Something's Fishy: Investigating Tuna Mislabelling Across the Pacific Northwest

Rabiah Dhaliwal, Katja Nell, Marcus Shew, Catherine Wang

Abstract

Seafood fraud poses a significant problem due to mislabelling having serious health, ethical, economic, and environmental implications. Despite this, it is commonly used as a method to reduce costs and to meet consumer demand. To investigate this issue in the Pacific Northwest, we tested seven unique samples of tuna, sourced from grocery stores and restaurants, for mislabelling. Three replicates each of four fresh samples (one albacore, one Atlantic bluefin, two yellowfin/ahi) and three canned samples (all skipjack) were tested using DNA extraction, PCR, and gel electrophoresis. The results were inconclusive, possibly due to a combination of factors including complications with the gel used, the small sample size, and the presence of metals and preservatives in the canned samples. We recommend future studies replicate the presented experimental design with primers specific to commonly substituted species for each tuna sample. Usage of a larger sample size would potentially result in a statistically meaningful calculation of mislabelled tuna prevalence.

Introduction

Mislabelling of various types of meat from different sources (such as grocery stores, restaurants, and docks) is a serious issue (Levin, 2018; Stawitz et al., 2016; Willette et al., 2017). Often referred to as "seafood fraud", some suppliers mislabel less expensive tuna as a more expensive species as a money-saving scheme, but this has serious environmental and social impacts (Gordoa et al., 2017; Levin, 2018; Stawitz et al., 2016; Willette et al., 2017).

A report by Oceana Canada found that 26% of seafood samples in Vancouver were mislabelled (Levin, 2018). They noted that in 82% of the mislabelled samples, the actual species was cheaper than the species it was marketed as. The same report showed a similar trend across Canada, with 41% of all tuna samples tested being found to be mislabelled.

Previous studies concerning seafood mislabelling have developed DNA isolation and PCR analysis methodologies using primers for various species (Gordoa et al., 2017; Hu et al., 2018; Lin and Hwang, 2007; Willette et al., 2017). The goal of these studies was to compare patterns in the molecular weights of specific DNA fragments of sampled tuna with known patterns of a wide range of species. This

process is known as DNA barcoding, which is useful for its low cost, quick results, and general efficacy, but it can pose issues when two species have DNA markers of similar molecular weights (Gordoa et al., 2017; Mitchell and Hellberg, 2016; Willette et al., 2017).

Tuna is often sold in both fresh and canned forms. However, identifying the species of canned tuna poses unique challenges due to metal exposure and the heat-treated nature of the tuna, as contamination and DNA breakdown can occur (Krčmář et al., 2019; Lee et al., 2022; Lin and Hwang, 2007; Mitchell and Hellberg, 2016). Some studies have tried to compensate for these concerns by soaking the canned tuna in water prior to DNA extraction and using mitochondrial DNA rather than genomic DNA for the analysis (Krčmář et al., 2019; Lin and Hwang, 2007). The PCR methodology we will use in this investigative study was modified from a study by Lee et al. (2022).

In order to further investigate the issue of seafood fraud in the Pacific Northwest, we decided to collect tuna samples from various grocery stores and restaurants and test if they were mislabelled or not using the aforementioned DNA isolation, PCR analysis, and DNA barcoding techniques.

Methods

Sample Collection

A total of seven tuna samples were collected from various locations across the Pacific Northwest. The samples included four fresh samples and three canned samples. Two of the fresh samples were sourced from restaurants and two were from grocery stores. All of the canned samples were from grocery stores. The sampled species were labelled as albacore (*T. alalunga*), yellowfin/ahi (*T. albacares*), skipjack (*K. pelamis*), and Atlantic bluefin (*T. thynnus*). A summary of sample information is outlined in **Table 1**.

Each sample purchased on February 28, 2023 was placed in the fridge for storage after collection; sample 4 was acquired the day of the experiment and did not require overnight refrigeration. Sample 7 was removed from its can and soaked in water overnight prior to the start of the experiment. Sample 5 was not soaked due to time constraints. Although sample 6 is denoted as a “canned” sample

in our paper for convenience, the tuna was actually packaged in a bag. Note that due to seasonal availability, all fresh tuna samples were previously frozen for import, but fully thawed at purchase.

Table 1. An overview of the locations and species sampled.

Sample No.	Fresh or Canned	Labelled Species	Source Location	Date
1		Albacore	Restaurant 1	February 28, 2023
2		Atlantic bluefin	Restaurant 2	February 28, 2023
3	Fresh	Ahi (aka Yellowfin)	Grocery store 1	February 28, 2023
4		Yellowfin (aka Ahi)	Grocery store 2	March 1, 2023
5		Skipjack	Grocery store 1	February 28, 2023
6	Canned	Skipjack	Grocery store 3	February 28, 2023
7		Skipjack	Grocery store 4	February 28, 2023

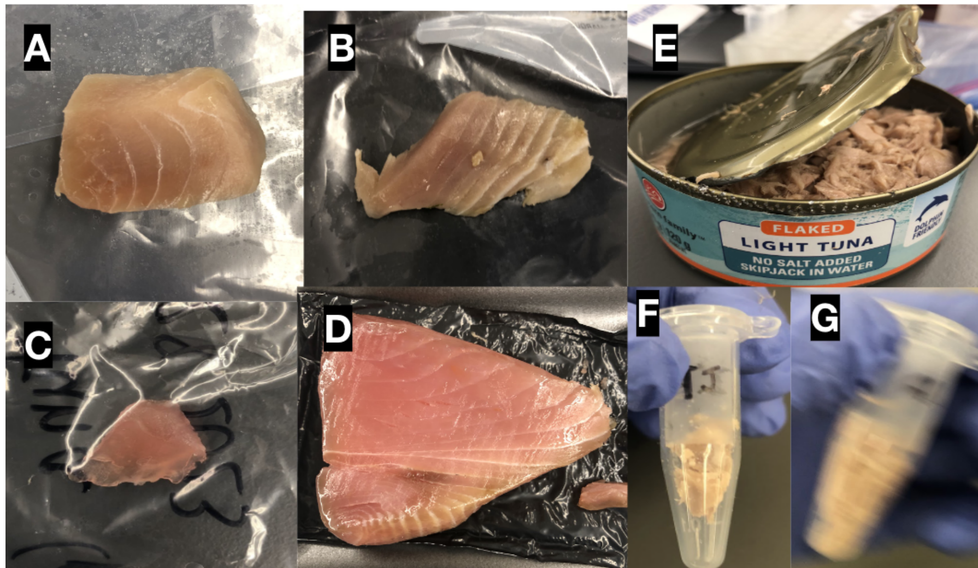


Figure 1. Tuna samples collected and tested for mislabelling. (A) Fresh “albacore.” (B) Fresh “Atlantic bluefin.” (C) Fresh “ahi.” (D) Fresh “Yellowfin.” (E-G) Canned “skipjack.”

DNA Isolation

All equipment and surfaces were sterilized with 70% ethanol prior to experimentation. Using a toothpick, a piece of tuna the size of a small pencil eraser was placed in a 1.5 mL Eppendorf tube and mashed as much as possible. Each tuna sample was sampled three times in order to generate three replicates per sample, for a total of 21 samples overall. Once sufficiently mashed, 300 µL of Cell Lysis Solution with Proteinase K was added to each tube. Using a water-filled dish on a hot plate, the samples were then incubated at 65°C for 15 minutes, with the tubes being removed and vortexed at high speed every 5 minutes until cloudy. They were then placed on ice for 5 minutes.

After cooling, 150 µL of Protein Precipitate Reagent was added to each sample, and the tubes were vortexed for 10 seconds at high speed. The tubes were then centrifuged at maximum speed for 10 minutes. The supernatant from each sample was transferred to a new 1.5 mL Eppendorf tube. 500 µL of ice cold isopropanol was added to the supernatant, and each tube was gently inverted 30-40 times. The samples were centrifuged again at maximum speed for 10 minutes after inversion.

Once centrifugation was complete, the isopropanol was poured out. 500 µL of ethanol was added to the resulting DNA pellet and poured off; this process was repeated once again. Once all the samples were rinsed, the tubes were placed on their sides with the caps open overnight to facilitate the evaporation of the ethanol.

Polymerase Chain Reaction (PCR)

DNA pellets were resuspended with 30 µL of TE buffer 24 hours after DNA isolation. A week later, PCR was prepared. A master mix was prepared following the order and volumes outlined in **Table 2**. Our PCR master mix formula was adapted from the formula described by Lee et al. (2022).

Table 2. PCR Master Mix formula (adapted from Lee et al., 2022).

Reagent	**Amount per sample**	**Amount for master mix (x21)**
Distilled H_2O	9.0 µL	189 µL
10X PCR Buffer	2.5 µL	52.5 µL
dNTPs (10 mM)	0.5 µL	10.5 µL
1 unit Taq polymerase	0.2 µL	4.2 µL
$MgCl_2$ (25 mM)	2.0 µL	4.2 µL
Bigeye (*T. obesus*) Forward Primer (50 µM)	0.7 µL	14.7 µL
Bigeye (*T. obesus*) Reverse Primer (50 µM)	0.7 µL	14.7 µL
Skipjack Forward Primer (50 µM)	0.6 µL	12.6 µL
Skipjack Reverse Primer (50 µM)	0.6 µL	12.6 µL
Atlantic bluefin Forward Primer (50 µM)	0.4 µL	8.4 µL
Atlantic bluefin Reverse Primer (50 µM)	0.4 µL	8.4 µL
Yellowfin Forward Primer (50 µM)	0.6 µL	12.6 µL
Yellowfin Reverse Primer (50 µM)	0.6 µL	12.6 µL
Albacore Forward Primer (50 µM)	0.3 µL	6.3 µL
Albacore Reverse Primer (50 µM)	0.3 µL	6.3 µL
50% Glycerol	5.0 µL	105 µL
Total	24 µL	504 µL

The DNA pellets were resuspended and 1 µL of each sample was added to a PCR tube. 24 µL of master mix was then added to each PCR tube. During the experiment, the volume of master mix made was insufficient to fill the last two samples; another batch of master mix was made using volumes intended for three samples to fill the remaining tubes. An additional PCR tube was filled with 25 µL of distilled H_2O as a control. All 22 tubes were placed in a thermocycler and run at (1) 95 °C for 5 minutes, (2) 95 °C for 30 seconds, (3) 62 °C for 30 seconds, (4) 72 °C for 30 seconds, and then (5) 72 °C for 5 minutes. Steps 2-4 of the PCR cycle were repeated 35 times.

Gel Electrophoresis

5 µL of 6X loading dye was added to each 5 µL PCR tube sample and mixed. Then, 10 µL of dyed sample was loaded in each well. Controls were loaded alongside the samples. In the first gel, both a 5 µL control and 10 µL control were loaded, while only a 10 µL control was loaded in the second gel. 6 µL of DNA ladder was added last. The gel was first run at 80 V for 10 minutes and then at 120 V for 60 minutes.

Analysis of Results

The results of gel electrophoresis were compared to the expected band patterns for each tuna species to identify mislabelled samples. Once completely analyzed, the total number of mislabelling incidences was determined.

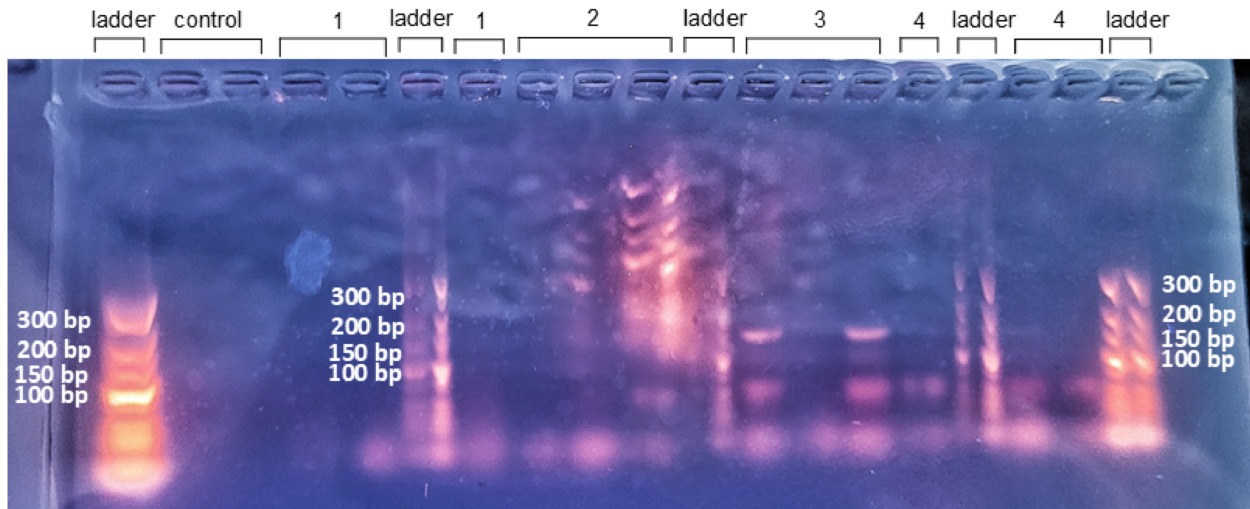
Results

Gel electrophoresis for the fresh samples (**Figure 2a**) where each sample was replicated in three columns. Sample 1, the restaurant sample labelled as albacore, produced a band in two columns; each band was below 100 base pairs (bp). Sample 2 was also a restaurant sample, labelled as Atlantic bluefin, and produced bands below 100 bp in all three columns, with two of the three columns producing significant smearing above 300 bp. The remaining two samples from the gel in **Figure 2a** were obtained from grocery stores. Sample 3, labelled as ahi tuna, produced bands far below 100 bp in all columns, and in two of the lanes each had an additional band slightly below 100 bp and another band between 150 and 200 bp. Sample 4, was labelled as Yellowfin, and produced two bands in each lane, both below 100 bp.

Canned samples (**Figure 2b**) were also each run in three columns per sample. Samples 5, 6, and 7 were all labelled as skipjack and obtained from grocery stores (see **Table 1**). Each column of sample 5 and sample 6 produced two bands below 100 base pairs: one slightly below 100 bp and another far

smaller. Columns of sample 7 produced a band far below 100 bp in all three columns, with one column yielding an additional band slightly below 100 bp.

a



b

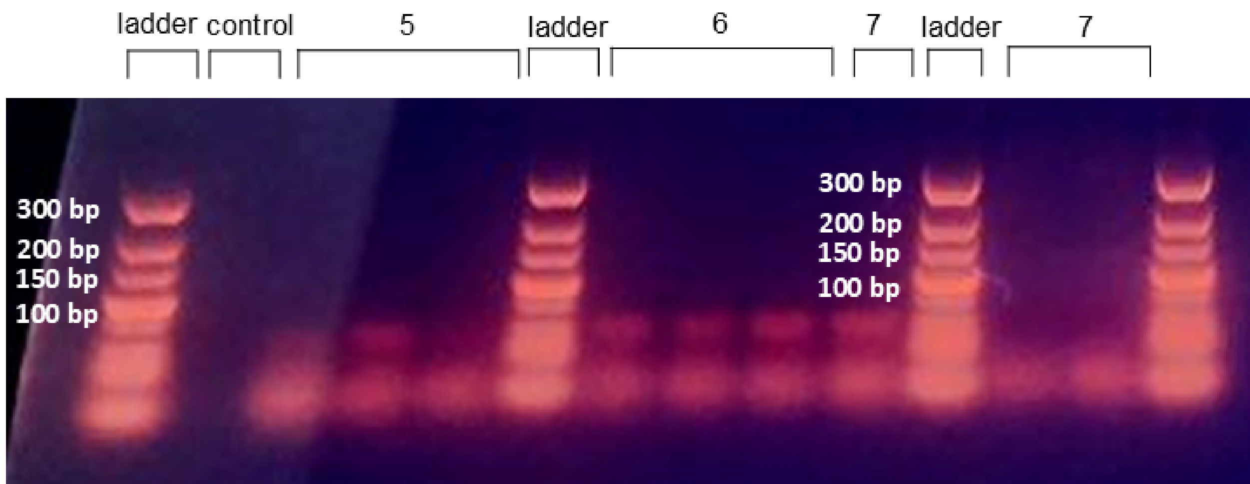


Figure 2. (a) Gel electrophoresis in gel #1 produced bands in columns for fresh samples: samples 1 (“albacore”), 2 (“bluefin”), 3 (“ahi”), and 4 (“yellowfin”). **(b)** Gel electrophoresis in gel #2 with bands in columns for canned samples: samples 5 (“skipjack”), 6 (“skipjack”), and 7 (“skipjack”).

Discussion

This observational study lacked a hypothesis and utilized a measurable factor, the prevalence of mislabelled tuna across all sources and product varieties. The factor was calculated as the ratio of mislabelled unique samples to the total number of unique samples tested. Tuna is notorious for having one of the highest rates of species substitution, with 41% of samples mislabelled nationally (Levin, 2018). However, we were unable to determine mislabelling prevalence due to inconclusive gel electrophoresis results for all samples tested.

Samples 1 and 2 were taken from two restaurants and respectively labelled as albacore and Atlantic bluefin. Correctly labelled albacore and Atlantic bluefin would show bands at 178 bp and 200 bp respectively (Lee et al., 2022). Samples 1 and 2 had bands below 100 bp, indicating primers. These bands might be due to issues with gel #1 on which the samples were run or indicate mislabelling, where the samples are not albacore or bluefin tuna, nor any of the other species we tested for. No bands in the ladder range are expected if mislabelling occurred, as the species would not match the tuna primers used. Sample 2 exhibited significant smearing, making identification of any other bands difficult.

Oceana Canada's nationwide investigation discovered that 52% of all fish samples from restaurants were mislabelled (Levin, 2018). Similarly, a study by Hu et al. (2018) found a higher mislabelling rate in restaurants (29%) compared to grocery stores (24%) in Metro Vancouver. These studies indicate that mislabelling in restaurants is a significant issue with multiple contributing factors. Consumer demand for certain species could be one factor behind mislabelling. Bluefin tuna is highly sought-after by consumers and is also the most expensive tuna species to purchase (Hu et al., 2018). As a result, restaurants may be incentivized to mislabel cheaper species as bluefin to reduce costs. Oceana Canada discovered multiple instances of yellowfin tuna being sold as bluefin tuna (Levin, 2018). Despite strict sales regulations in Canada, Japanese escolar is often misrepresented as albacore. This is concerning as escolar can pose significant health and environmental risks (Levin, 2018). However, it is less expensive for restaurants to purchase escolar than albacore, potentially leading to mislabelling practices (Elkin & Hudson, 2011).

Sample 3, labelled as ahi tuna from the grocery store, showed a band within the range of our gel ladder. However, it is challenging to determine where the band falls due to smearing in gel #1. Therefore, we cannot be certain whether it is correctly labelled or mislabelled. If labelled correctly, we would expect a band of 127 bp (Lee et al., 2018). Sample 4, labelled as Yellowfin from the grocery store, showed bands below 100 bp on gel #1, indicative of primers. As with samples 1-3, it is unclear whether this is due to issues with the gel or the species being mislabelled. Interestingly, Lee et al. (2018) observed that two Yellowfin-labelled samples amplified Atlantic bluefin in their multiplex PCR assay, despite bluefin being more costly. There were not enough PCR samples remaining to rerun samples 1-4 on a different gel.

Samples 5-7, canned skipjack from grocery stores, were analyzed on gel #2 with improved resolution and less smearing compared to gel #1. The expected band size for skipjack is 238 bp, but only primers below 100 bp were present in our results, potentially due to metals and preservatives affecting the gel. Lee et al. (2018) found 4 out of 5 canned skipjack samples mislabelled after pretreating samples overnight in water to remove any compounds. They also used the cetyltrimethylammonium bromide method for DNA extraction, which could have helped them detect results. Overnight soaking of Sample 7 still yielded inconclusive results, making it unclear if soaking all samples would have influenced our findings. Canned goods are usually subjected to more frequent testing, so it is unlikely that all of our canned samples are mislabelled.

Inconclusive results across all samples may also be due to human error in micropipetting and gel loading. Additionally, our small sample size (N=7) could have resulted in increased variability and standard error, affecting the validity of our findings. Previous studies, such as by Gordoa et al. (2017), have used larger sample sizes (N=375). Future studies could examine the prevalence of mislabelling using larger sample sizes and primers specific to commonly substituted species for each tuna sample.

Conclusion

From our seven different samples of tuna, six of the seven samples produced bands below 100 base pairs, indicating either the true sample species did not match the species of primers used or procedural errors failed to produce the expected gel band patterns. One of the seven samples, sample 3 labelled as ahi tuna from a grocery store, yielded a band pattern that may be consistent with its true species, however, given the smearing on the gel, we cannot determine conclusively if the sample is labelled correctly nor incorrectly. Thus, given these overall inconclusive results, further DNA barcoding of tuna is required. To increase the chance of conclusive results, sample size of tuna samples should be increased and more primers should be used. Specifically, primers for common substitutes of tuna, such as Japanese escolar, may yield more conclusive results. Further research into the prevalence of tuna mislabelling is critical to informing buyers in the Pacific Northwest, and wherever tuna is consumed.

Acknowledgements

We acknowledge that our research was conducted on the traditional, ancestral, and unceded territories of the xʷməθkʷəy̓əm (Musqueam) people; it is a privilege to work and learn on their native land. We would like to thank the University of British Columbia for the opportunity to conduct this work through BIOL 342. We would also like to thank Dr. Celeste Leander, Tessa Blanchard, and Jarnail Chandi for their support of our project. Dr. Leander provided lab time to work on our project, performed DNA resuspension, and helped with troubleshooting. Tessa Blanchard helped develop our methods and provided us with our PCR Master Mix formula. Jarnail Chandi prepared the reagents and equipment required for our study.

Literature Cited

Elkin, L. M., & Hudson, P. (2011, April 13). Here's why most restaurants lie about their tuna dishes. Business Insider. Retrieved March 17, 2023, from https://www.businessinsider.com/restaurants-tuna-2011-4.

Gordoa, A., Carreras, G., Sanz, N., and Viñas, J. (2017). Tuna species substitution in the Spanish commercial chain: A knock-on effect. *PLOS ONE*, 12(1).

Hu, Y., Huang, S. Y., Hanner, R., Levin, J., and Lu, X. (2018). Study of fish products in Metro Vancouver using DNA barcoding methods reveals fraudulent labeling. *Food Control*, 94:38–47.

Krčmář, P., Piskatá, Z., and Servusová, E. (2019). Identification of tuna species *Thunnus albacares* and *Katsuwonus pelamis* in canned products by real-time PCR method. *Acta Veterinaria Brno*, 88(3):323–328.

Lee, G.-Y., Suh, S.-M., Lee, Y.-M., and Kim, H.-Y. (2022). Multiplex PCR assay for simultaneous identification of five types of tuna (*Katsuwonus pelamis, Thunnus alalonga, T. albacares, T. obesus and T. thynnus*). *Foods*, 11(3):280.

Levin, J. (2018). *Seafood Fraud and Mislabelling Across Canada*. Oceana Canada. https://oceana.ca/wp-content/uploads/sites/24/seafood_fraud_and_mislabling_report_2018.pdf.

Lin, W.-F. and Hwang, D.-F. (2007). Application of PCR-RFLP analysis on species identification of canned tuna. *Food Control*, 18(9):1050–1057.

Mitchell, J. K. and Hellberg, R. S. (2016). Use of the mitochondrial control region as a potential dna mini-barcoding target for the identification of canned tuna species. *Food Analytical Methods*, 9(10):2711–2720.

NOAA Fisheries (n.d.). Marine Mammal Protection. *National Oceanic and Atmospheric Administration*. Retrieved April 15, 2023, from https://www.fisheries.noaa.gov/topic/marine-mammal-protection

Stawitz, C. C., Siple, M. C., Munsch, S. H., Lee, Q., and Derby, S. R. (2016). Financial and ecological implications of global seafood mislabeling. *Conservation Letters*, 10(6):681–689.

Willette, D. A., Simmonds, S. E., Cheng, S. H., Esteves, S., Kane, T. L., Nuetzel, H., Pilaud, N., Rachmawati, R., and Barber, P. H. (2017). Using DNA barcoding to track seafood mislabeling in Los Angeles restaurants. *Conservation Biology*, 31(5):1076–1085.

Wood, G. (2018, June 21). Offshore 'slipper skippers' and local monopolies target of new fishing industry study. *Richmond News*. Retrieved April 15, 2023, from https://www.richmond-news.com/local-news/offshore-slipper-skippers-and-local-monopolies-target-of-new-fishing-industry-study-3077965

Appendix

Appendix 1. Expected gel electrophoresis band sizes for tuna species used in PCR stage

Species	Band size (bp)
Albacore	178
Bluefin	200
Yellowfin (also known as Ahi)	127
Skipjack	238
Big eye	270

Appendix 2. Interview with MP Ken Hardie

We spoke with Mr. Ken Hardie, a Member of Parliament who is on the parliamentary Standing Committee on Fisheries & Oceans, to understand more about the complexities of seafood mislabelling from a government and political standpoint. The following is an edited and condensed version of our interview, which does not contain exact quotes from Mr. Hardie.

Q: What is the role of the House of Commons Standing Committee on Fisheries and Oceans and how does it contribute to the management of Canada's fisheries and oceans? Could you share some details on the kind of work that the Standing Committee on Fisheries and Oceans engages in and how it helps to safeguard the marine resources of Canada?

A: The Standing Committee's objective is to study issues related to fisheries on all three coasts, to make recommendations on what the government should do, and to produce reports. Reports are voted on by all members on the committee, including Liberal, Conservative, Bloc Québécois, and NDP representatives in a very collaborative process where the committee is entrusted in enacting all legislation.

The committee is also focused on identifying gaps on what should be done; right now the biggest gap is the state of the fishing industry in B.C. On the West Coast, earnings are significantly lower, and the amount of fishing boats from local communities have declined since quotas and licenses required to fish are mostly owned by "skipper slippers" [investors who buy these licenses and lease them out to local

fishers for a large cut (Wood, 2018)]. Most of the quotas needed to fish, about 70% of them, are owned by Jim Pattison Industries and the Canadian Fishing Company, which is also owned by Jim Pattison.

Q: Does the Standing Committee on Fisheries and Oceans undertake any research initiatives to support its work on fisheries and oceans? Do you collaborate with any other institutions? If yes, could you provide some examples?

A: There has previously been a "study on science" process by the committee, after a report claimed aquaculture on the West Coast had no impacts, which was not really true. As well, there is currently ongoing research on pinnipeds [commonly known as seals] that is studying how much these animals are consuming salmon. [Reducing seal populations is not really an option in Canada] because there is often public push back to reduce seal populations, so stakeholders and Indigenous communities do try nor want to reduce pinniped populations. [As well, in the U.S. reducing seal populations isn't really an option either because of] the U.S. Marine Mammal Protection Act [which generally prevents the 'take' (capturing, collecting, or killing) of marine mammals (NOAA Fisheries, n.d.)].

Q: Is the committee involved in developing legislation related to the accurate labelling of seafood products? What are some of the key challenges faced by the committee in this area? Could you elaborate on the legislative process for seafood labelling and the steps involved in enacting such regulations?

A: While the Fisheries committee doesn't write any legislation, it does review and influence it. Regarding seafood labelling, traceability in Canada certainly isn't as robust as in Europe, where they have "hook-to-plate" tracing. In Canada, tracing only requires reporting where a fish came from one step before, for example retailers just have to trace one step backwards. So if a fish is caught in Vietnam, but comes to a Canadian processor, then it could be labelled as a Canadian fish, even though it is not. As well, overall there aren't solid standards on what constitutes a fish species, the terms are too broad. However, the DFO (Department of Fisheries and Oceans) does have a desire to develop a "boat to plate" system in Canada by the end of 2023.

Q: Can you speak to the issue of tuna mislabelling in Canada and what measures are being taken to address this problem? Incentive to mislabel them?

A: [I am not able to specifically] address tuna labelling, but Sonia Strobel runs a community fisher called Skipper Otto, and she might be able to speak more to honest and ethical fisheries.

Q: We understand that Japanese escolar, a species that is often mislabelled as tuna, is not completely banned in Canada despite being prohibited in other countries. Could you explain the reasons behind this decision?

A:The Canadian Food Inspection Agency (CFIA) may be responsible for banning, or not banning, of species. They check if food is safe, but not so much if the labelling is accurate, so there is a gap here. CFIA should broaden its mandate, or some other group may need to step in to address mislabelling.

Q: From your perspective, why is it crucial to ensure proper labelling of seafood products? How do issues related to seafood labelling impact the environment and human health, and what role does the committee play in addressing these concerns, specifically Indigenous perspectives and unique problems faced by those communities?

A: In Indigenous communities, food is important for social and ceremonial reasons. Unethical fishing is a problem because it cheats consumers and damages domestic fisheries. On a global level, international affairs are more complicated, but for an Indo-Pacific strategy we want to apply Canadian standards and requirements to people we do business with overseas, which would be good for the domestic industry and consumers. We also want to bring back a 2018/2019 study that provided recommendations to the DFO, and see what they have done based on these recommendations.

Appendix 3. Interview with SeaChoice Canada

We spoke with Christina Callegari, sustainable seafood coordinator for the Ecology Action Centre and SeaChoice team member, to learn more about the contributions being made by non-profits to combat mislabelling. The following is an edited and condensed version of our interview, which does not contain exact quotes from Ms. Callegari.

Q: In your opinion, what are some of the main drivers behind tuna mislabelling, and how can they be addressed?

A: Economic reasons can drive mislabelling. While canned tuna does not hold super high value, tuna steaks do; retailers may be motivated to pass off a cheaper fish as a more expensive tuna steak. Sometimes, it can just be a mistake, especially over the counter for fresh products. It's hard to identify how much traceability and quality control is going on with products, and fish are often traded back and forth, from catching to processing all the way to the sale of fish. Lack of traceability is really the biggest issue, but some headway has been made. For canned products, one large tuna, which is correct at the dock, is turned into many small products as it is sent out to multiple processors. This can lead to ambiguity in packaging. Mislabelling causes headaches for people along the supply chain and in quality control.

Q: What kind of collaborations or partnerships does Seachoice Canada have with other organizations or stakeholders in the seafood industry to address the issue of tuna mislabelling?

A: SeaChoice is made up of a partnership of three different NGOs. We mainly focus on regulatory and policy work but also do DNA testing in partnership with labs like Lifescanner. We've also worked with people in the United States (US) and Europe. The conservation line is a good space for collectively moving as a movement against seafood mislabelling. In government relations, we make sure that staffers and MPs are aware of this work. Academia can be helpful as well; research helps provide evidence of mislabelling. Consumers are also important collaborators, helping with petitions. We have a platform called Seafood Progress, where we score brands on their seafood commitment. Consumers can send emails to brands sharing what changes they'd like to see.

Q: Can you speak to the role of consumer awareness and education in reducing the prevalence of tuna mislabelling?

A: SeaChoice used to be very consumer focused; we would do green-yellow-red mislabelling ratings of companies and host outreach events. While these are still very important, we've expanded to focus more on legislation and traceability. The David Suzuki Foundation, one of the NGOs that make up SeaChoice, has noted that seafood traceability campaigns get the most engagement. It's evidence that people care about seafood fraud and traceability.

There are a few ways consumers can work to protect themselves from mislabelled seafood. If a product label includes more than just the common name, such as the scientific name or information QR code, the suppliers have likely gone to a greater effort to prevent mislabelling. Talking to retailers is also helpful; if they can provide more information on the product, consumers can feel more confident that it has been properly labelled. One source of confusion that may arise is the place of origin. Currently, the listed place of origin is actually the place where the product underwent its last major transformation. Even if processing is performed by a Canadian company, not all of the seafood products are locally sourced.

Q: Are there any future plans or initiatives that SeaChoice Canada has in the works to further address tuna mislabelling or promote sustainable seafood consumption?

A: We are interested in testing shelf staples, looking at mislabelling and the presence of hidden species in canned tuna. We previously didn't have the technology for it, but now we do. Advocacy and research are important. We are constantly talking to the CFIA and DFO about traceability. There is a political will to take action on mislabelling. The CFIA is doing their own mislabelling tests, but I don't know if they have tested tuna. In terms of protecting the consumer, there isn't so much that we can do. We frequently collaborate with Oceana Canada. We also sign on to letters to the government with other organizations and companies interested in traceability. A lot of work goes into building relationships with MPs too. However, more government involvement is needed.

Q: The Canadian identification system for seafood does not fully track seafood origins from 'hook to plate' (whereas Europe does track to this level). What obstacles prevent us from increasing the traceability of seafood?

A: SeaChoice has been working on this for a long time. The main drivers are cost and resources. Traceability takes a lot of money and resources in the sense that people are needed to collect information and systems need to be put in place to house the information collected. We have come a long way in terms of how many technology providers there are.

There is currently a global dialogue on seafood traceability, with lots of people working on the issue. The European Union (EU) has set up more of a gold standard, and the US has also been doing a ton of work on this. They have a new Food and Drug Administration (FDA) traceability rule that came out this year. Japan also has new Illegal, Unreported and Unregulated (IUU) fishing import regulations. Traceability is moving forward, but the barrier of cost is a major obstacle.

I've also heard colleagues say that traceability is not an individual effort. It can't just be one business— it involves the entire supply chain. The collaboration and teamwork required to pull off a full chain traceability system, whether voluntary or regulatory, is immense. You need people to be involved. That's the key issue in trying to get that system to come along. Seafood is globally sourced, and such a large scale of organization is difficult to accomplish.

It's easier to implement traceability measures for some seafood products compared to others. Farmed shellfish already have good traceability due to safety regulations (e.g., must have the farm harvest date). On the other hand, lobster is harder. As a high value industry, tons of product is moved constantly, which makes it hard to slow processes down and record things. Tuna and larger fish also pose a problem, as they get broken down rather than moving as one whole fish from start to finish. The sheer amount of times a product may get moved around and processed makes traceability difficult.

There are also differences in aquaculture compared to wild products. Aquaculture can be traced back to specific farms, whereas with wild products, we're deciding where to track it from (e.g., ocean, landing dock, etc.). The US is approaching traceability by identifying which species are at the greatest risk of mislabelling and going from there. The EU focuses on all species from a labelling perspective. This creates some different challenges: if you only have a few species involved, there is more of an incentive to mislabel, as you don't have to comply with more rules, causing more mislabelling in some cases.

Overall, cost and collaboration are the two biggest challenges when it comes to implementing traceability. Traceability can also be difficult if the technology is not up to speed; exchanging physical paper can make products tough to trace.

Q: Are there any incentives currently in place to prevent mislabelling?

A: Being untruthful with your labelling is considered illegal, but in practice it can depend on interpretation. For example, herring being called sardines may be considered mislabelling by some, but it's debatable because "sardine" can be a general term for a small fish. In Canada, we have a fish list that acts as a guidance. Technically, if you mislabel a fish, they will look into it if they get notice. They will contact the seller and try to resolve the issue, but strictly on the labelling front. The penalties are not huge in Canada. In the United States, the penalties are more severe; the same penalty may cost ~$50k in the US compared to ~$5k in Canada.

Enforcement can influence the uptake and seriousness of these regulations and rules. I've heard anecdotally from colleagues in Europe that there has been some difficulty enforcing things. On the labelling front, we're looking at point of sale, so grocery stores and restaurants; they're a bit iffy because they're more provincially managed. Direct fishers are usually not getting in trouble because they are not selling directly to consumers. Maybe a processor, but it's mostly retail.