address mislabelling in seafood ignore the social and economic implications. Wong and Hanner's paper touches on this matter, and though it is brief, this is one of the first cases that presents this issue with estimated costs. They mention how the market price of "red snapper" at the time of writing was 2.93 USD per pound, while the species that was most frequently mislabelled as red snapper was redfish, which along with other oceanic perch species, had a price of .72 USD per pound. In the South United States, according to the National Oceanic and Atmospheric Administration ("NOAA"), Red Snapper harvest figures from both recreational and commercial fisheries accounted for approximate 9.1 million pounds (NOAA, 2017). This quantity of fish would serve a large portion, if not all, of the North American demand for red snapper; however, much of this product is exported, and cheaper, often mislabelled product, is imported to fulfill the demand. The United States market imported approximately 11 million pounds of snapper at this time, with prices ranging from 3 USD to 5.5 USD per kilogram, or approximate 1.37 USD per pound to 2.55 USD per pound (Tveteras, 2012). Using this information, combined with Wong and Hanner's findings, if three quarters of these products are mislabelled, and the value differential between the most common substitute (redfish) and red snapper is 2.21 USD, then there is a lost value to consumers of just over 18.23 million USD[3], a significant loss to consumers and a threat to consumer trust. The Wong and Hanner paper brings light to this issue, but does not push the depth far enough to cause governments to change their agenda and make this a key issue.

The most comprehensive review on seafood fraud in North America was put forward by Oceana, an environmental NGO, that provided data, offered causation for the issues and presented some potential solutions to the issue in North America.

This report, released in 2012, has much of the same findings as previous reports, with 33% of products mislabelled, with peaks in snapper (87%) and tuna (59%) (Warner et al., 2013). The below figures show the mislabelling rates across all products sampled.

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[3] Calculated using the imported figure multiplied by the price differential and the average mislabelling of three quarters

Mislabeling Among Most Commonly Sampled Fish Types

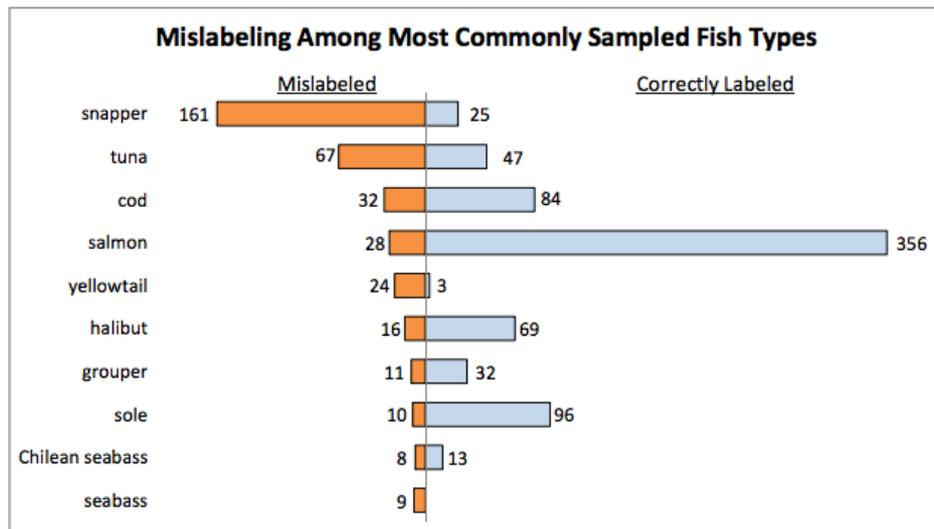|	Mislabeled	Correctly Labeled
snapper	161	25
tuna	67	47
cod	32	84
salmon	28	356
yellowtail	24	3
halibut	16	69
grouper	11	32
sole	10	96
Chilean seabass	8	13
seabass	9	

Figure 3.1: Mislabelling Among Most Commonly Sampled Fish Types (Warner et al. 2013)

They acknowledge a key attribute that few other papers do, "… fishermen already provide much of this information at the dock, little to none of it follows the fish throughout the supply chain" (Warner et al., 2013). There exists the ability for transparency in the supply chain, but no party has ensured this information is carried throughout.

This paper does come up short in conclusion and recommendations. They recommend that the federal government increase testing for seafood fraud in the United States (currently less than 1% is tested) and this is a good recommendation; however, it is obvious. Oceana ignores the political and economic reasons behind this not already being done; if it would benefit all parties, then rationally, it would point to this already being done. The consumer recommendations are equally weak including: ask questions, check the price and purchase whole fish. Except for the last option, the other two are no more informative than if the consumer did nothing. What questions do they ask? Who are they asking? Is this person informed? Checking the price is also not a solution, the price is set by the market, it tells you nothing more than the value of the good to consumers, there are too many externalities for this to help identify if a product was labelled correctly. Only the last option presents a reasonable way to identify if the product is labelled correctly, but even this conclusion is weak. A consumer cannot be expected to be able to identify the subtle differences between similar products. For example, it is easy enough to tell the difference between a halibut and a salmon, but identifying the difference between a Pacific and Atlantic halibut, or between a Sockeye salmon and a Chum salmon, is extremely difficult to experts in the industry, let alone consumers.

These articles all do a fine at showing that an issue exists in North America, but that is not enough. They largely ignore solutions and economic ramifications, unlike their European counterparts that took a much broader look at the issue. They also fail to address things like consumer advocacy groups and the ability of government to make meaningful policy. Most of all, they do not consider the costs and benefits of their solutions. They throw solutions out there that are cover-ups rather than addressing the root of the issue.

4.4 Contribution to the Existing Literature

Taking articles on seafood fraud as a general area, then understanding how Europe successfully combatted and finally how these lessons can be used for North America gives perspective, but it is not complete. There needs to be a deeper understanding what motivates actors to act fraudulently, to understand which actors are most likely to commit fraud and how to apply the learnings from this to solve for fraud in North America.

This paper aims to prove that it is possible for Canada's government to utilize their limited resources on a specific set of policies that should combat fraud. By identifying which actors benefit most from fraud, the Canadian government can create policy that helps to decrease mislabelling and increase consumer confidence. As it currently stands the Canadian government largely chooses not to act, due to lack of information. This paper will set out to give information that influences Canada and CFIA to act.

The model used in the next section will attempt to show to show the incentives from each stage of the supply chain. This will help to bridge the gaps in the literature and solve for the issues addressed at the beginning of this section – how can the research that has been done on mislabelling in various areas be backed with economic theory and present a compelling case to encourage regulators to change policy to combat mislabelling in Canada, as Europe did.

5.   A Model of Incentives for Mislabelling

5.1 Seafood Market Model in North America

Canada has experienced rapid growth in the demand for seafood with 79% of Canadians eating seafood regularly or occasionally, with up to 80% of that seafood being imported (Oceana, 2017). This rise in global seafood trading has been seen around the globe and has coincided with the rise of globalisation in many markets. However, where seafood lacks in contrast to other products is the ability to identify where the product originated and if it is correctly labelled. Food health risks are increasing as well, according to the Center for Disease Control and Prevention 1 in 6 Americans get sick from food borne illness each year, and this has coincided with a growth in seafood consumption (from 10-12 pounds per person to 16.5 pounds) as well as an increase in illnesses brought on by seafood consumption (from less than 100 cases in the 1980s to just below 600 in 2006) (Iwamoto et al., 2010; Center for Disease Control and Prevention, 2017). The rise in the global seafood trade and the rise in food borne illness are not coincidence, but are symptoms of each other. As supply chain complexity has arisen, as has the ability to mislabel products to increase profits, risking consumer welfare and costing them money. A product that is exposed to higher temperatures, or to bacteria, viruses or parasites, presents a health risk to consumers. With an inability to effectively understand the path of a product through the supply chain.

This has allowed for economic mislabelling. If products are difficult to track, unscrupulous actors can fraudulently label their product as a higher value product, increasing their profitability. This allows the entrance of IUU product into the chain, or in a more dangerous scenario, the seller can mislabel a compromised product as a different, uncompromised product. This increases health risk to consumers and can potentially result in deaths.

5.2 Variables

Empirically investing non-compliance is difficult as it is in the interest of firms to keep their product information hidden. There are two reasons for this, the first being that since seafood is a commodity business with low differentiation on product, sharing any business information (including suppliers, product information or processes) to competitors can erode the margins

of a business. The second reason is that making supply chain data public would eliminate the ability of mislabelling firms to continue to mislabel. Therefore, firms that are not mislabelling may make their information public, but because of the first reason they also may not. Thus, if a firm does not publicize their data, they cannot be assumed to be mislabelling. The only foolproof way of identifying if a firm is not mislabelling is them doing DNA authentication and supply chain audits; however, this is not industry standard and few firms undertake this process. Firms that are at other stages of the supply chain perpetuate this issue as well, not giving up their sources or customers for many of the same reasons, but also not to be implicated with mislabelling if a customer or supplier is caught. These firms, in practice, are operating in a grey zone where non-compliance data can only be collected when the firms are caught, which currently, none have.

Since the data on supply chain sand products tends to be private, identifying if a firm is undertaking mislabelling or not, at a given stage of the supply chain, can only be done using theory. This is also upheld by other firms that may not be mislabelling, because If a firm is worried about non-compliance in their supply chain they are more prone to hide potential data that could implicate them. These firms, in practice, are operating in a grey zone where non-compliance data can only be collected when the firms are caught, which currently, none have.

In my model, firm's decisions to label correctly or act fraudulently depends on parameter values. As mentioned above, collecting these values is not possible, as the information remains private. To overcome this, I utilized industry knowledge, expert opinion and literature. I use this to generate plausible ranges of parameters that allows the model to predict firms labelling behaviour at each stage of the supply chain

5.3 The Model

In the model, firms face a choice between correct labelling practices or mislabelling of seafood products. The model I have created uses the basic of the decision making found in Becker's (1968) paper on Crime and Punishment. This model was created to determine the expected utility of an individual that is faced with the choice commit, or not commit a crime. The individual receives a given utility from abstaining from the crime. However, if the individual decides to break the law, they receive a different utility based on whether they are caught or not. If they break the law and are not caught, they receive a benefit greater than their utility of

being lawful equal to the value of what is attained from the crime. If, they break the law and are caught, they not only do not gain the new expected utility from the benefit of the crime, they receive a value lower than the lawful utility; the value is equal to the utility of acting lawfully minus the punishment associated with crime. There is a value for the risk of being caught, this value helps to determine the perceived value of committing the crime.

In this model, Becker has shown the justification for an actor to determine the utility attained from committing a crime, allowing them to value the costs and benefits of the give crime, helping to decide if the actor will commit it. When applying this model to seafood mislabelling certain aspects are adapted. Consider a firm in the seafood industry, they could be at any stage of the supply chain and they face two decisions on how to act. The firm could choose to correctly label their product and sell a given quantity (Q_i^{CL}) at the market price (P_{CL}) to get a profit equal to the product ($Q_i^{CL} * P_{CL}$) of these values (Π_{CL}^{Firm}). If the firm chooses to mislabel there are two ways it can end. They can mislabel and not get caught, this means that their reputation is not affected, that they face no fine and they receive a profit equal to the quantity they sell at increased price from the mislabelled product. The firm would face the risk of being caught ($1 - \beta$) multiplied by the quantity of mislabelled product (Q_i^{ML}) and the market price plus the expected profit from mislabelling each product ($P_{CL} + EP_{ML}$) to determine how much value could be gained from mislabelling. The firm also must account for the risk of being caught and potential loses to their reputation and customer base. This is shown by including the risk of being caught time the costs to the reputation and any fines, costs to the business and restitution payments, equal to ($-[\beta * (F + R)]$). Taken together, these two cases show the potential profitability of a firm that chooses to mislabel ($E\Pi_{ML}^{Firm}$) by accounting for the potential profits (and potential costs) the firm faces. The quantity of this product and the market price of it are held constant to the given firm at each stage and do not change whether the product is labelled correctly or not. When taken together, the incentive for mislabelling is a combination of these two outcomes, where the expected profit attained from mislabelling is compared to the profit from correctly labeling and compared to determine the incentive for a given firm to act fraudulently. On a market level, if each individual firm's incentive to mislabel at the given stage is great enough, then it is assumed that all firms will mislabel. This is represented in the below model:

Firm level,
$$E\Pi_{ML}^{Firm} = -[\beta * (F + R)] + [(1 - \beta) * Q_i^{ML} * (P_{CL} + EP_{ML})]$$
$$\Pi_{CL}^{Firm} = Q_i^{CL} * P_{CL}$$

$E\Pi_{ML}^{Firm} > \Pi_{CL}^{Firm}$ Mislabelling is preferred; $\Pi_{CL}^{Firm} > E\Pi_{ML}^{Firm}$ No incentive to mislabel

Where,

$$E\Pi_{ML}^{Firm} = \text{Profit from mislabelling}$$
$$\Pi_{CL}^{Firm} = \text{Profit from correct labeling}$$
$$Q = \text{Quantity of product}, > 0$$
R = Reputational risk or loss of goodwill associated with being caught mislabelling
P = Constant marginal profit per unit of product net of all relevant costs, > 0; and such that the expected profit per unit of mislabelling (EP_{ML}) is >= the profit per unit of correctly labeled products (P_{CL}); EP_{ML} >=0
β = Perceived probability of being caught mislabelling
F = Cost of being caught such as fine or loss of business
i; 1…I represents the individual firms in the market

In the model, I assume that the price of the mislabeled product is greater than the price of the correctly labelled product, otherwise there is no logical reason to mislabel. Also, I assume that there is more than one firm in the market; however, even if there is incentive to mislabel on a per firm basis, some may not choose to do so. Therefore, even if the profit for mislabelling is greater than correct labeling, some firms may choose not to mislabel, or some firms may mislabel some products but not all.

In this model EP_{ML}, F, R and β all determine the $E\Pi_{ML}^{Firm}$ for a given firm. These values are all negative correlated with the expected profitability and the greater they become the less incentive a firm has. β can be a value between 0 and 1, as this number nears one, the firm is more likely to be caught cheating. The greater the R value, the greater the reputational damage associated with being caught mislabelling and the greater the damage. This can be in the form of lost business, poor media or overall devaluation of trust. Finally, as F increases, the larger the cost on the business, potentially to the point where the EP_{ML} is completely lost and e $E\Pi_{ML}^{Firm}$ is negative. This is shown below.

Probability being caught mislabelling correlated with respect to expected profitability,

$$\frac{\partial E\Pi_{ML}^{Firm}}{\partial \beta} = -(F + R) - (Q(P + EP))$$

Cost of being caught mislabelling correlated with respect to expected profitability,

$$\frac{\partial E\Pi_{ML}^{Firm}}{\partial F} = -\beta$$

Reputational cost of being caught mislabelling correlated with respect to expected profitability,

$$\frac{\partial E\Pi_{ML}^{Firm}}{\partial R} = -\beta$$

Expected profit per unit from mislabelling with respect to marginal profit per unit of correct labeling,

$$\frac{\partial E\Pi_{ML}^{Firm}}{\partial EP} = (1 - \beta)Q$$

Applying this model to each stage of the supply chain, the values for each variable will change and this will allow the model to effectively show the given incentives to mislabel or to act correctly at the given stage. This then will help identify the position where CFIA can dedicate their resources most efficiently to combat seafood fraud.

If all seafood products were DNA authenticated, the cost would outweigh the potential benefits to consumer's health and the economic gains. However, by identifying the potential gains from mislabelling at each stage in the supply chain this model will show the most incentivized firms. This will then be used to guide CFIA on how to authenticate products most effectively.

5.4 Harvester to First Production Point

The profit gained from a seafood transaction by a harvester is maximized when the price they received is the highest. The purchaser of the product from the harvester is referred to the as first production point (as shown in the supply chain model). The variable values used for this stage of the supply chain show the lack of incentive for a harvester to mislabel their product when selling to a first production point.

The harvester (either a fisher or aquaculture producer) is incentivized to try and maximize their profit, yet the purchaser of their product, the first production point buyer is trying to do the same. This buyer is well informed on the product they are buying and their profit comes from the ability to pay the lowest possible price for the product they are receiving. To do this effectively, they must know the product and the characteristics of it, as well as its market value. Thus, when the primary producer or harvester tries to falsely label their product, the first purchaser should be able to quickly identify the false claim, implying a high likelihood of being caught. In many countries, Canada being one, there is oversight from a governing body

that requires information on species, harvest area, and other details. This model does not mention that, but it is acknowledged by the author and further makes the case that this stage is not the leading cause of mislabelling.

At this stage of the supply chain, while the likelihood of being caught is very high, the cost is minimal. Potential costs would be the transaction cost of having to change buyers, have low prices to account for the risk of fraud or more oversight of harvesters. These costs are small, but do make mislabelling less appealing. Unless the price of the mislabeled product is substantially greater than the correctly labelled product, there is no justification to attempt mislabelling as the risks would be too great. When extrapolating this across the various firms, it would show that the profit from correctly labelling would be greater, or at the very least, equal to mislabelling expected profits. When accounting for the various costs mislabelling could have on a harvester, if the profit is equal, then it is assumed a firm would choose to correctly label.

The only potential exceptions to this is if the harvesters collude with the purchasers to work together to mislabel or if the products are processed onboard the vessel to the point where they are unidentifiable. Both scenarios are illegal and unlikely, although they may occur in some scenarios they do not represent most cases and therefore do not impact the outcome.

Based upon the variable values utilized at this stage, the firms are not incentivized to mislabel their products, as they will receive greater profits from correct labelling. This only holds true if the purchasers are informed and are not colluding with the harvester to share profits; however, due to purchaser's desire to maximize their profits, the best option for them is to push the price down as far as possible and not profit share. Moreover, in developed markets like Canada there exists validation processes to ensure the products harvested off vessels are correctly identified. As for imported products, these values hold true. Moreover, Canadian importers are often not purchasing their product directly from harvesters from other countries, without having some form of validation. They must provide country of harvest to CFIA if this product is coming direct from the harvester, making mislabelling difficult. Thus, this exchange in the seafood supply chain need not receive DNA testing by CFIA.

Where,
Q is constant for both CL and ML, small figure
R is near 0
β is high, nearing 1
F is minimal, with no actual costs unless caught by governing body

Predicted outcome,

$$\Pi_{CL}^{Firm} > E\Pi_{ML}^{Firm}$$

5.5 First Producer to Value Add

The incentive structure in this section is analogous to the previous section, with a few distinct differences. With the expected profit being greater from mislabelling than correctly labelling the product, there is initial the incentive to mislabel. Moreover, at this stage in the supply chain there are fewer suppliers than the previous stage. In the harvester to first production point stage of the supply chain there are numerous actors. They include major commercial fishing vessels, small family vessels, large aquaculture operations, small aquaculture operations and various other types of harvesters. These harvesters do not each have a different purchaser they sell to, and in many cases entire fleets or coastal areas will sell to a single first production point. Therefore, there is a consolidation of product in fewer primary production points. What this means is that at this stage there are fewer transactions, but they tend to have greater value and higher quantities. The market value will be comparable to the previous stage, but the quantity of product sold by each firm will be greater, increasing the firms bargaining power.

A few variable values change at this stage, the greatest being reputational risk. In the previous stage reputational risk is minimal, if a harvester mislabels their product to the buyer, the buyer should be able to identify it immediately and negotiate to the correctly labelled price of the product. The reputation of the harvester may be slightly tarnished, but since the market determines price and the buyer is the one paying for it, their reputational accounts for little and is largely unaffected. However, comparing that outcome to this stage of the model changes things. The actors in this stage of the supply chain are much larger, thus the quantity of goods exchanged at each transaction tends to be much greater. Therefore, if a transaction is caught as being fraudulently labeled by the value-add distributor, this party will look to another trusted source of supply. Even though there exists some fine or cost to this party, the greatest risk comes in the loss of business and the cost associated with a tarnished reputation. The nominal fine for selling illegal seafood in Canada is up to 100,000 CAD and up to two years in prison (Fisheries and Oceans Canada, 2017). However, in the first major case of its kind, CFIA and the Justice Department of Ontario levied a fine of 1.2 Million CAD on Mucci Farms, with executives being charged 150,000

CAD each and facing three months' probation (Buck, 2016). Mucci Farms was found to be labelling product as Canadian, when the products had been imported from other countries. This is the first major case of this nature and highlights the potential costs of being caught mislabelling; however, it also shows the risks that come from the media attention associated with mislabelling. Since this incident, Mucci Farm's story has been covered by various news outlets including the Financial Post, Globe and Mail and CTV. Their brand may recover, but if this were to be a seafood company, the outcomes may be amplified, as the health risks from fraudulent seafood consumption are often greater than other food products.

With the other variables largely remaining the same as the previous section, although the quantity per exchange is greater and expected price received could potentially be much greater than the true market value of the product, there are some large deterrents to mislabelling. The risk of being caught remains relatively high and the potential loss of a customer, when the number of transactions is low but quantities are large, is a deterrent. Pairing that with the potentially high reputational costs of being caught, either by CFIA (which seems unlikely as they have never acted on this stage of the supply chain) or by the value-adding customer (much more likely, but with less legal implications), the incentive is low. Moreover, at this stage the product is still a whole fish, which makes it very difficult to mislabel the product to the experts (the purchasers) and thus, the likelihood of being caught mislabelling remains high.

To summarize the findings from this stage, there now exists the theoretical potential for major financial implications if caught, but in seafood specifically, this has yet to happen and thus fines from the governing body remain minimal or non-existent. The potential of being caught is quite high, there is a good chance that the fish will be correctly identified as mislabeled by the purchaser and therefore, either bought as the correct product for the correct price, or refused to be purchased. If this product is identified as mislabelled, there then exists the risk to the primary producer's reputation, which can cause the value-added purchaser to no longer buy their product. This purchaser can then tell other customers of this firm about the fraud and risk their future business operations. This increases the reputational risk and cost. When this is combined with the high chance of being caught, this makes mislabelling much less appealing and makes the first production point to value-added transactions an unlikely point for large scale mislabelling.

Where,

Q is constant for CL and ML, large figure
R is relatively substantial
β is near 1
F is high

Predicted outcome,

$$\Pi_{CL}^{Firm} > E\Pi_{ML}^{Firm}$$

5.6 Value Add to Retail

According to the variables inputted to the model at this stage, I argue this is where mislabelling is most incentivized. At this stage of the supply chain there exists a logic for the firm to mislabel, where, for any quantity there is almost no risks or costs associated with mislabelling, allowing firms to capture the entire difference in price between the correctly labeled and mislabelled products. That is because the likelihood of being caught mislabelling β is near zero. Thus far, no importers of processed seafood, domestic processors or any other value-added businesses have been prosecuted in Canada for mislabelling. This has been allowed to occur while various experts and pieces of literature citing processed seafood as having the greatest rates of mislabelling exist. The cost of being caught, or F value, at this stage is high (as seen from the one case of Mucci Farms), but largely irrelevant because with the chance of being caught (β is extremely low, meaning there is little concern about the value of the fine or the cost of reputational damage. Also, although the fine, or other costs of being caught, is seemingly a large number, in relative terms to the size of these businesses and the size of profits they have been able to make without being caught thus far, the real value may be low, depending on the firm. This is tough to estimate, but since the risk of being caught is currently as low as it is, the other information is large irrelevant as the incentive to mislabel is high in any case. At this stage, reputational risk is nearly eliminated as well, though if they were to be caught the value would be high.

In the previous stage of the supply chain, a firm that is caught mislabelling, the reputational and financial values matter a substantial amount. At this stage of the supply chain, the values are nearly the same, but they are insignificant due to the lack of risk in being caught mislabelling. The reason for the low risk is the inability to identify products that have been processed or value-added as mislabelled. Below is an image that Oceana produced that shows how low-value products that have been processed can be sold as high-value similar looking products.
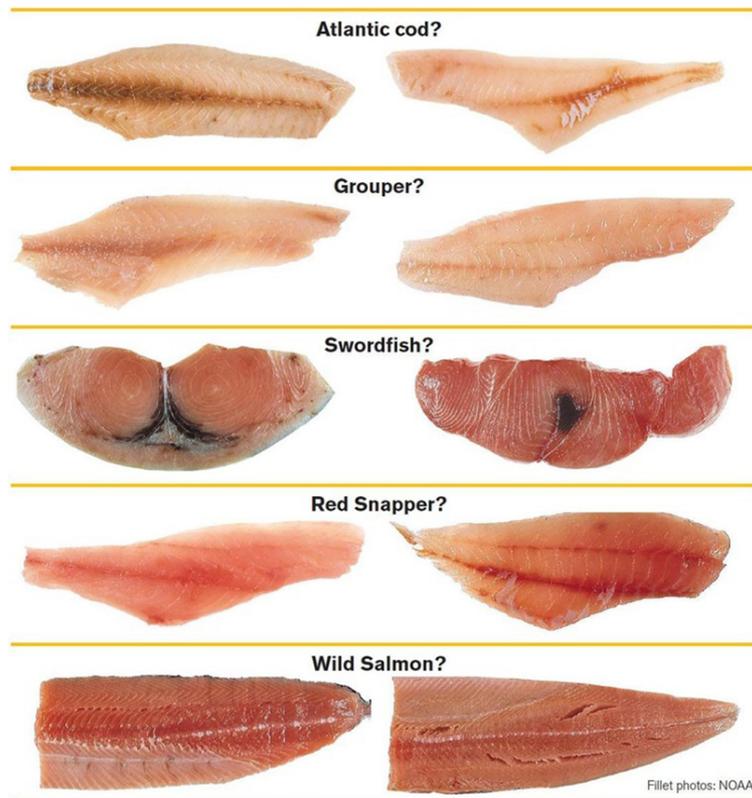
Figure 4.1: Showing difficulties in processed seafood identification (Oceana, 2011)

For context, the top left of the Atlantic cod section is Escolar, the previously mentioned seafood product that can cause adverse health effects. In the second frame, the photo on the left is a Nile perch fillet, which is a fresh water fish being misidentified as a saltwater based grouper. Finally, in the middle picture the left of the photo is swordfish, while on the right is Mako Shark, a threatened species (Oceana, 2011). This is only a small sampling but shows the challenges that purchasers face when buying value-added seafood, and how easy it is for processors to act fraudulently.

These findings are the first step in identifying the major incentives that have pushed seafood mislabelling issues to the extreme levels they are at in Canada. The expected profits from mislabelling and real profits from correctly labeled fish can differ vastly, for example, the Nile perch fillet is less than half the value of grouper in a retail (Oceana, 2011). In many cases the increase in profits from mislabelling can be in the hundreds of percent range. Someone must pay for this fraudulent profit and that is the average consumer, a price conscious person, who could be living hand to mouth. Canada is lucky enough to have a population that is well off, however, in 2011 the average Canadian home earned 80,940 CAD, before taxes, and spent 8,629 CAD of their after-tax income on food alone (Statistics Canada, 2015). That means that

Canadians are spending over 10% of their income on food; 40% of these food expenditures are on protein and restaurant foods[4], and with seafood accounting for some portion of this, there is justification for concern. This is costing the Canadian consumers substantial amounts of money on fraudulent products, and as the consumption of seafood grows, as does this cost. The implications of this are far reaching, but at the very least it is damaging to consumer trust and to the actors in the seafood industry that do not take part in fraud.

This finding begins to shed light into the black box that is the seafood supply chain. There does exist one more stage which can also have implications on mislabelling. However, this stage of the supply chain has the greatest amount of product in terms of value passing through it. This stage of the supply chain, in terms of value, is greater than domestic marine fisheries, freshwater fisheries and aquaculture in Canada, combined (Fisheries and Oceans, 2008).

Processed seafood products are imported, exported and sold domestically. With the knowledge that this stage of the supply chain is the crux of this issue, there becomes a foundation for government to increase the oversight of this stage, to increase the punishment, which, through publicity, will increase the reputational risk. If this occurs for one business and the cost implications are great enough, there is likely a spillover effect that may yield results across all seafood processing and importing businesses operating in Canada.

Overall, in terms of size and incentive, this stage has the greatest influence thus far to mislabelled seafood. The cost of this fraud cannot be easily determined, yet clearly the magnitude is immense. This is fraud on a scale rarely seen and, has yet to be punished.

Where,

Q is constant for CL and ML, large figure
R is substantial
β is near 0
F is high in nominal terms, may be low in real

Predicted outcome,

$$E\Pi_{ML}^{Firm} > \Pi_{CL}^{Firm}$$

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[4] Calculated from figures provided at http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/famil132a-eng.htm

5.7 Retail to Consumers

This stage of the supply chain presents the most challenging analysis. Retailers include restaurants, grocery stores and fishers or distributors (with validated product in developed countries) selling to consumers. This is an extremely broad category and is challenging to group such into one segment. At this stage of the supply chain there is a small incentive to mislabel. The reasons for this depend on the situation of the firm, the price from selling the mislabelled product and the reputational risk.

At this stage of the supply chain there is a relative-to-size reputational risk for all parties. Consumers would avoid a retail location if seen as fraudulent. However, when you take restaurants of various sizes that can vary. For example, a small sushi restaurant that gets caught is unlikely to face large reputational backlash, but if a large restaurant chain, like McDonalds is caught, the costs would be much greater. This is the same with retail locations like grocery stores or delis, if a small actor is caught, the reputational risk is minimal, but if a chain of grocery stores, or worse, a grocery chain like Whole Foods, which prides itself on quality and organic products, is caught, this could potentially destroy their business. The factors that affect this are many including the size of the business, the business model (are they the low-cost option? Do they highlight their sustainability and traceability of products? How large is their exposure risk?) and the scale of the issue (is one product mislabelled or are many?).

Beyond reputational risk, the next major factor is the risk of being caught. This is again dependent. Restaurants face intense scrutiny by local health authorities and must face sanitation audits and product inspections; however, these inspections do not include genetic testing of seafood. That makes restaurants unlikely to be caught mislabelling; however, if consumers become sick from their products (such as mislabelled Escolar being sold as Tuna and causing gastrointestinal issues) the business does face a cost and risk. As for grocery and retail stores, they face some audits and are under pressure by NGOs and the public to be transparent. With pushes for labels like Fair Trade, MSC and others. These businesses are under public scrutiny to improve traceability and sustainability, but not much oversight is given to mislabelling by the governing bodies. The local health authorities do not have the resources or ability to test seafood products at this stage; however, this is being done by others. Groups like Oceana, CBC Marketplace and SeaChoice have undertaken testing of retail products and restaurant offerings, and found mislabelling (Oceana, 2017). Although the

mislabelling was discovered in almost half of the samples, the businesses have not been publically named. Thus, there exists the means to catch mislabelling businesses, or possibly, catch the processors that supply them with mislabelled product. That being said, the organizations have not made the names public and thus the risk of them bring caught is low. That is because, to have a high catch rate at this stage relies on these groups releasing information on where the mislabelled product was found. The only current information they have made public is listed below.
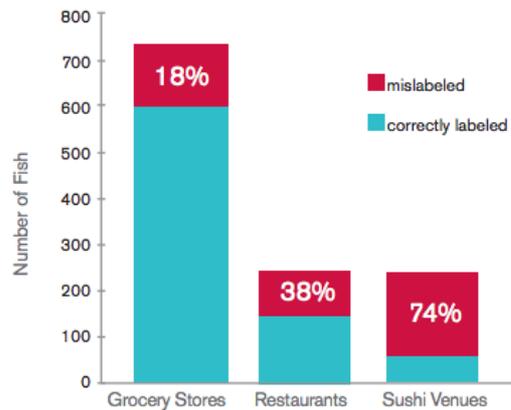
Figure 4.2: Oceana Mislabelling Rates in Retail locations in North America (Oceana 2012)

DNA analysis shows 41 per cent of fish in Canadian seafood outlets is mislabelled, but food experts say Canadian consumers are not paying enough attention. (AP Photo)

Figure 4.3: CBC Marketplace finding 41% of retail samples were mislabelled, with only 7 of 120 Red Snapper samples being correct and 84% of white Tuna being mislabelled (Huang 2013)

To correctly address these issues, there must be a greater push for testing by government or more oversight. This is currently not the case and until it is, there is the risk that at this stage mislabelling will occur, but, thankfully, NGOs are keeping the businesses honest. The work of these NGOs (testing products and publishing results) should discourage mass level intentional mislabelling by firms at this stage; however, there exists the issue of these retailers selling product that is already mislabelled and being wrongly accused. As shown by the values used in the model, the previous stage of the supply chain has the greatest incentive to mislabelled, and if they are selling fraudulent product to these retailers, when they are caught mislabelling, the blame may be falsely placed on them, with no way to distinguish if they are intentionally or unintentionally mislabelling. This complicates the potential solutions further.

The final stage here is the price incentive. Selling low value products as much higher value products increases the expected profit and incentivizes the increase of mislabelling; however, this is not often the case in retail locations or grocery stores, where prices are set at market value, which limits how high they can go. Restaurants have a greater incentive here, as they can turn a low value product into a much greater value product, increasing their margins. This can occur because it is easier to disguise a low value product as a high value product in a restaurant dish, than a whole product sold in a store. Nonetheless, relying on the market is not enough on its own to prevent mislabelling, as the other factors (such as food regulation, oversight and NGO testing) are needed keep this in check.

Overall, there is incentive at this stage to mislabelled, but it is not as great as the previous stage. Reputational risk is large and could shut down a business. The cost of being caught by the health authority or governing body could be great, but has not been explicitly set, yet the risk of being caught is low, but if the NGOs testing for fraud begin to expose which businesses have been tested, there would be less need for government to conduct testing and would serve to fulfil the value for oversight. With this information, the largest issue with identifying the incentive of mislabelling at this stage is the inability to tell if the retailers are the ones mislabelling or if a stage before them mislabelled. In the next sections this will be addressed, but the belief of the author on this matter is that concentrating on this stage is irrelevant. That

is because catching and punishing businesses that are sold fraudulent product and punishing them does not address the overarching issue. It is similar to illicit drugs, targeting individual small scale dealers is largely ineffective, while going after those who supply them is the end goal. This is the same with fraudulent seafood, using the governments limited resources to combat fraud for each small retailer is less effective than stopping mislabelled product from entering this stage of the supply chain. The focus must be on the greatest incentivized actors, and therefore should be a top down approach, beginning with the value add and processing firms, before moving onto retail.

Q is constant for both CL and ML, small figure
R can range from low to high
β is low to medium
F is relative to size, ranging from low to medium

Predicted outcome,

$$\text{Negligibly } E\Pi_{ML}^{Firm} \geq \Pi_{CL}^{Firm}$$

5.8 Implications for Governing Authority

The findings from the values utilized at each stage of the supply chain in this model show the most likely stage of mislabelling and, equally importantly, which stages were not incentivized to mislabel or not. This gives a starting point to addressing solutions in Canada. Thus far, the efforts have been undertaken by NGOs, and have been focused on informing consumers of traceability of the supply chain and which products are sustainable. However, it will be shown in the next section that neither of these solve for mislabelling, instead, it theoretically helps correct labelling firms increase their profitability (without any substantiated return on investment information) without targeting the businesses that are mislabelling.

It will also be shown that the actions of the governing body heavily dictate the success of managing mislabelling. Relying on the actions of NGOs does not sufficiently dissuade actors from mislabelling and that legislation and oversight must be utilized effectively, otherwise progress will be limited.

The key finding from this model is that in domestic production of seafood, there is largely no reason to police the stages before processing or value-add. There is little incentive to cheat and even when there is, it is not to large enough scale to dedicate resources to. This means that efforts can be placed on the latter sections, with a focus on genetically identifying products

that leave or enter the 722 registered processing plants in Canada and head to retail (Agriculture and Agri-Food Canada, 2016). To further prove this, it would be good to get an idea of how many genetic audits at this stage would need to occur to discourage these actors from mislabelling. However, that research does not yet exist and could build off this paper.

For imported products, the genetic testing again can focus on processed seafood. As identified earlier in the paper CFIA can test products that visually seem to be mislabelled or compromised. This is extremely tough to prove on processed product and with the random audits they do for current products, adding in a genetic testing aspect on processed products could help address some of the problems.

One opportunity to address fraud throughout the supply chain is improving labelling standards. Canada's dated documentation in this area does not address the necessary information needed to prevent IUU fish from entering Canada and makes mislabelling much easier.

In the following sections the current ways mislabelling is being combatted in Canada will be assessed, the success of the EUs response to their seafood mislabelling issues will be reviewed and then policy options for Canada will be presented based upon the findings from this paper.

6.   Current Solutions to Mislabelling in Canada

6.1 What is currently being done?

Canada has not combatted mislabelling via government actions, instead relying on NGOs and private enterprise thus far. Most of the work has been undertaken by groups like Oceana, SeaChoice, Marine Stewardship Council among others. I argue that, although these groups have done fantastic work, they do not offer a comprehensive solution to mislabelling. I do feel that they must be acknowledged and the role they play must be addressed. This section will highlight how ecolabelling is currently used, which actors contribute to it, what they do and the shortcomings of this system. Following this I will address the solutions that have been used in the European case and how they can be used, along with ecolabelling, to successfully combat mislabelling.

6.2 Ecolabelling and Traceability

A growing answer to mislabelling has been undertaken by various non-governmental groups which use labels and audits to follow supply chains of products and ensure they are environmentally and socially responsible. An ecolabel is a voluntary way of a business or product supplier to receive certification and labelling for the practices in the production and distribution of their product; moreover, an ecolabel identifies whether these products are environmentally and socially preferable to other options in the product or service category (Environment – EU, 2017). This system is widely visible in the consumer good market, with recognizable labels such as Fair Trade, Marine Stewardship Council and the EU Ecolabel. Ecolabelling allows consumers to choose a product, which has the same characteristics as the alternative yet is viewed as premium, due to the responsible way in which it is produced and traceability. Ecolabelled products rely on the audits conducted by the NGO or firm to prove the product is correctly labelled and scrutinized, therefore, helping to solve for mislabelling issues, and creating value for the firm and customer. Ecolabels allow consumers greater transparency and trust into a brand which choose to use this method. However, there are cost implications of this choice that must be covered. First, the ecolabelling and auditing costs must be borne, or split, by either the group undertaking the audits, the producers or the consumer, depending on the label and industry. Second, there must be a price premium to justify this

action, otherwise there exists no incentive to undertake this process. Finally, there must be a demand for this transparency, otherwise the premium put on a product would be above the consumers' willingness to pay and would leave the product without a market.

Ecolabelling has proven successful in various industries including coffee and organic agriculture. There are limitations however, ecolabelling is most successful in industries where consumers are ecologically conscious, which implies a willingness to pay the premium. Price conscious consumers are unable to afford the premium on the product (Schumacher, 2010). The findings showed that an ecolabel acts as a tax on good and the willingness to pay depends on the preferences and income of the consumers (Schumacher, 2010). These are consistent with traditional economic theory where consumers with higher disposable income are able to purchase premium products, but those without must settle for the lower cost option. Applying this information to seafood, ecolabelling is a partial solution to the supply chain issues in seafood, however, it cannot fully solve for all products in the market.

A second major issue is that ecolabelling is a voluntary way of a business highlighting their supply chain transparency. This implies that the businesses that choose to undertake this process are confident in the origin and integrity of the supply chain of their product. Since the businesses and consumers split the cost of implementation, there is an incentive for business to use this as a potential value capture opportunity. In doing this, there is an incentive to correctly label, as shown below.

Firm level,

$$E\Pi_{ML}^{Firm} = -[\beta * (F + R)] + [(1 - \beta) * Q_i^{ML} * (P_{CL} + EP_{ML})]$$
$$\Pi_{CL}^{Firm} = Q_i^{CL} * P_{CL}$$
$$\Pi_{EL}^{Firm} = (Q_i^{CL} * (P_{CL}*[1+EL]))$$

Where,

$E\Pi_{ML}^{Firm}$ = Profit from mislabelling
Π_{CL}^{Firm} = Profit from correct labeling
Q = Quantity of product, >0
R = Reputational risk or loss of goodwill associated with being caught mislabelling
P = Constant marginal profit per unit of product net of all relevant costs, > 0; and such that the expected profit per unit of mislabelling (EP_{ML}) is >= the profit per unit of correctly labeled products (P_{CL}); EP_{ML} >=0
β = Perceived probability of being caught mislabelling
F = Cost of being caught such as fine or loss of business
i; 1…I represents the individual firms in the market
EL = Percentage increase in profitability from Ecolabelling

In this case, ecolabelling is only contingent on the potential profitability increase of value gained from ecolabelling a correctly labelled product. There is no incentive for a firm that is mislabelling to use an ecolabel as they would first, must pay into it, decreasing the EP per unit, and second, would be paying into something that catches their mislabelling (which creates the value of EP+P>P); therefore, not only would this business be losing potential profit from od nad paying into the ecolabel, but they would be catching themselves acting fraudulently. This makes the chance of being caught 100%, causing damage to the firm's reputation and drives EP below P. Overall, it shows that mislabelling is only effective for businesses that are correctly labelling their product and does nothing to address for businesses that are incorrectly labelling.

These labels, then, are a tool for creating competitive advantage for firms, not a solution to addressing underlying issues. They can be used to prove which businesses do correctly label, but cannot prove that the businesses that do not use ecolabels are necessarily mislabelling. Therefore, this allows correct labelling firms to distinguish themselves, but cannot prove that firms that do not buy in are mislabelling.

Other solutions ecolabelling groups have proposed involve informing consumers on which products to purchase. Oceana came up with the chart featured below on how consumers should purchase products to ensure they do not get sold mislabelled products:

Ways to Protect Yourself When Buying Fish	
Buy a whole fish	It's harder to misrepresent a whole fish than a fillet.
Know the fish you eat	When purchasing fish, ask what species it is, where and how it was caught and if it is sustainable. This can trigger a chain reaction extending back to the seafood supplier.
Be wary of fish that seems cheaper than it should be	If it is too good to be true, it probably is.
Learn about the seasonality of your favourite seafood products	Products sold out of season are more likely to be fraudulent

Figure 5.1: Adapted Oceana's suggestions to consumers on which seafood products to buy to limit risk to mislabelling (Oceana, 2017)

According to an interview with Xiaonan Lu, a UBC professor of food science and expert on the matter, he suggests that consumers buy seafood that is in season, as this helps ensure it is less likely to be fraudulent (Dimoff, 2018). However, neither of the above cases does anything to address the issue, instead they offer ways of avoiding product that may be mislabelled. There is no actual change that prevents mislabelling, but an attempt to shift consumers purchasing power away from products that can be mislabelled. Yet, as identified by Schumacher, this only works for consumers that can afford these higher value products and are willing to pay for them. This solution does not address a substantial portion of consumers, leaving a lot to be desired. It does present an opportunity for government, health authorities and CFIA to create legislation to encourage chance.

6.3 Lifescanner and Labelling Change

SeaChoice has taken a further step and informed consumers on various rates of mislabelling in retail locations. They broke down the locations into groups, including poor labelling, unsatisfactory labelling, okay labelling and good labelling (Lifescanner 2018). These are based off the standards used in Europe, which include commercial designation and scientific name, harvest method (aquaculture or wild and what gear type was used), catch area, processing country (if processed) and others (European Commission, 2014). These standards are much more stringent than CFIA's current labelling requirements and ensures that traceability is maintained for all products. Shown below is a contrasting of the various requirements from the European Union, United States and Canada
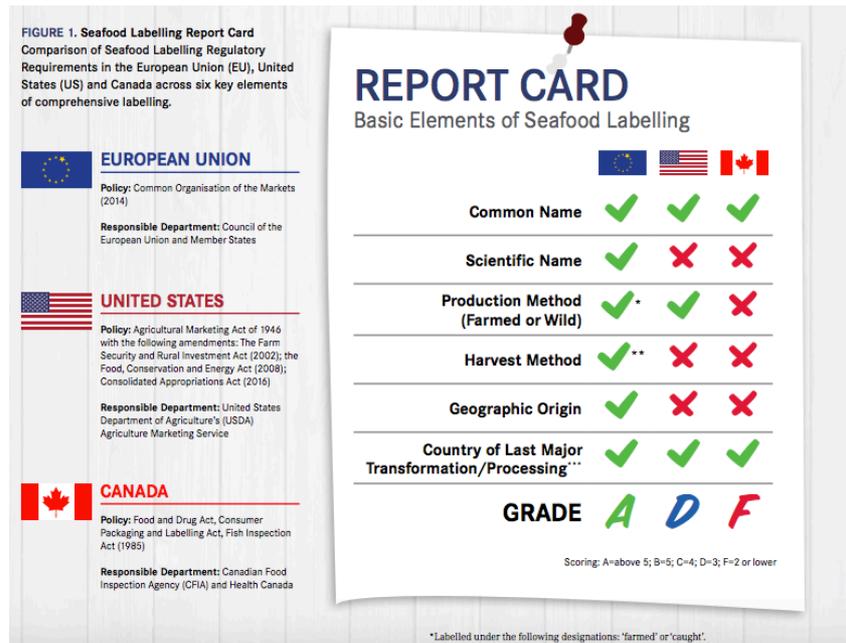
Figure 5.2: SeaChoice report card on Seafood Labelling (Roebuck et al. 2017)

Since this report, SeaChoice has been working with the University of Guelph on a project called Lifescanner. It allows consumers to take samples of seafood and send them in for testing. The hope being that this will force CFIA to increase their standards, which as seen from the above image have not changed since 1985, while the EU updated their policy in 2014 and the United States in 2016 (Roebuck et al., 2017).

The push for improved labelling standards has been forwarded by Oceana, CBC and many other sources; however, these groups are not currently willing to name the businesses they caught mislabelling. This allows these fraudulent actors to remain hidden and continue to take advantage of consumers. To solve for this, a more thorough analysis of how Europe utilized the data from academics to guide policy and generate results will be needed to convince the NGOs and firms to share the fraudulent firm's identities.

7. European Case

7.1 European Standards

Europe has enacted the most stringent regulations on food labelling practices, these span all products, including seafood. They have done this to protect their consumers from adverse health effects, from allowing illegal or unethical products to enter the European market and to prevent consumers from being subject to fraud, costing money and losing consumer trust. This has proved immensely effective seafood, with some mislabelling rates being the lowest in the developed world, single digit percentages in many of the EU countries versus high double digit figures in North America (Mariani et al., 2015; Naaum and Hanner, 2015). This was not always the case, before the change in regulation, rates were much close to North America at 25% (Miller and Mariani, 2010). This drove political changes to ensure that product labelling was made more comprehensive, which created a market where mislabelled seafood was much more difficult to import or process and therefore, harder for consumers to purchase.

The proactive change led to substantial fraud decreases, as the new regulations, which included harvest method, area of harvest, country of processing, and correct names, were enacted. In a sense, the European union removed the necessity of third party traceability programs because the labelling standards required the product to be traced throughout naturally. Moreover, the European Union began to take food fraud seriously, they ensured that the regulations were upheld by including the administrative branches of government, judiciary and police and customs in the process. This ensured that regulation was upheld and punishments levied if fraud was identified (European Commission – Food, 2013).

28 EU countries, plus Switzerland, Norway and Iceland, formed the European Commission on General Food Law with the stated goal of cooperating and upholding food chain law with cross-border impact (European Commission – Food, 2013). They chose to not set exact punishments, but instead deal with issues on a case by case basis and levy punishments as fir for each instance. This created a system where unscrupulous, large scale fraud is not punished the same as small scale accidental fraud. Moreover, it ensures that if an actor is caught, their punishments are made public, increasing the reputational risk this business faces in the future.

An example of the success of the European system can be seen in the case of Vietnamese seafood imports from 2016 when the Ministry of Agriculture and Development chose to disallow the licensing of Vietnamese seafood shipments to Europe (European Commission – Food, 2016). The commission prevented European business from importing products from this country and made this punishable by up to 20 years in prison; 15 countries agreed to this and the Vietnamese government was warned to act and stop fraudulently deceiving European customers (European Commission – Food, 2016). This does two things, the first being it ensures that the importers who either, intentionally or unintentionally, distributes this product are forced to act and second, the suppliers are brought to justice if their actions continue. It also creates a precedent for future businesses or states that look to act in this way, the bar is set, punishments are created and there is no ambiguity.

The European Union has also created centers for research into food fraud. In 2018, the European Union launched the Knowledge Centre, which responds to consumer concerns on food quality and fraudulent practices (European Commission, 2018). The underlying belief in Europe is that, "Concerns about food fraud and food quality undermine consumer confidence and damage the whole supply chain in Europe, from farmers to retailers." (European Commission, 2018). This approach punishes all parties that are taking part in fraud, making them understand that they are accountable for their actions and, then market factors can dictate the best solution to food fraud.

How this affects the model is that both the rick of being caught and cost of being caught are known and are high; moreover, the risk to the reputation, by the sharing of information to the public of actors caught acting fraudulently, is substantial. This creates accountability, visible punishments and an incentive to not act fraudulently. This makes the ecolabelling system an option to increase value, but not a necessary factor. It also prevents unscrupulous actors from remaining in this market, and pushes the risk all the way down the supply chain, by closing markets for producers that choose to act fraudulently.

The European commission acts to limit or prevent IUU fish from entering the market. By ensuring that labeling standards are strict, punishments for not abiding are large enough and oversight is thorough, there is little way for IUU to enter the market. IUU product relies on a lack of transparency, high value from cheating and weak labelling to enter markets. Thus, the European labelling standards address these major areas and make IUU product a much less viable option. This has massive implications for the IUU industry as a whole; the actors

supplying this good must then either change their actions by finding a new market for their product or becoming legitimate. If they do not, they cannot sell to their previous market and lose revenue. Moreover, they could be subject to large punishments by either their own government or international governing bodies, as the product is easily traced back to the origin.

7.2 Challenges

This European system does not come without challenges, with the most obvious being immense cost in oversight and policing. Not only does this require the governing body to take part in audits and understand where a product comes from and how it arrived, but it also requires significant input from the various branches of government and other international governments. The European government system is split into various sectors and implementing a system with the depth and breadth of the one used on food labeling practices requires many of these branches, including the legislative and judiciary. To push through legislation of this nature takes time, money and public support. Also, to create punishments that the judiciary can enforce requires one of two major things, a precedent to justify the punishment, or a guideline to determine what a fair punishment is. Since there existed nothing like this before, the EU had to use the latter. Therefore, there was substantial time and effort used to determine what kind of punishments should be levied, on who and how to enforce them.

These kinds of challenges would be faced by any country following the EU's model; however, the countries implementing the changes would be able to use the EU as a first-mover example. There is however, the issue of how to initiate this change. The EU acted due to a scandal that garnered huge media attention: Horse meat was fraudulently being sold as beef. This happened in 2013 and sent ripples through the EU after being identified in the UK (BBC News, 2013). This drove genetic testing of numerous products and spawned the changes in regulation and oversight. The issue with this is that it took a reactive response to change these rules rather than a proactive one. To create this change in other countries, it is likely (based upon this case) that the other countries would also be waiting for a reactive moment rather than a proactive change.

The final and most challenging aspect of taking the EU's response and applying it to other countries is the nature of the EU. The EU is recognized as being a very centre left system of governments of that the overall continent has a very liberal democratic perspective. This kind

of system does not exist in all liberal democracies, where there can be more conservative values. In these systems, conservative economises argue that oversight of the food system should be done by the market and that impinging on the rights of businesses in the capitalist system is government overstepping. This is most prominently seen in the United States where a system for tracking the country of origin in products (known as Country-of-Origin-Labelling or COOL) was becoming mandatory during President George W. Bush's second term (Thompson, Sylvia & Morrissey, 2006). However, on January 17, 2004 President Bush signed public law 108-199, an exception to mandatory COOL labelling for wild and farmed seafood and shellfish products, due to large backlash from industry (Thompson, Sylvia & Morrissey, 2006). These industry players argued that the cost of implementation (estimated at 3.9 billion USD) was too great and that the Bio-Terrorism Act requires certain traceability related information already, making COOL unnecessary (Thompson, Sylvia & Morrissey, 2006). This argument held up and Bush signed the document delaying the decision. This delay was expected to be dealt with in 2005; however, it was not until December of 2016 when a response to this issue was dealt with (National Oceanic and Atmospheric Administration, 2016). This ruling implemented stronger traceability measures, including country of origin; however, this was due to market pressure against the allowance of IUU fish into the country and took over ten years to be implemented. For a country like Canada that would sit in the middle of these two countries in terms of the political spectrum, what kind of reactive measure it would take to cause a change cannot be estimated; however, it can be noted that there should be some form of response as countries with very different political agendas, with many sitting on either side of the political spectrum, have been able to address this issue.

8. Policy Options for Canada

8.1 Where Canada is Now

This has been touched on many times throughout the paper and will be briefly summarized here. Canada is a laggard, our two closest allies and most similar nations (Europe and the United States) have both started to, or largely, addressed seafood fraud issues. Canada has not progressed labelling or fraud legislation since the 1980's, even with public understanding and dissatisfaction on the issue growing. It has reached a point where Canadians are taking kits from NGOs to test the products they are buying to ensure it is not fraudulent; something that consumers should be able to rely on the government for (Roebuck et al., 2017). This section will offer some suggestions on what the Canadian government can do to help transparency become a greater norm in the seafood supply chain and address the epidemic of fraud in this sector. The proposed solutions should help with both domestic production and imported products. The costs of these solutions will be borne by government, industry and the population; however, the actual market price of products should not largely increase, rather the distribution of costs should be distributed more accurately than the current system.

8.2 Find Justification

Canada needs to find a means to spend a significant amount of time and money redressing their seafood, and food in general, regulation. The starting point must be the Consumer Packaging and Labelling Act of 1985, this sets out all the rules and regulations that guide packing information and what must be disclosed by business (Justice Laws – Government of Canada, 1985). The updating of this legislation should follow the actions of both the United States and Europe, where information on whether the product is farmed or wild the country of origin are minimum requirements. Canada should, still, be pushing the standards even farther, to match the European regulations. That would require both scientific and common name, harvest type (farmed or wild), harvest method for wild products, country of origin, FAO harvest area and countries of processing (European Commission – Food, 2018). This would largely diminish the need for large scale genetic testing of product and would be a solution that puts Canada on parity with leaders in this area. Moreover, it creates a precedent for the United States to do the same, which puts even greater pressure on those who are mislabelling to discontinue their actions as three large markets would no longer be accessible.

Finding justification for genetic testing comes from analyzing the consumer losses on fraudulent seafood, which as stated easier, look to be immense. In a recent interview with CBC the National Sylvain Charlebois, Dalhousie professor of food distribution and policy, fish fraud is immensely lucrative, comparable to the value of illicit street drugs (CBC, 2018). Though this income is not technically lost, as it transfers from consumers to fraudulent actors, creating a precedent for government. Furthermore, the saving in expenditures on fraudulent seafood, the restitution payments that will be required from fraudulent businesses to their consumers and the fine revenue to government should serve to cover a portion of the future genetic testing costs.

Finally, if Canada increases their regulation on labelling, genetic testing and creates a system to punish those who are caught acting fraudulently, they will not be alone. Europe did this and created a model which Canada can use as the guideline to create an adapted system that works for the country. The United States has taken the first steps and by working on a similar schedule Canada and the United States can create monumental progress and share in the costs of the shift and knowledge share. There is no reason for Canada to reinvent the wheel, Europe created a successful system, now adaptation and fine tuning are all that is required to ensure the success Europe sought attained is available to Canada

8.3 Strengthen Label Standards

As listed in the previous section Canada must make changes to labeling. By changing the legislation that guides the labelling requirements of food, Canada will limit what products can be imported in the short term (while they change labels to meet the new standard) and will require adaptation from domestic business; however, many businesses already do this for Europe and the pains will be short lived. This has been pushed for by SeaChoice, a group supported by the David Suzuki Foundation. More recently, the FAO published a report on seafood fraud and stated a few main concepts that were needed to combat this issue, with mandatory labelling requirements being one of the main answers. They stated that seafood labels must be mandatory, with correct information, and must include the below information (Food and Agriculture Organization, 2018).

- commercial and scientific name of the species;
- production method ("… caught …" or "… caught in freshwater …" or "… farmed …");
- area where the product was caught or farmed (using the FAO Major Fishing Areas [FAO, 2018b]);
- category of fishing gear used;
- whether the product has been defrosted (with limited exceptions);
- date of minimum durability – where appropriate.

Figure 7.1: FAO Labelling Guidelines for Combatting Global Seafood Fraud (Food and Agriculture Organization 2018)

These are copied from the European standard and set guidelines that are relatively simple to abide by, while requiring enough information that fraud becomes more difficult. When coupled with the other policy suggestions, fraud becomes extremely challenging.

Correct labelling practices makes an intricate system simpler. Instead of having various labelling requirements and levels of scrutiny in oversight, there becomes a standard that businesses will be forced to abide by. This new standard, forces business to adhere to the legislation, leaving no option but to include more information on labels. Businesses will be faced with increased cost as they adapt, but when it is a standard, they have no other option. It also solves the issue for both aquaculture and wild caught products; labelling requirements are the same for both industries, leaving no grounds to argue unfair support of either industry.

Implementing this change is the necessary first step in solving for fraud, and currently presents the greatest return on investment. This solution is cheap, shown to be effective and requires little more than legislative amendment for government. Any of the other policy suggestions require implementation of a new system or oversight; this however, requires very little. The FAO has pushed this idea on a global level and it is not a radical change.

Canada tries to lead in many areas of the world in social programs, economic redistribution and environmental care, but when it comes to seafood and fraud it lags. Canada came through the most recent financial crisis due to strong oversight by the Canadian government in the banking sector, which went on to be praised by many governments and parties around the globe (Bordo, Reddish and Rockoff, 2010). When it comes to food, on the other hand, Canada is behind their neighbours and has not made a major change in the last 30 years.

This is not a policy suggestion, instead this is a statement to government that this change must be made. Canada cannot advertise itself as a liberal democracy that is socially, economically and environmentally progressive, yet allows one of our largest industries, and one of the

world's largest cases of fraud, to exist when there are meaningful solutions that are available. Labelling changes will be made, because they must be made. If they are not, Canada would be an embarrassment on the international stage with countries much less developed discussing this change before Canada.

8.4 Genetic Testing

To ensure that the labelling standards are upheld, Canada must undertake some genetic testing. These tests make sure that the species named on the label match the actual product. Hanner, the FAO and Europe all support genetic testing; however, the scale of this is debated. There could be the case made that all products should be genetically tested, but with a basic understanding of economics one knows that decreasing marginal returns would occur from this. Rather, there is some point between no testing and complete genetic testing where there is an optimal return on investment. I will not delve deeply into how much testing should occur as this requires substantial analysis, but some testing needs to occur. It can be undertaken as a differentiation strategy, using the increased revenue generated from increased willingness to pay by consumers, as was shown with ecolabelling, to offset some of the costs. I believe CFIA should be undertaking random testing on a frequent basis and not relying on the private sector to initiate this.

This kind of testing does currently occur in small pockets, but is largely done by private companies at the retail stage, which is often too late. Rather, the testing should be undertaken when domestic product is processed then sold to then next stage of the supply chain. For imported product, it should be done when it is validated by CFIA. This keeps the supply chain honest, as shown in the model, and ensures that products need not be tested twice, increasing unnecessary costs.

8.5 Levy Strong Punishments

When trying to encourage positive change incentives, such as subsidies, can be offered to business or individuals. When trying to discourage illegal or detrimental actions, there must be punishments. If a punishment levied on mislabelling or fraud is minimal, then there is no incentive to stop (as seen by the model). The intention of this suggestion is to increase the cost of punishments for being caught acting fraudulently, particularly at the importer/processor

point. The rationale is, if the punishment value is sufficiently high then it can compensate for a lower oversight value. What this allows for is government to save money by not having to test as many products, but to see the similar results. That is because if one business witnesses the large cost on another business, for acting fraudulently, both their reputation and profitability take a hit. This, then, discourages other business from acting in such a way and forces the companies to start ensuring their supply chains are scrutinized, or else they risk their reputation and revenue.

This occurred in the horsemeat scandal in Europe and has started to happen in Canada. Mentioned earlier was the case of Mucci Farms, which faced punishment for mislabelling product origins. The costs of their actions were borne by executives and the business, to the tune of around 2 million CAD (Buck, 2016). However, in more recent news, the Ontario Greenhouse Vegetable Growers has since levied an additional 3.2 million CAD fine against Mucci (Kuitenbrower, 2017). This brings the total cost up to around 5 million CAD, enough to discourage this kind of action again. The original punishment levied by CFIA, the 1.2 million in fines, was over 10 times greater than their previous largest punishment (Kuitenbrower, 2017). This showed CFIA's commitment to food fraud, and can be used as a guiding principle to apply similar punishments to seafood mislabelling.

Though CFIA has showed it can levy fines and punishments that are discouraging it has not done enough clearly. A few major issues still exist. The first being that CFIA's punishment was not the greatest. The Ontario union of vegetable growers nearly tripled the fine by the federal body which is supposed to prevent this type of fraud.

Second, CFIA has only done this once, and never has done it in seafood. DNA authentication has proven to be viable, now it is CFIA's responsibility to provide this service to the Canadian market. Once authentication has become the standard, a punishment to match the crime must be the next. With less than 1000 processors and importers of seafood in Canada generating billions of dollars in business, a small punishment will not suffice. A firm must be made example of; Tesco suffered substantially when they were found to be distributing horsemeat. Canadian fraudulent businesses need to suffer as well.

Finally, the punishments and scrutiny cannot be directed at the small businesses at the end of the supply chain. As shown by the model, though these businesses do have some incentive to mislabel, the greatest incentive comes from the large, middle of the chain, processors and

importers. These businesses have the most to gain and the least to suffer within the current structure. Thus far, NGOs have placed their efforts on the end of the supply chain to show mislabelling is occurring. This paper has shown the incentive structure of the various parties, now government has a responsibility to act on the information presented to them and act accordingly.

CFIA has all the tools and information needed to act, now the responsibility is on them to use it. However, they do not have to act alone, they have NGO support, many academics have shown an interest in addressing this issue, private businesses want this solved and most of all Canadian consumers need a solution.

8.6 Work Together

If CFIA were to go about this alone they would largely be ineffective and would see very little returns on investment for what they undertake. Instead, using Europe as a guideline, working with the United States as they change their policy and using their domestic resources, CFIA has a high probability of effectively combatting this issue.

The basis of the paper was to show where mislabelling and fraud in the seafood supply chain happens, but it was also about applying the success of Europe in combatting it to Canada. Europe created programs to test seafood products, discourage actors from acting fraudulently and created strict standards on the information businesses need to provide. This system is not foolproof, but has thus far been the most progressive and effective. Canada has a great relationship with Europe and needs to use this to learn from what they did, but also to work together going forward. Instead of every country acting independently to research problems and develop solutions on their own, pooling resources and devising solutions together would serve to generate greater benefit for lower cost. This would also serve to create a more comprehensive solution when all countries adopt similar standards and share information, with the eventual goal of catalyzing a global shift in this direction.

The second relationship Canada must leverage is the United States. Being neighbours, each other's main trading partner and sharing many of the same issues, addressing this issue together will be fundamental to the success of it. The United States has made the initial move and Canada will have to do this. Once that occurs, Canada and the United States will be able to work through solutions that work well for both parties and hopefully countries beyond.

Most discussions between these two countries have been over trade balance issues. Collaborating on combatting seafood fraud is an opportunity to shift discussion from issue to benefit. Both parties would see gains in consumer confidence and the benefit serve to save consumers money, promote domestic jobs (through fisheries and aquaculture) and create an integrated food safety standard that is near, or equal to, the European standard. The benefits are obvious and there could be externalities that arise from this that serve to benefit other industries, or at the very minimum, quell tensions on current trade issues.

Throughout this paper there has been a theme of parties acting independently to try and achieve a goal, while often overlooking an opportunity to work together. CFIA has been one of the largest perpetrators of this. Various NGOs and private enterprises have each pandered their own agenda rather than working together to create a comprehensive solution. Finally, many academics have highlighted the need for change, have generated the data to support it, yet have not collaborated with each other to force governing parties hand. This needs to end. Collaboration is the only way to solve this issue. Europe learned that the hard way and Canada needs to learn from this.

9. Conclusion

Overall this paper has tried to distill a complicated matter into simple terms and offer some adequate solutions to the complex nature of seafood fraud. The initial section of this paper tried to convert the intricacies of the seafood supply chain into simple groups that distinguished the various stages in the process of 'bait to plate' seafood. Taking this information, the goal was to show that mislabelling was happening and that it was a systemic issue that had permeated all markets. Next, it was imperative to identify the issues of seafood fraud, which included consumer trust, money and health. In doing this, I showed that there did not currently exist an adequate solution to these issues in North America. Contrasting this, I presented Europe, which has solved most seafood fraud issues. This indicated that a potential solution exists and that North America could use this information to guide policy and deal with seafood fraud, but so far had failed to do so effectively. A model was built to show where this fraud was occurring and presented the most likely parties that were perpetuating it.

Once this was distilled down to what it meant, the current solutions that existed in Canada were evaluated on their merits and where they fell short. Using Europe as a guideline, solutions and options for Canada were presented, offering suggestions on how to address this issue, where collaborations could occur and how to be most efficient and cost effective.

There exists much more research to be done on the topic of seafood fraud and how to effectively combat it. The economic implications are derived without explicit data, they rely on supply chain understanding and logic. The true costs of this fraudulent actions are not understood and could be greater or smaller than implied by this paper. Economics is not the only sector that is at play in seafood fraud, politics (on a global scale), social implications, industrial sectors and various other external areas affected. Overall, there is much more to be done regarding this topic, but this paper begins to address the economic issues behind seafood fraud and tries to offer meaningful solutions to the problems presented.

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Appendix

Appendix 1