The ‘More-than-Food’ Geographies of Omega-3s

by Danielle Browne ©

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Department of Geography

Memorial University of Newfoundland

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Abstract

Omega-3s are known and understood scientifically from the perspective of a biochemist. From this perspective, it is a polyunsaturated fatty acid, also known as a PUFA. Several well-known benefits are associated with this macronutrient, including heart health, brain health, and early childhood development. However, omega-3s can also be fruitfully considered what Aya Hirata Kimura would call a "charismatic nutrient." Approaching omega-3s as a charismatic nutrient allows me to reveal controversies and the socio-political networks associated with this important macronutrient.

This research aims to examine omega-3s as a charismatic nutrient by focusing on the sociopolitical networks that support this macronutrient. The research is also framed through recent approaches to the geography of food and nutrition. The thesis is organized into 2 chapters. In chapter 2 the focus is on two controversies associated with omega-3s, namely reports on the declining levels of omega-3s in farmed salmon, and reports that farmed salmon also contain toxic chemicals such as methylmercury. The approach in this chapter is controversy mapping, a methodology that allows researchers to bring controversies 'down to earth'. Key findings include the way a single scientific fact is used by different actor networks, the source of knowledge on farmed salmon nutrition, and the actors that are absent from these networks. While controversy mapping is a key method for brining utterances back down to earth, care must be taken in interpreting some of the results of the analysis.

Chapter 3 considers another problem associated with omega-3s, but in this case global deficiencies in this important macronutrient. I examine two proposed solutions to this problem and critically assess them through more-than-food approaches to food geography. The proposed solutions involve shifting land-sea sources of food (*Omega-3 World*) and improving the efficiency of omega-3 systems (*Systems World*). Using the more-than-food approaches allows me to critically assess these proposals by revealing what I call the *Real World* of omega-3s. In this real world of omega-3s the problem of global deficiencies is unlikely to be solved.

Key Words: omega-3, more-than-food, controversy mapping, food geography

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The Omega-3. A part of the class of polyunsaturated fatty acids, also known as PUFAs, with a carbonyl group on one end and a methyl group on the other. Omega-3 fatty acids (or more commonly known as omega-3(s)) have a double bond located on every third carbon from the methyl end of the chain. The presence of a double bond can make the difference of an omega-3 being distinguished as saturated or unsaturated. There are "three major omega-3 fatty acids in human diets the 18-carbon chain alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA)" as shown below in Figure 1 (Innis, 2014; 82). Omega-6 fatty acids on the other hand, "comprises a second series of essentially fatty acids for which the major dietary fatty acid is Linoleic Acid (LA) and their inseparable links" (Innis, 2014; 82).

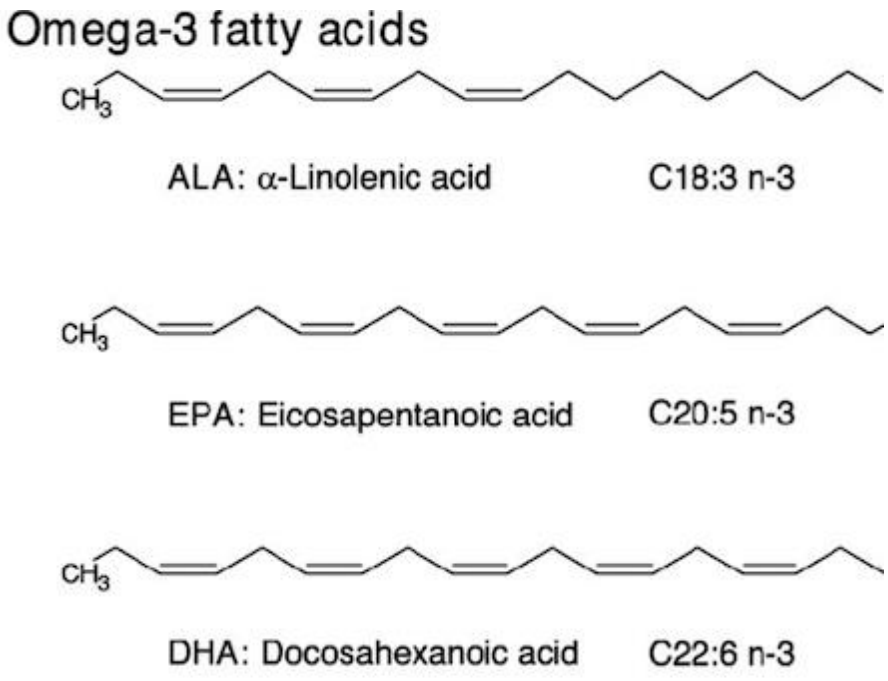

Figure 1: Various Polyunsaturated Fatty Acids (PUFAs)

"The omega-3 fatty acids are essential nutrients throughout the animal kingdom explained by the enzymatic inability to insert a double bond at the Δ-15 position of an 18-carbon chain fatty acid"

(Innis, 2014, 82). Crucially, this means that the human body is unable to make its own PUFAs, a key concern given that omega-3s are essential fatty acids for the body. Omega-3s must therefore be obtained from the diet to maintain practical levels of these fatty acids. There are several foods that contain omega-3s including canola and soybean oils, most commonly, fish and fish oils, and omega-3 supplements.

Research on omega-3s intensified during the 1970s and early 1980s. This was partly in response to research showing that not all fats led to chronic health problems, often associated with Western diets. Greenland Inuit and Japanese populations, for example, who consume significant amounts of fat through fish and meat, did not suffer from the chronic health problems affecting Western consumers. This important finding changed the approach and understanding of the role of fats in human diets. Indeed, it led to an understanding of the important role of omega-3 fatty acids in heart health, brain health and early childhood development (Hjalmarsdottir, 2018; Jeromson et al., 2015; Dusheck, 1985; Roy and LeGuennec, 2017). The discovery that omega-3s can positively impact human health and has continued to the present day, including during the current global pandemic. In the context of COVID-19, omega-3s are being recommended for the role they play in providing a 'health halo' for consumers (Daniells, 2020; 1). Omega-3s are thus widely considered to be a solution to a range of health problems. Yet there is more to omega-3s than simply their nutritional benefits.

Omega-3s can be considered something Aya Hirata Kimura has called a “charismatic nutrient”. Charismatic nutrients can "command center stage in international food and nutritional politics when their suboptimal intake defines the nature of the food problem in developing countries" (Kimura, 2013; 19). In other words, nutrients have become the focus of debate and discussion during particular periods of time and for particular populations. Kimura goes on to say, "the

charisma of nutrients cannot be fully captured by their "scientific" values, but rather, depends on sociopolitical networks around them" (Kimura, 2013; 19). Kimura's argument is that although we need to recognize the physiological impact of micronutrients, we also need to consider the public and development experts and the sociopolitical networks that surround nutrients like omega-3s.

This thesis examines omega-3s as a charismatic nutrient through two separate and interconnected chapters. In Chapter 2 I focus on the problem of declining levels of omega-3s in human diets and specifically the controversy around declining levels of omega-3s that have been seen in farmed salmon, which is widely considered to be a key source of omega-3s. The problem of declining levels of omega-3s in salmon is compounded by the issue of other things that may reside in salmon flesh. In particular, I focus on the problem that farmed salmon may also contain toxic chemicals such as methylmercury, leaving consumers with more than what they bargained for. These considerations generate significant controversies and leave consumers confused about the foods they are consuming, therefore shaping consumer anxieties and behaviours. In order to analyse this problem, I use controversy mapping, a methodological approach that helps researchers make sense of controversies, including those associated with omega-3s. While there are different ways of conducting a controversy map, for this chapter I draw on Lepawsky et al.'s (2019) proposed approach. Their method behind controversy mapping is to "analyze debates including, but not limited to, those involving public concern around science, technology and society (STS)" (Lepawsky et al., 2019; 441). With a controversy map, I contribute to analyzing these controversies by "bring[ing] the utterance[s] back down to earth" (Lepawsky et al., 2019; 441). This allows me (and other researchers) to identify "statements, spoken words, and claims to become understood as being connected to people, places and networks of knowledge

exchange" rather than being 'up in the air'" (Lepawsky et al., 2019; 441). To begin to map a controversy, you start by finding what Lepawsky et al. call a floating statement. A floating statement is "any utterance (ex: verbal, textual, visual, audio, etc.) that claims factual knowledge" (Lepawsky et al., 2019, 440). For the purposes of Chapter 2 and for the controversy map, the floating statement I identify is: "salmon contains nutrients for overall health and wellness such as omega-3 fatty acids…increased consumption of [farmed salmon] provides excellent nutrition for a healthy lifestyle" (Salmon de Chile, 2021; GSI_ Salmon, 2022; Mowi, 2022). Once the floating statement is identified, the method of controversy mapping involves finding debates, identifying actors and networks, and specifying locations and timelines associated with the controversy. Controversy mapping is not designed to provide 'anxious consumers' with the knowledge they need to make the right decisions about food consumption choices. Instead, its value lies in providing a clear understanding of the actors in controversies, the networks that they build to make claims, and the locations from which these claims originate. This is how controversy mapping brings controversies 'down to earth'.

In Chapter 3, I focus on a different problem associated with omega-3s. I do so through a chapter entitled "More than food geographies of omega-3s." The specific problem I explore involves widely reported uneven distribution of omega-3s globally: as Hamilton et al. (2020) found, "the unequal geographical distribution of omega-3s has led to omega-3 deficiencies worldwide and affects populations in North America, the Middle East, India, etc." (Hamilton et al., 2020; 59). The problem of uneven distribution of omega-3s and omega-3 deficiencies is due to distributional issues, but it is also due to the nature of our food production system. As Greenberg has argued it is the "the imbalance of omega-6s and omega-3s in the typical Western diet - often associated with highly processed foods - leads to consumers' health problems" (Greenberg, 2017;

14). In other words, our food system is focused more on foods that are high in omega-6s, at the expense of food that is high in levels of omega-3s. The result is the widely reported and discussed health problems associated with Western diets. In addition to these problems, some of the foods we eat that do contain omega-3s, such as farmed salmon, are showing lower levels of omega-3s (Norwegian Seafood Council, 2016; Ghosh, 2016). Overall, then, there are several inter-related factors that mean that our access to omega-3s in the food system is declining, which is a concern given what we know about how these nutrients are important for human health.

In response to these problems with omega-3s, scholars and food experts are providing potential solutions articulated at the global scale. Paul Greenberg, the well-known food advocate and popular writer, has suggested that we need to find a better balance between omega-3s and omega-6s, and that this should involve a stronger focus on the Mediterranean Diet, combined with a stronger emphasis on food from the ocean. He presents these arguments through his widely read book, *The Omega Principle*. For the purposes of this third chapter, I call Greenberg's proposal the *Omega-3 World*. Helen Hamilton et al. (2020) provide a different solution, but also articulated at the global scale. Their focus is on improving the efficiency of the systems through which omega-3s are produced and distributed. Given their emphasis on systems and efficiency, I call this proposal the *Systems World* for omega-3s. These different proposals for improving the distribution of omega-3s represent prominent solutions to problem of omega-3 access and deficiency.

In Chapter 3 I raise critical questions about the two proposed solutions to the problems with omega-3s. I do a critical engagement with the "more-than-food" approach to food geographies (Goodman, 2016). Goodman's recent engagement with the more-than-food approach provides a useful set of methodological prompts for mapping what we might call the *Real World* of omega-

3s. In engaging with the literature on more-than-food, Goodman (2016) asks three critical questions about the field, which allow me to build what I am calling the *Real World* of omega-3s.

Goodman's three questions are as follows. First, he asks what is the "role of powerful actors on the global foodscape that have a socioeconomic stake in manipulating our visceral reactions to food?" (Goodman, 2016; 261). In examining the role of powerful agents in the foodscape of omega-3s, I focus on two organizations: The Global Organization for EPA and DHA Omega-3s (GOED), who "encourage new product development for food categories that contain omega-3s across several regions of the world" (GOED, 2022, A) and Cooke Aquaculture, one of the largest producers of farmed salmon in Canada, and a company that supplies farmed salmon to markets both in Canada and the United States (Cooke Seafood, 2022).

The second question Goodman asks in relation to the literature on more-than-food geographies involves other agents along the food chain. To this end, he is concerned with other bodies, beyond the consumer, along the food chain, such as those "who labour over, stack, and prepare our food" (Goodman, 2016; 261). Goodman suggests that we should acknowledge other bodies other than our own and what this could mean. I consider two examples of worker and salmon bodies to bring forward in elaborating on this question. In the first example, I discuss the events surrounding a video released on a processing facility owned by Cooke Aquaculture. In the second example, the discussion shifts to Chile, where I explore salmon workers' labour conditions in that region.

Goodman's third question of more-than-food geographies is about food shortages and the stress faced by households in securing sufficient healthy food. He asks: does the more-than-food

approach address the “violence of hunger and deprivation and lower-level stress caused by the inability to buy the 'right' kind of 'good' food for one's family” (Goodman, 2016; 261). In this question addressed to scholarship on more-than-food, Goodman points to areas of potential hunger and deprivation and what impact this has on other parts of the chain and consumers. In response to this question, I examine two sites where nutritious fish are extracted for fish feed and then fed to farmed salmon. The sites are the coast of Peru, the site of the largest source of pelagic fish for fish feed, and the coast of West Africa, an emerging site for fish feed production. The sites provide a way of answering Goodman's concern with visceral approaches; it shows people who are unable to buy the right food for their family and the stress that comes with food insecurity.

While these questions and concerns are directed at 'more-than-food' approaches, as I hope to demonstrate in Chapter 3, they are equally relevant to my goal to map the *Real World* of omega-3s. Crucially, they provide a way of critically assessing existing options for addressing deficiencies in omega-3s – including Greenberg’s *Omega-3 World* and Hamilton et al’s *Systems World*. And the questions provide a way of mapping what I call the *Real World* of omega-3s.

Chapter 4 presents the conclusions to the thesis. I draw together the key themes in the two empirical chapters, and I outline the contribution that the thesis aims to make to debates on charismatic nutrients, critical assessments of more-than-food geographies and the future of omega-3s.

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Chapter 2: Controversy Mapping Omega-3s

2.1 Introduction

Changes in food production over the last 30 to 40 years have had a significant impact on human health. This is especially true in Western countries where food – and especially processed and fast food – often contains high levels of fat and sugars. There is strong evidence to suggest that these foods have led to significant increases in health problems such as cardiovascular disease, chronic inflammation, and type 2 diabetes (Jeromson et al., 2015). In the late 1970s and early 1980s, however, researchers discovered that not all fats led to the chronic health problems associated within Western diets. Greenland Inuit and Japanese populations, who consume significant amounts of fat through fish and meat, did not suffer from the chronic health problems affecting Western consumers. The explanation for these differences in health outcomes was, nutritionists discovered, associated with high levels of omega-3 fatty acids in the consumption of seal and fish in these populations. This important finding changed the approach and understanding of the role of fats in human diets. Indeed, it led to an understanding of the important role of omega-3 fatty acids in heart health, brain health and early childhood development (Hjalmarsdottir, 2018; Jeromson et al., 2015; Dusheck, 1985; Roy and LeGuennec, 2017).

The discovery that omega-3s can have a positive impact on human health has continued to the present day, including during the current global pandemic. Based on research from patients affected by COVID-19, Arash Asher et al (2021: 1) recently argued that “omega-3 fatty acids have anti-inflammatory properties that may help reduce morbidity and mortality from COVID-19 infections”. A pilot study by William Harris found that “patients with the most omega-3s in

their system were 75% less likely to die from COVID-19" (Schultz, 2021; 1). In the context of a global pandemic, omega-3s are being recommended for the role they play in providing a 'health halo' for consumers (Daniells, 2020; 1).

Although omega-3s are widely considered to be a solution to a range of health problems, controversy remains. For example, declining levels of omega-3s have been seen in farmed salmon, a fish widely considered to be a key source of this important fatty acid. At the same time, there are concerns that while farmed salmon may contain omega-3s, they may also contain toxic chemicals such as methylmercury, leaving consumers with more than what they bargained for. This leaves consumers confused about whether the foods they are consuming (like farmed salmon) contain sufficient omega-3s, and whether by eating farmed fish they are consuming other harmful toxins. Peter Jackson, the well-known food geographer, describes these dilemmas as one where consumer attitudes to food are being shaped by the broader 'age of anxiety' within which we live (Jackson, 2015: 147). Based on interviews with consumers of chicken and sugar he finds that they are "worried about food safety and the risks that industrialized food poses for their own health and that of their families and friends" (Jackson, 2015: 161). Omega-3s and the promise they present to consumers alongside the potential risks they pose, is a clear example of what Jackson calls the 'anxious appetite' when it comes to food.

It is worth considering consumer anxiety over omega-3s in more detail. A first concern is that it is not clear to consumers that the foods typically associated with omega-3s – such as salmon – contain sufficient amounts of omega-3s to influence human health. Consumers are also presented with confusing messages over whether there are more omega-3s in farmed versus wild salmon

(Mansfield, 2011). A second important concern facing consumers involves the potential risks with salmon, described by some as the 'world's most toxic fish' (Mercola, 2022). As I noted earlier, these claims around toxicity deem salmon to be risky for consumer consumption. Consumer anxieties around salmon and omega-3s are leading to a shift where consumers are seeking alternative sources of this important fatty acid through pill type supplementations or through vegetarian sources of omega-3s including flax seeds. One of the challenges for anxious consumers is coming to terms with the wide range of experts, sources of knowledge, and promotional materials that they are presented with when it comes to omega-3s. While the case of omega-3s suggests that it fits well into the frame of what Jackson calls the 'anxious appetite' (Jackson, 2015), his approach does not provide a way of making sense of the controversy around specific commodities like omega-3s.

Controversy mapping is a promising method that helps researchers make sense of controversies such as those associated with omega-3s. Controversy mapping allows researchers to explore the processes that lead to a spoken word, statement, or claim and what evidence is behind or can be provided through such statement(s). With a controversy map, researchers are able to do "bring the utterance back down to earth" (Lepawsky et al, 2019; 441). In other words, it allows statements, spoken words, and claims to be understood as connected to people, places and networks of knowledge exchange rather than being 'up in the air' and without attribution. While controversy mapping provides important insight into controversies, it does not provide an answer or solution to 'anxious consumers' when it comes to food choices. In other words, it does not tell us what we should do with our electronic waste (e.g., Lepawsky et al., 2019) or where to find the best source of omega-3 fatty acids. Rather, it provides a clearer understanding of the actors in

controversies and the networks that they build to make claims. The aim of this chapter is to undertake a controversy mapping analysis of omega-3s and farmed salmon.

The remainder of the chapter is organized as follows. The first section will present a detailed description of controversy mapping as a method and it will discuss examples where controversy mapping has been used. In the second section I will present the results of my analysis on mapping the omega-3 controversy. This will involve examining two key controversies and 'bringing them down to earth' using the techniques and methods associated with controversy mapping. The third and final section will then examine implications of these findings specifically for omega-3s and more generally for the practice of controversy mapping.

2.2 Mapping Controversies: Methodological Considerations

The word 'controversy' refers to "disputes, discussions, or disagreements around particular issues" (Munk, 2015; 74). Controversies involve "articulating different positions around a particular topic" (Munk, 2015; 74). Controversy *mapping*, as Lepawsky et al. argue, helps to gain new insights into the controversy: "like a conventional map describing the terrain… a controversy map helps navigate the messy terrain of unsettled and competing knowledge claims" (Lepawsky et al., 2019; 438). The method behind controversy mapping is to "analyze debates including but not limited to those involving issues of public concern around science, technology and society (STS)". Lepawsky et al. continue to explain that, "although controversy mapping was initially put to use to reach consensus amongst scientists and engineers, controversy mapping has since then been taken up by geographers and other social scientists as a way of gaining a better understanding of the nature of controversies" (Lepawsky et al., 2019; 438).

Public controversies have become more complex and challenging to understand given the concern about bias, especially with the Internet and the rise of social media platforms. As Noortje Marres explains, “digital media technologies are ubiquitous, but there continues to be widespread concerns about the “bias” of online information and knowledge” (Marres, 2015; 656). Marres also points to the problem of search engines, which are not objective views of what is on the internet: “search engines have been criticized for introducing bias into online environments, most notably via their selection and ranking algorithms. These tend to favour popular, fresh, and institutionally accredited sources” (Marres, 2015, 656; also see Introna and Nissenbaum, 2000; Gillespie, 2013). This leaves numerous consumers of online media with information that tends to confirm particular biases rather than balance them. Consider anti-vaccinators as an example. We tend to see the spread of dubious claims via social media about the dangers associated with vaccinations, including the widely circulated claim that vaccines develop a higher risk of autism. Despite the fact that such claims are challenged by the Center for Disease Control and Prevention (CDC) and U.S. Food and Drug Administration (FDA), anti-vaccinators remain powerful purveyors of particular views on vaccination - including for COVID-19. Internet critics like Evgenvy Morozov claim that it is “time to build proactive measures into Internet infrastructures, most notably by having search engines identify and label suspect sources as ‘compromised’” (Morozov cited in Marres, 2015). Until new systems are put into place to manage how information comes to consumers of media, however, the problem of bias in knowledge will remain. Controversy mapping can play a role in helping to gain an understanding because it brings the controversy ‘down to earth’ by revealing the actors, places and networks that are responsible for circulating ideas about controversies.

There are several different tools and techniques that are available to researchers interested in building or drawing a controversy map. Lepawsky et al. have recently provided a 'how to' guide of "specific approaches and free scholarly software that researchers without specialized coding skills can use to achieve their own controversy mapping goals" (Lepawsky et al., 2019; 437). To provide a summary of the different steps involved in a controversy map, I have listed each step and the associated techniques below drawing from Lepawsky et al (2019) (Table 1).

Table 1: Breakdown of Each Step to Organize A Controversy Map by Lepawsky et al., 2019

Step	Description	Techniques
1. Floating Statement	Any utterance (ex: verbal, textual, visual, audio, etc.) that makes a claim to factual knowledge	• Can consider one's own interest in a given issue or consult one's own newsfeed • Solicit suggestions from others who are part of a public interested in an issue
2. Statement → Debate(s)	Framing statements situated in the arguments and counterarguments of which it is part based off the search	• Using the "Wild Web" to signal platforms where public controversies play out (ex: search results, social media, etc.) • "Scholarly Web": online databases specifically designed to facilitate academic scientific and technical research (ex: Scopus, Web of Science, etc.)
3. Debate(s) → Actor(s)	Attributing positions and counter-positions, and depicting relationships relevant to a given controversy to the specific actors who utter them	Wild Web - Voyant - DebateGraph - Sciencescape Scholarly Web - Online database such as Scopus
4. Actor(s) → Network(s)	Networks involved with web linkages among one another	Wild Web - Hyphe

		Scholarly Web - Online database such as Scopus
5. Network(s) → Location(s)	Comparing and contrasting the location(s) of the actors of the controversy at hand	Wild Web - Hyphe - GeoIP Scholarly Web - Online database such as Scopus
6. Location(s) → Timeline(s)	How the relevant debates have changed overtime and are continuing	Wild Web - In search engine website Scholarly Web - Online database such as Scopus

The **first** step in controversy mapping, Lepawsky et al. suggest, is to start with what Bruno Latour called a *floating statement*. A floating statement is one where a claim is made about a process or event in the world. Beginning with a floating statement can help to "disentangle the researcher from the search" (Lepawsky et al., 2019; 440). In other words, with the use of a floating statement the researcher is better able to understand the controversies in that field. To make this first step more clear, Lepawsky et al (2019) consider the example of the issues involved in the transboundary movements of electric waste (e-waste). The floating statement that Lepawsky et al identified was: "E-waste is exported largely for the same reason manufacturing jobs have been sent overseas: lower labor costs and fewer regulatory burdens" (2019; 440). They note that the statement is not attributed to any individual or organization but instead is presented as a fact about the flows of electronic waste. To begin the process of controversy mapping involves building a body of knowledge around the controversy through a series of search statements. In Lepawsky et al's (2019) case they use a number of search terms in Internet search engines related to electronic waste and labour and jobs (Figure 1).

Table 1 Search criterion used to generate a trans-boundary e-waste controversy corpus

Search criteria base	Floating statement key term
"e-waste" OR "electronic waste"	AND "export"
"e-waste" OR "electronic waste"	AND "labor"
"e-waste" OR "electronic waste"	AND "labour"
"e-waste" OR "electronic waste"	AND "labor cost"
"e-waste" OR "electronic waste"	AND "labour cost"
"e-waste" OR "electronic waste"	AND "regulatory"
"e-waste" OR "electronic waste"	AND "regulation"
"e-waste" OR "electronic waste"	AND "overseas"
"e-waste" OR "electronic waste"	AND "manufacturing"
"e-waste" OR "electronic waste"	AND "jobs"
"e-waste" OR "electronic waste"	AND "manufacturing jobs"

Figure 2: Key terms to navigate through e-waste floating statement (Lepawsky et al., 2019)

From here, such framed statements can be situated with particular arguments and counterarguments which are part of the search. We can call these the "debates of that field" (Lepawsky et al., 2019; 440).

The **second** step in controversy mapping involves moving from statements to debates while the **third** step is tracing debates to actors, which involves identifying the sources of statements and the discovery of positions and counter-positions relevant to a given controversy (Table 1). With the use of open-access software such as Voyant, DebateGraph, and ScienceScape, it is possible to gain a better understanding of the controversy and to "depict relationships between actors and their positions, along with who is arguing about what issues and who is in alliance with whom" (Lepawsky et al., 2019; 443). Not all internet searches are the same. For example, searching Google Scholar or Scopus will lead to different results and a potentially different controversy map than searching through search engines such as Google or Bing. One way of differentiating between Internet searches is to distinguish between what Lepawsky et al (2019) call the 'wild web' and the 'scholarly Web'. While the wild web searches the Internet directly through Google

or other search engines, the scholarly web will involve searches for academic sources only. As they write, “research into public controversies needs to approach the wild Web and the scholarly Web using different tools but with the common goal… to identify points of contention relevant to the controversy at hand” (Lepawsky et al., 2019; 441). This helps to “signal the many opinions that comprise the online platforms and compose of online databases specifically designed for academic scientific and technical research, respectively” (Lepawsky et al., 2019; 441). With the case of e-waste, “does the scholarly literature on transboundary e-waste indeed emphasize a reversal of the well-known waste hierarchy (ex: reduce, reuse, recycle)?” (Lepawsky et al., 2019; 443). This leads to the **fourth** step in controversy mapping, which is to trace the networks involved with web linkages among one another using software such as Hyphe. When using Hyphe in the example of e-waste, Lepawsky et al. found two networks, “one belonging to an environmental NGO, and one belonging to a U.S Government agency” (Lepawsky et al., 2019; 443). Moving on from networks to locations, the **fifth** step in controversy mapping, seeks to compare and contrast *where* actors are located within the controversy. Software to find locations includes Hyphe and GeoIP. Again, with the example of e-waste, when locating locations, they found that “...many of the places [with] transboundary e-waste movements [are] located on the African continent, despite much actor discussion of sites in Ghana and Nigeria as e-waste hot spots" (Lepawsky et al., 2019; 444). From here, we finally reveal how the relevant debates are changing or have changed since the controversy emerged as a public issue. Lepawsky et al. would call this “a move from locations to timelines" which could use TimeLine JS, Zotero, Voyant, and RAWGraphs software (Lepawsky et al., 2019; 444). This is the final step in controversy mapping.

By following the steps shown in Table 1 it is possible to draw and construct a controversy map. Their approach outlines a "recipe" to mapping one's own controversy. As Lepawsky et al. explained, "the subsequent steps in the recipe are about preparing answers to questions that will start to bring the utterance back down to earth" (Lepawsky et al., 2019; 440). In other words, by having statements that "floated free of [no] need for qualifications… These steps can be described as concrete actions to extricate… the researcher(s) from the search(es) they are about to perform" (Lepawsky et al., 2019; 440). Controversy mapping is an emerging approach to mapping debates, identifying actors and networks. We can illustrate its potential as a tool through two additional examples: wind power technology and New Nordic Cuisine.

Wind power is a prime example of where social media has become a powerful tool involving a public dispute. Since the 1990s, the list of concerns has been expanding. Concerns have ranged from "health concerns (e.g. sleep disturbances), safety (e.g. fear of catastrophic failure including destruction or fire), and noise" (Borch et al., 2020; 3). These concerns have become especially evident in Denmark, a country with a very large wind power infrastructure. In contributing to the method of controversy mapping, Borch et al. (2020) set out to quantitatively map the wind energy controvers(ies) on Facebook. In addition, they evaluated and tracked the concerns being communicated through social media, which are shaping protests toward wind power sites. Their conclusions are in a sense counter-intuitive, revealing the value of controversy mapping. While Borcher et al do not follow the method and approach outlined above, their study nonetheless tells us about the controversies and how they can be mapped. By bringing the controversy 'down to earth', Borch et al (2020) are able to challenge conventional wisdom associated with the wind energy controversy.

Broch et al. (2020) begin their controversy map through an analysis of posts made on Facebook. Their search revealed a floating statement using "the terms "vind" (wind) and "muller" (turbines) in different combinations", *what is the role of Facebook groups in the formation and distribution of concerns towards specific wind farm sites in Denmark?* (Borch, Munk, and Dahlgaard, 2020; 3). The content of the corpus (e.g. different categories of posts) were then generated using coding and analysis. This led to using a program called Atlas.ti which sets categories of identifiable themes and subjects that characterize the debates (i.e. tangible and intangible) and actors (i.e. community actors and cross-cutting actors) selected post statement (Broch Munk, and Dahlgaard, 2020). The results of the categories were visually presented in graphs to explore the networks, locations and activity of users, and the timelines in which concerns were expressed (Ex: Figure 3 and 4). An example of part of the results can be found below:

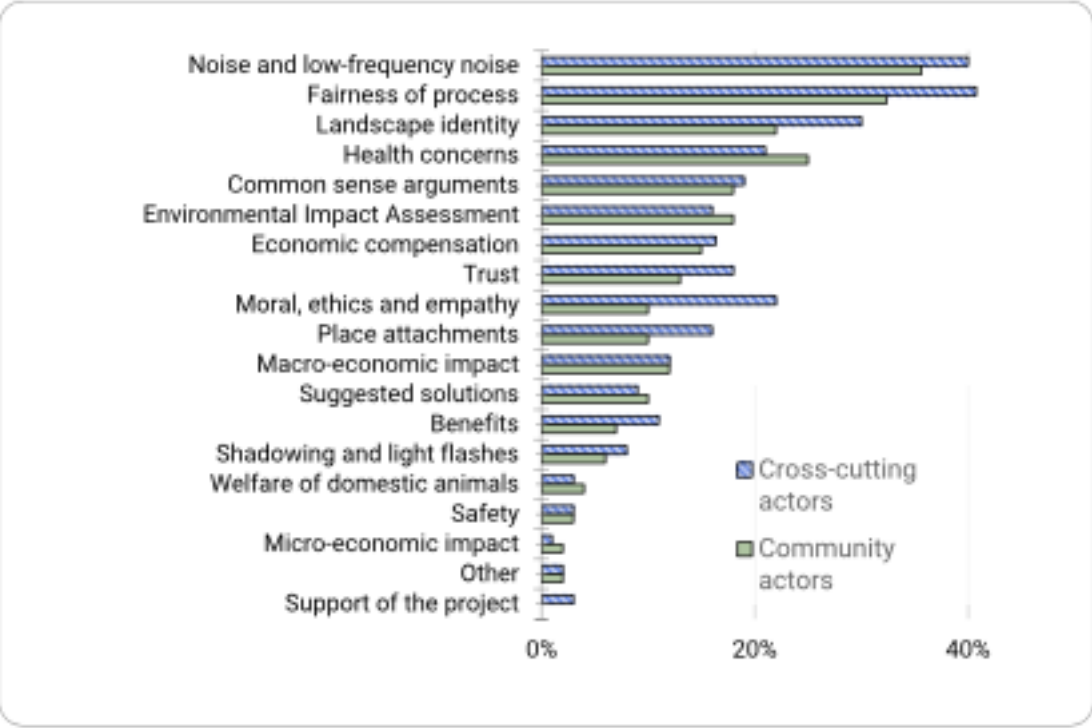


Fig. 5. Distribution of concerns across community actors (n = 662) and cross-cutting actors (n = 422).

Figure 3: Types of concerns documented from Wind Power Controversy (Borch, Munk, and Dahlgaard, 2020)

"A lot of money (taxpayers!) for the developers and landowners. The losers will be citizens who must live with health risks with low frequency noise, house losing value, and a nature spoiled by these giants"

"You cannot ignore all these people who report severe health nuisance in connection with their nabourship to giant wind turbines? Quite a lot of the people who complain about nuisance even was pro wind turbines before they were put up! Together this tells me that a problem exist, and it must be investigated, but I personally do not want to be a guinea pig…"

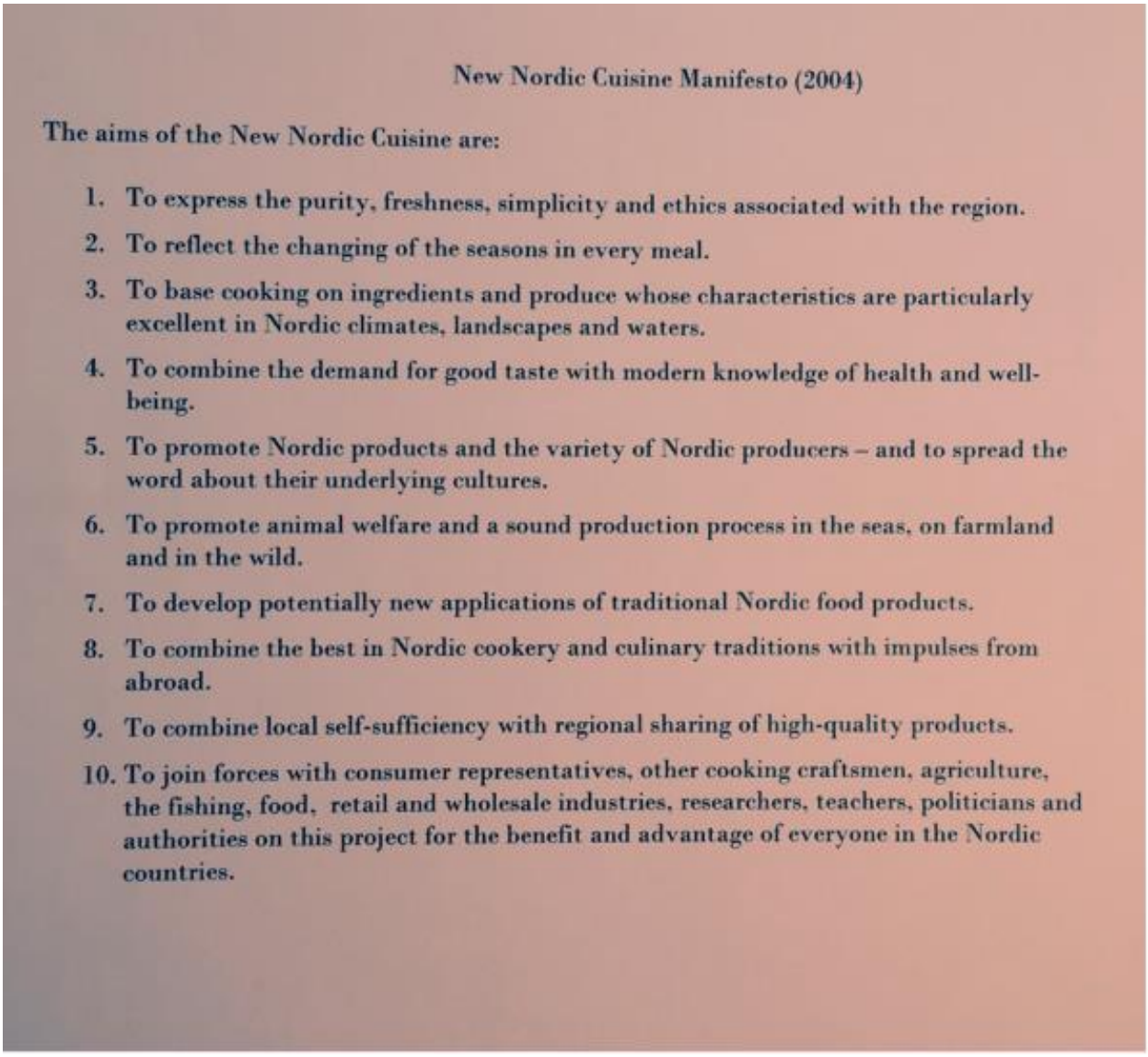
"It is a scandal that the large wind turbines are put up this close to humans and animals. Even a fool will know why the mink ran amok"

"I hate these formulations like "the area can be used for (giant) wind turbines..." why will they not listen to reasonable arguments??? It's probably just about money money money!!"

Figure 4: Quotes of concerns from Wind Power Controversy (Borch, Munk, and Dahlgaard, 2020)

Although the method followed is not as detailed as the one presented by Lepawsky et al. (2019), there are important similarities. By bringing the 'utterance down to earth' and breaking down the selected controversy, we can gain a more concrete visual representation of the controversy and a better understanding of where problem(s) are emerging through Facebook users and instead of a floating statement, "the coder has chosen to assign codes to engagements [of concern] rather than words, sentences and paragraphs… to provide statistics of the distribution of codes, i.e., how many post-engagements have been associated with certain codes by the coder" (Borch, Munk, and Dahlgaard, 2020; 4). We also see, as readers, the awareness, why this is occurring, and what can or will be brought forward in the future as we can how prominent the role of Facebook can have on concerns.

The rise and fall of the New Nordic Cuisine is a third example of a controversy, this time in the food sector. The New Nordic is Cuisine, as Jonatan Leer has argued, is a controversy which is not mapped using the detailed method discussed by Lepawsky et al. (2019). Nonetheless, the case of New Nordic Cuisine provides additional insights into controversy mapping that brings the controversy down to earth and reveals actors and networks in particular locations. Jonatan Leer describes, "The New Nordic Cuisine was initiated in 2004 with a manifesto proposing a cuisine based exclusively on products from the Nordic territory" (Leer, 2016; 2). Leer continues to explain that there are "ten declared aims presented in the manifesto" (Fig. 5), however, controversy remains.



New Nordic Cuisine Manifesto (2004)

The aims of the New Nordic Cuisine are:

1. To express the purity, freshness, simplicity and ethics associated with the region.
2. To reflect the changing of the seasons in every meal.
3. To base cooking on ingredients and produce whose characteristics are particularly excellent in Nordic climates, landscapes and waters.
4. To combine the demand for good taste with modern knowledge of health and well-being.
5. To promote Nordic products and the variety of Nordic producers – and to spread the word about their underlying cultures.
6. To promote animal welfare and a sound production process in the seas, on farmland and in the wild.
7. To develop potentially new applications of traditional Nordic food products.
8. To combine the best in Nordic cookery and culinary traditions with impulses from abroad.
9. To combine local self-sufficiency with regional sharing of high-quality products.
10. To join forces with consumer representatives, other cooking craftsmen, agriculture, the fishing, food, retail and wholesale industries, researchers, teachers, politicians and authorities on this project for the benefit and advantage of everyone in the Nordic countries.

Figure 5: What New Nordic Cuisine is aiming to achieve (Leer, 2016)

In his article, he sets particular focus on the "Copenhagen restaurant scene which has been recognized as the epicenter of debates which include the horizontal social class struggle for the right to define culinary capital" (Leer, 2016; 3). He does not specifically go through the process of how he seeks the challenges from within a "generation of chefs who were brought up in New Nordic restaurants, but are currently distancing themselves from the movement" (Leer, 2016; 1).

Rather, he discusses how the "different *actors* in different *contexts* have used the New Nordic Cuisine to position themselves in the culinary field either by *adhering* to or *rejecting* the concept, and how the example highlights the complex and often contradictory dynamics of the *local and global* dichotomy in temporary food and consumer culture" (Leer, 2016; 1). Therefore, by breaking down the article through the knowledge of understanding a controversy map, we can see how the analysis of Nordic Cuisine can be seen through the use of controversy mapping. For example, *"The Ideology behind The New Nordic Cuisine"* helps explore the several statements New Nordic Cuisine has entailed over the years to bring forward the "*The Politics*" and "*The Counter Reactions*" that have occurred through various debates and actors because of it (Leer, 2016). In doing so, we even see a section discussing "*The New Nordic Cuisine Moving to New York*" enabling location and timeline conversation. This is Leer's way of bringing this down to earth by extrapolating these steps in a version that betrays this specific controversy.

In this chapter, the focus is on the controversies associated with omega-3s described earlier. The floating statement I use is: "*Salmon contains nutrients for overall health and wellness such as omega-3 fatty acids and increased consumption [of farmed salmon] provides excellent nutrition for a healthy lifestyle*". The floating statement comes from the salmon farming industry, but it reflects a broader understanding about the benefits of eating salmon as they relate to omega-3s (Salmon de Chile, 2021; GSI_ Salmon, 2022; Mowi, 2022). This floating statement was unpacked in more detail after searching the wild web where debates and controversies were revealed around omega-3s and farmed salmon. It led me to focus on two specific search strings: a) "aquaculture" and "farmed salmon" and "omega-3", and b) "aquaculture" and "farmed salmon" and "toxicity". Using Search terms from the keywords listed above were chosen based on previous google searches of controversies within aquaculture and omega-3s,which led me to

key debates from both 'in the wild' websites and academic sources. Following the method of controversy mapping, I searched the websites and documents to identify the actors that were making statements within these debates. In doing so, I followed a similar method to Borch et al. (2020) in discussing their wind power controversy by quoting the actors within each debate. To identify the actors making the statements in each debate, I used a Sankey Diagram to visualize the actors identified through a Wild web Search and Scopus for the Scholarly Web academic search results (Debates to Actors). Using Issuecrawler, as well as Hyphe, I was then able to make the connections between the various actors visualized from the Wild Web browser (Actors to Networks). Next, I mapped these actors and networks using GeoIP in order to show trends in geographic location and the extent of omega-3 decline and toxicity claims (Networks to Locations). Finally, I contextualized the story of the omega-3 decline and toxicity claims within a timeline to discuss the changes that have and are occurring (Locations to Timelines). A detailed breakdown of my analysis is presented in Table 2.

Table 2: Breakdown of Each Step to Organize the Omega-3 Controversy Map

Step	Technique	Result
Floating Statement	Wild web search with search: 1. "aquaculture" and "farmed salmon" and "omega-3", and 2. "aquaculture" and "farmed salmon" and "toxicity"	"*Salmon contains nutrients for overall health and wellness such as omega-3 fatty acids… increased consumption [of farmed salmon] provides excellent nutrition for a healthy lifestyle*".
Statement → Debates	Search terms from keywords led to two key debates from both the wild web and academic sources	Two key debates: 1. Omega-3 decline in farmed salmon 2. Toxicity claims within farmed salmon and the environment in which they live in

Debates → Actors	Similarity to Borch et al. 2020 method in discussing by quoting actors within each debate Identifying various actors in each debate using a Sankey Diagram and Scopus Database	Sankey Diagram → lead to specific areas of actors on Wild web search Scopus Database diagrams for academic search of scholarly web
Actors → Networks	Issuecrawler and Hyphe	Connections between the various actors visualized from Wild Web browser
Networks → Locations	Mapping of actors and networks using GeoIP	Show trends in geographic location and the extent of omega-3 decline and toxicity claims
Locations → Timelines	Scopus database diagrams	A contextualized story of the omega-3 decline and toxicity claims to discuss the changes that have and are occurring

For the purpose of this chapter, I will break my controversy map discussion into two sections based on my searches and my analysis. The first section focuses on the search results from "aquaculture" and "farmed salmon" and "omega-3", while my second section will arise from my search of "aquaculture" and "farmed salmon" and "toxicity". The first search focuses on the controversy surrounding declining levels of omega-3s in farmed salmon, which are a consequence of changes in the composition of aquafeed. The controversy is whether consumers are receiving sufficient nutrients from farmed salmon, and how they are responding to this decline in omega-3s. The second keyword search reveals a connected set of controversies about the toxicity of farmed salmon and the potential response of consumers who are seeking sources of omega-3s from supplements rather than from farmed salmon. Each of the sections will reveal the actors, networks, locations, and timelines that emerge from the searches, thereby bringing the controversies 'down to earth'.

2.3 Controversy 1: Declining Levels of Omega-3s in Salmon

2.3.1 Statements to Debates

Over the last decades the composition of aquafeed for farmed salmon has changed dramatically. Two decades ago, 80% of farmed salmon feed including fish meal and fish oils was made from pelagic fish harvested around the world but especially off the coast of Peru. The composition of aquafeed has, however, changed significantly. Current global figures show that "oil from fish make up only 14.5% of feed ingredients" (The Fish Site, 2019). In place of pelagic fish, aquafeed manufacturers have begun to rely on vegetable proteins and oils, as well as other novel fish feed ingredients. The shift away from pelagic fish is due to the rapid global growth of aquaculture and the higher cost of fish from pelagic sources. Additional drivers have been the relatively low price of soy, grains and vegetable oils compared to oils derived from fish. Finally, growing social protest against the depletion of wild fish like herring and anchovies, and their role in human nutrition, has also played a role in the shift of farmed fish diets away from fish to vegetable oils and proteins. One of the important consequences of this shift in the decline of marine omega-3s in feed has been a reported decline in the level of omega-3s in farmed salmon (Ghosh, 2016). The controversy that has followed is the concern that farmed salmon – widely promoted as a source of omega-3s – no longer has high levels of omega-3s, a crucial fatty acid that is so important to human health. The controversy emerged largely due to the findings of research conducted by academics at Stirling University who found that omega-3s in farmed salmon had declined by 50% in only five years (Figure 6).

Omega-3 oils in farmed salmon 'halve in five years'

By Pallab Ghosh
Science correspondent, BBC News

6 October 2016

Figure 6: Journal Headline of the Omega-3 Decline (BBC, 2016)

The Stirling University researchers who undertook the study of omega-3s in farmed salmon explain how "replacing the traditional finite marine ingredients, fishmeal and fish oil, in farmed salmon diets with sustainable alternatives… represents a significant challenge for the aquaculture industry" (Sprague, Dick, and Tocher in Ghosh, 2016; 1). The researchers compared the fatty acid composition of over 3,000 Scottish Atlantic Salmon over a 9-year period and found substantial declines in omega-3 levels in farmed salmon. With the decline in omega-3 levels in salmon, the researchers recommended increasing the consumption of farmed salmon as a way to make up for lower levels of nutrients: the "nutritional value of the final product is compromised requiring double portion sizes, as compared to 2006, in order to satisfy recommended EPA/DHA intake levels endorsed by health organizations" (Sprague, Dick, and Tocher in Ghosh, 2016; 1). Even though Tocher and Sprague (2016) stated that farmed salmon still delivers more EPA and DHA than most other fish species, their research was highly publicized and widely circulated in the media. Both Tocher and Sprague were interviewed by British Broadcasting Corporation (BBC) and the Global Aquaculture Alliance in 2016 as well as numerous other media outlets. A sample of their statements is provided below where they attempt to defuse and explain the implications of their research to the average consumer.

Farmed salmon is still one of the richest sources of beneficial fish oils and [he] urges people who buy farmed salmon for its potential benefits to continue doing so (Tocher, in Ghosh, 2016)

At the moment, they are advising to eat portions of fish per week… but the advice of one portion of oily fish really should now be two portions at least (Sprague in Ghosh, 2016)

Of course we knew the consequences, of course we know the consequences of [changing the feed]... we knew exactly what the impact would be… there were no better options, and we did a huge amount of research into determining what we could do without impact fish health and welfare - something that was paramount - while still maintaining a healthy level of omega-3s. This is why I object to this story being portrayed in a negative light. There are masses of positives! (Wright, 2018)

While it was difficult for Tocher and Sprague to control how their research was being interpreted, there were some media agents that supported their attempt to suggest that farmed salmon remained an important source of omega-3s.

Yes, there has been clear reduction in EPA and DHA levels in farmed salmon since 2006… but levels… are still higher than any dietary source of omega-3 (Byrne, 2016)

Other media outlets questioned Tocher and Sprague's results, suggesting that their data exaggerated the level of declines in omega-3s, and was not representative of the situation for farmed salmon in Norway or farmed salmon consumed in the United States. Consider for example these statements:

We cannot quite understand how they arrived at these figures… We have kept a close eye on developments over the years, and levels have indeed fallen slightly, but I have never seen as low levels as suggested by Stirling… not representative of Norwegian salmon… levels are considerably higher (Hosteland, 2018).

Farmed salmon sold in European retail provides the least EPA and DHA per unit non carcinogenic risk… those from Chile and Washington State, and those sold in retail markets in the US provide the highest EPA and DHA intake per unit non carcinogenic risk, yet can still eat both and is still recommended to eat both (Foran et al., 2005).

Despite the efforts of Tocher and Sprague to control the media message around their research, the finding that farmed salmon had much lower levels of omega-3s was seized on by other media outlets, celebrity food writers and representatives of non-governmental organizations:

> Omega-3s are not labelled [on farmed salmon], so consumers can't possibly have any idea how much-farmed fish contains (Leschin-Hoar, 2014)

> Alternatives are expensive, and most [WHAT] don't solve the problem of how to keep the omega-3s in farmed salmon (Leschin-Hoar, 2014)

Tocher and Sprague's research on omega-3s in farmed salmon was the source of a controversy about whether this farmed fish continues to play a role in providing humans with easy access to this important nutrient. In what follows, I will bring the controversy of omega-3s 'down to earth', using the methods and techniques of controversy mapping. In this way, the controversy about farmed salmon and omega-3s will be mapped and its terrain will be revealed through actors, networks and timelines.

2.3.2 Debates to Actors

The aim of this step is to shift from a focus on the debates to the actors responsible for the debates and the positions they take. Using Sankey and Scopus for the Google searches and academic searches respectively, I identified the actors behind these statements and debates. I used 20 URLS for identifying the Google search actors as there was data saturation if adding more. The actors identified in the Google searches were divided into five categories for both controversies: Journalism, Government, Non-Profit/Community/Justice Groups, Industry/Consultants, and Research.

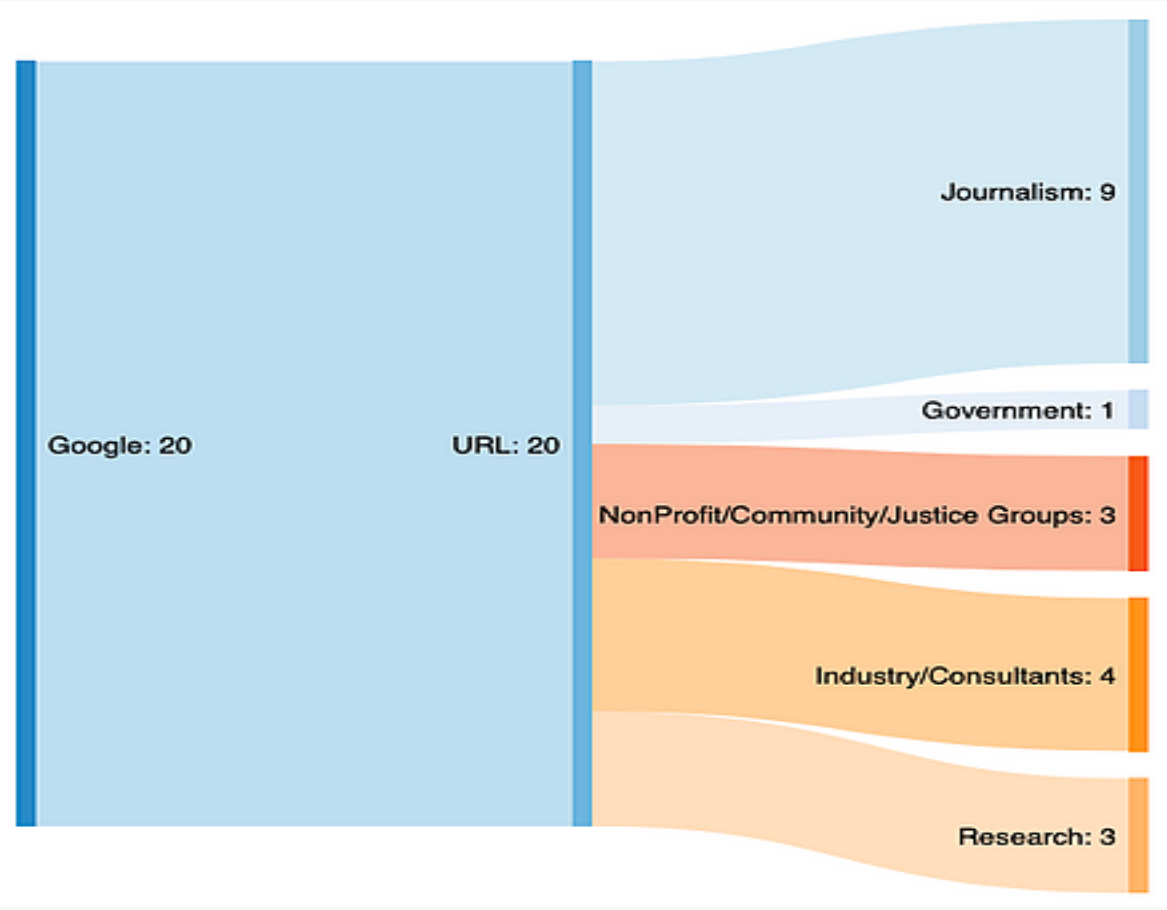


Figure 7: Sankey Diagram of Google Search “Aquaculture” and “Farmed Salmon” and “Omega-3”

The journalism search results presented an extensive range of views from local and national news. While these articles focus on the same concern around omega-3s, there is a wide array of opinions presented. Many of these articles included interviews with researchers, both discussing their own research and others contributing to the investigation through the research collected, as well as the community members, medical and academic doctors who are identified in the debate previously outlined. The industrial/consultant actors, while fewer, include the Feed Navigator (Byrne, 2016) Vital Choice (‘farmed salmon get more lice, lose omega-3’, 2018), DSM Feed Talks (Nickell, 2019) and Salmon Facts (Norwegian Seafood Council, 2016). These websites

were at the top of the search results and seemed to have a significant impact when it comes to the sustainability of feed and the nutrition of farmed salmon.

The NonProfit/Community/Justice Groups include Surfrider Foundation (Fish Farms and the Decline of Pacific Salmon, 2020), The Global Aquaculture Alliance (Wright, 2018), and Safe Salmon (Defend our Salmon, 2020). Despite being a global environmental non-profit organization dedicated to the protection and enjoyment of oceans, waves and beaches through a robust activist network, Safe Salmon involve themselves with farmed salmon and what their impacts are on humans, species, and environment. To focus on the omega-3 decline solely, Safe Salmon recommends that we find other sources of omega 3s rather than farmed salmon. The Global Aquaculture Alliance is a team that wants to embrace and enable the role of responsible farmed salmon seafood and how it can meet global nutrition needs (Wright, 2018). In contrast to Surfrider, they argue that farmed salmon remains a top source of omega-3s and continue supporting farmed fisheries. The three research groups identified included UK Research and Innovation (U.S. Department of Health and Services, 2018), the Food and Climate Research Network (FCRN) (Hogeboom, 2014), and Scientific Reports. The Washington Department of Health (Farmed Salmon vs. Wild Salmon, 2019) was the only research that considered a governmental position to this controversy.

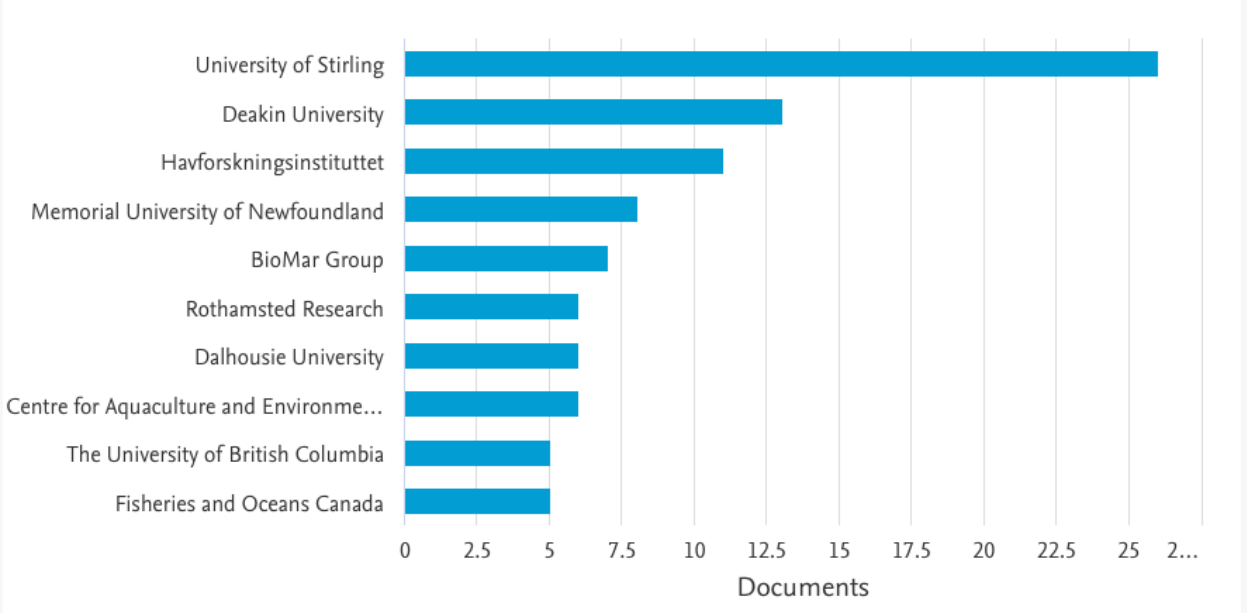


Figure 8: Scopus Diagram of Academic Search "Aquaculture" and "Farmed Salmon" and "Omega-3"

By using the same search terms, I used in Google, it is possible to identify the top academic search affiliation results in Scopus. Both the academic search and Google search presented information that overlapped with each other. However, the academic search resulted in more of the scientific evidence behind the journalism articles.

Despite journalism being the highest discussed actor involved with the debate presented, several of the articles were directly affiliated. When considering Figure 8, the headlines of the majority of the articles were primarily involving several authors of academic papers who are researching and employed at the University of Stirling. Both Dr. Douglas Toucher and Dr. Matthew Sprague are affiliated with the University of Stirling and working with the Nutrition Group at the Institute of Aquaculture.

In this step of the controversy mapping it is possible to identify the key actors involved in the controversy around omega-3 levels in salmon. Journalists remain a key source of information for

consumers, and industry plays an important role in interpreting the impact of the research being generated within Universities. For non-governmental organizations, who are also well represented in the controversy, the controversy is understood differently depending on their approach to the farmed salmon sector. One of the surprising – and important – results of this research is the absence of government actors in their role as promoters of healthy diets for their citizens through food guides and other dietary advice. I will return to this issue in the discussion where I reflect on these debates in relation to Canada's recently released food guide.

2.3.3 Actors to Networks

To visualize the networks involved in the debates surrounding omega-3 decline and farmed salmon, both IssueCrawler from the Digital Methods Initiative and Hyphe was used. IssueCrawler and Hyphe 'crawl' across specific sites and they capture the 'outlinks' from the sites identified. In other words, these applications identify the web links between sites. IssueCrawler provides three additional ways of crawling through sites: co-link analysis, snowball analysis, and inter-actor analysis. Co-link analysis crawls the 'seed' (or common link) URL(s) and retains the pages that receive at least two links from such seed. Snowball analysis crawls sites and retains pages receiving at least one link from the seed. Inter-actor analysis crawls the seed URL(s) and retains inter-linking (or linking between other links) between the seeds. The IssueCrawler visualizes the results in a circle, cluster, and/or geographical maps ("Issuecrawler"). For the purpose of this particular research, I was using both the inter-actor analysis and snowball analysis, as they both were useful for visualizing how the actors identified in the URL search and who are connecting to each other.

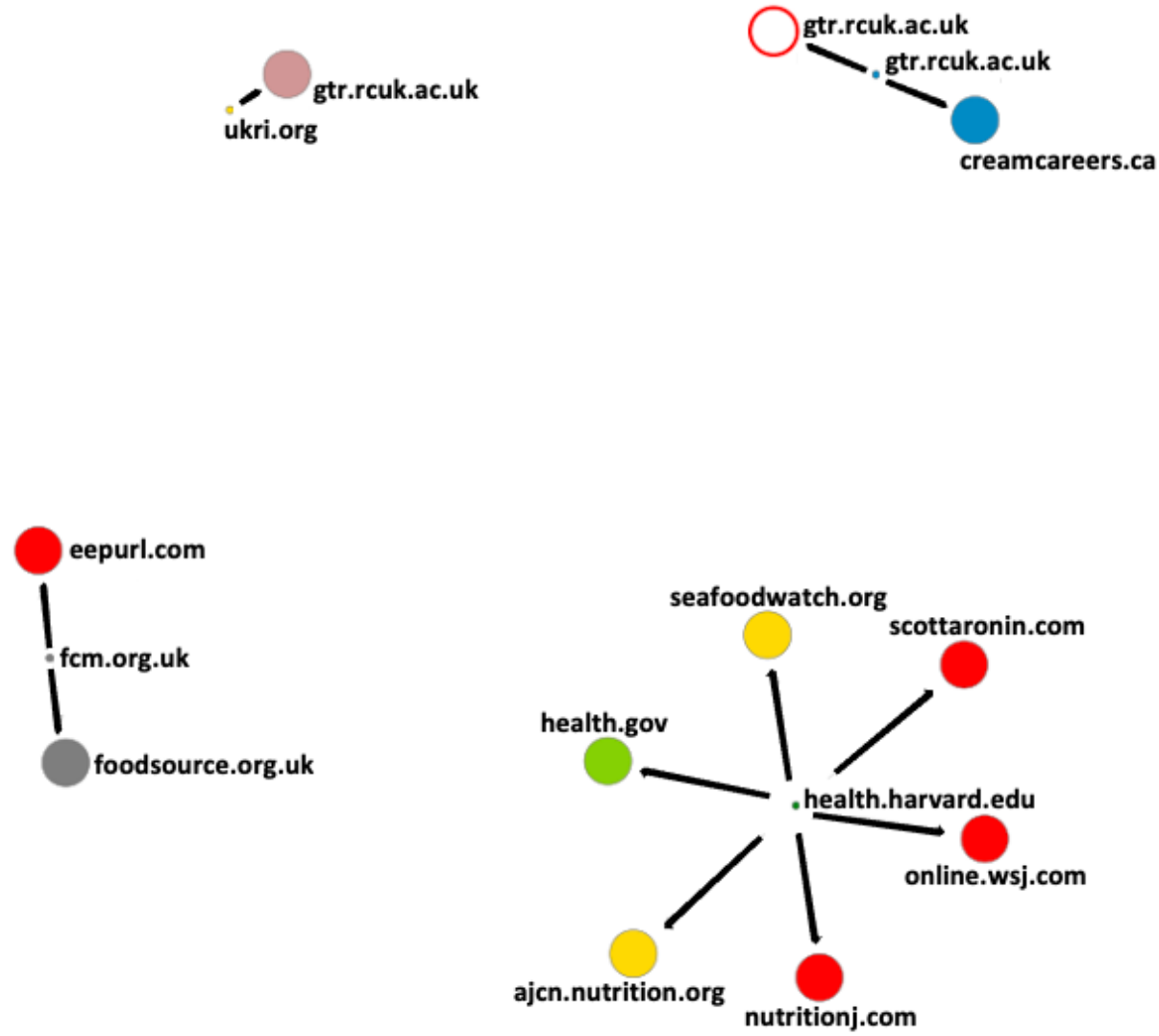


Figure 9: Snowball Analysis of “Aquaculture” and “Farmed Salmon” and “Omega-3”

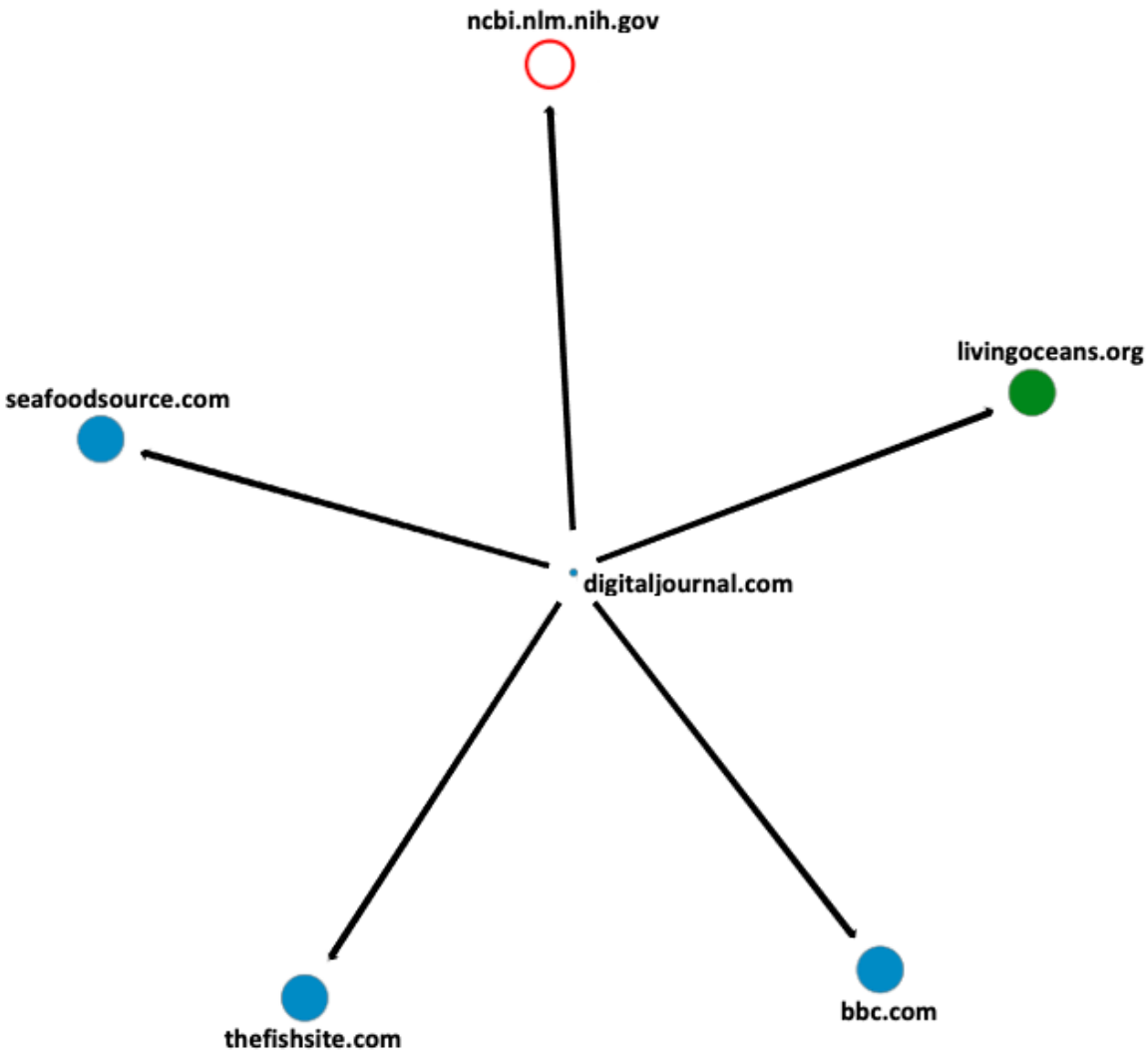


Figure 10: Snowball Analysis of "Aquaculture" and "Farmed Salmon" and "Omega-3"

Out of the 20 URLs (also known as nodes) analyzed, 15 of them became connected in some way, while the remaining 5 were considered outliers and not part of this analysis. This crawl led to two links being in "crawl depth" ("Issuecrawler"); meaning the connection was stronger compared to the others analyzed, this included digitaljournal.com and health.harvard.edu. The sites linking connections then followed by Food Climate Research Network (FCRN), the UK Research Innovation, and the Saltwater Network.

When analyzing the inter-actor analysis with the 20 URLs, only six came out to be interlinked. However, most interaction is occurring between Digital Journals. With this, Salmon Safe, BBC, The Fish Site, Seafood Source, and the University of Stirling are connected, but are not linked by any other actors. In this case, the links between both the study discussed and the journalism, researchers, and non-profits, therefore, are visible.

Based on the results, research community members are the 'root' of information presented from the debate, helping form discussions elsewhere through the other groups. Despite research facilities displaying interconnectedness, the debates presented by other areas however are not equal, showing a separation bigger than expected between actors, especially through the snowball analysis. What is obvious however, is the dominance of the research and journalism defining discussions on the omega-3 decline, at least when looking at the top Google search results. It is also apparent that connections between government websites are not visible.

2.3.4 Networks to Locations

The fifth step in controversy mapping involves grounding the networks in specific locations. When using Geo-IP from the Digital Methods Initiative which geo-locates the URLs, it is important to note that while the website may be referring to a particular location, the URLs may be located elsewhere. This is important because the location of the URLs will reflect server locations rather than the place where the actors are located.

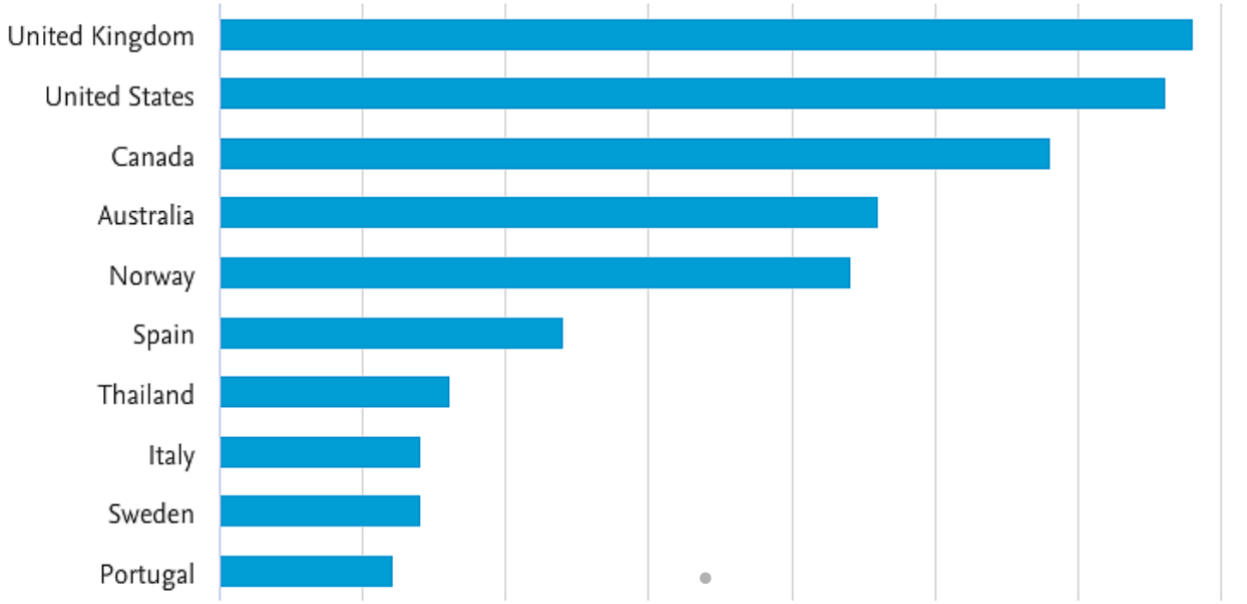


Figure 11: Scopus research of Locations “Aquaculture” and “Farmed Salmon” and “Omega-3”

For example, the Surfrider Foundation and Safe Salmon both have URLs located in New York and Los Angeles respectively even though they are organized by residents living in Vancouver, B.C. and surrounding areas. As for The Global Aquaculture Alliance, they are located in New Hampshire, but the URL has indicated Seattle, Washington. Because of the possibility of both websites being created using a site builder, the URLs would generally not reflect the actual geographical location of the organization. In terms of journalist sites, the articles extracted were from larger news organizations with URLs located in San Francisco (BBC, The Conversation), Amsterdam (CBC), and Montreal (The Guardian). Despite such discrepancies between the actual locations and the URL 'locations', the results do nonetheless show the concentration of activity in areas like the United Kingdom, reflecting the important role of important actors like Douglas Toucher and Matthew Sprague. In addition, researchers UK Research and Innovation, Food and Climate Research Network (FCRN), and Scientific Reports also are located in Swindon, Oxford, UK and Netherlands, respectively.

Despite the location differences resulting in misleading or misrepresentation of ‘locations’, we must constantly remind ourselves that the debates do not necessarily have to be in a particular location/site that they are anchored around (ex: see Figure 11). This can be considered acknowledged in the in the framework designed by Lepawsky et al. to be aware of this limitation. However, we can see prominently through the divisions of actors discussed previously that these claims are presented internationally through not only researcher results, but via nutritionists, consultants, and doctors giving their own advice and opinions on things like the omega-3 decline.

2.3.5 Location to Timelines

Mapping a timeline for farmed salmon with omega-3 controversies is the final step in controversy mapping. Through a Scopus search we can see that a spike of interest in this controversy began around 2007/2009, and interest has been consistent since then (Figure 12). It suggests an enduring concern on the relationship between salmon and omega-3s.

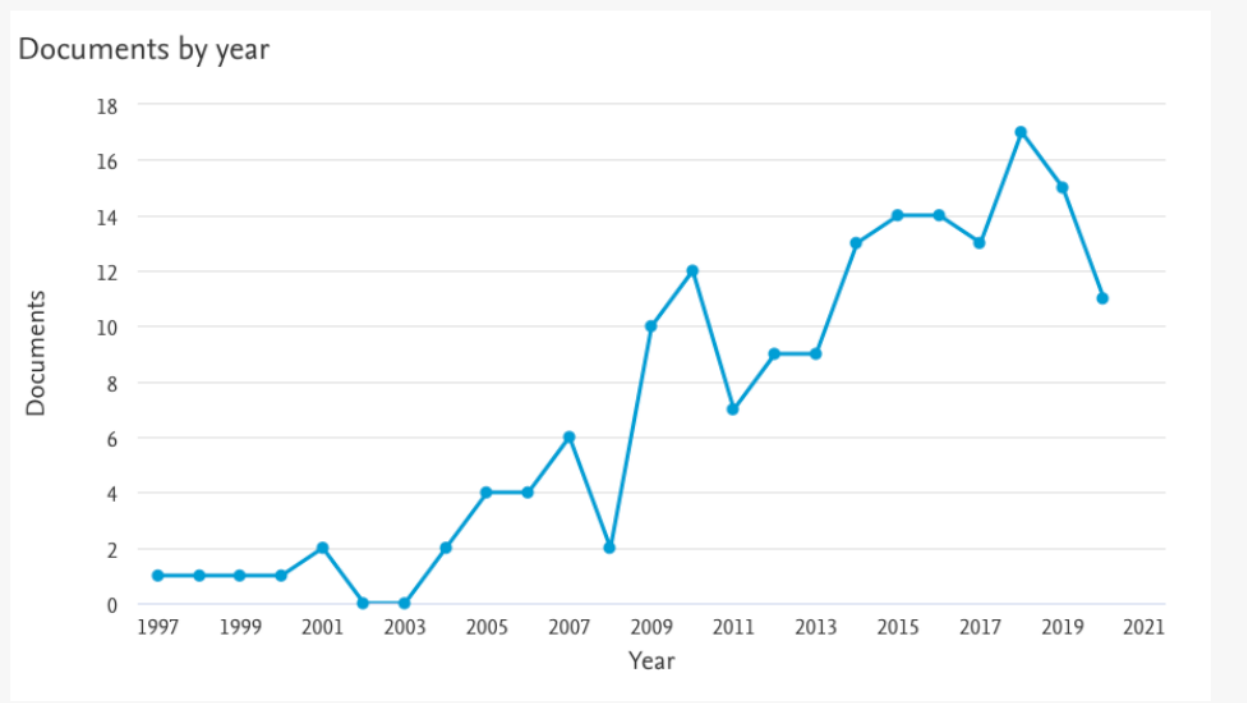


Figure 12: Scopus research of Timelines “Aquaculture” and “Farmed Salmon” and “Omega-3”

While the timeline provides an important insight into whether the controversy is sustained, it does not provide insights into why or how it is changing. For example, since the widely publicized research on omega-3s and salmon emerged, the salmon aquaculture industry has been exploring different ways of making up for the decline through other feed ingredients including algae and krill. This means that while the controversy may be sustained, the terms of debate may be changing as industry responds to the initial controversy.

2.4 Controversy 2: Farmed Salmon and Toxicity

Salmon farmers are driven by the goal of rapid growth of the fish, which requires a high-calorie diet for the fish. As a result, farmed salmon deliver substantial calories, and they also accumulate fats, including of course those associated with omega-3s. The problem for fish farmers is that fat-soluble pollutants have more area to bioaccumulate in the bodies of fish like salmon. Researchers

recently found that in some regions “farmed salmon contain levels up to 13 fat-soluble persistent organic pollutants that are on average ten times higher than those in wild salmon” (The Fish Site, 2022). Commonly discussed pollutants amongst the 13 organic pollutants include Polychlorinated Biphenyls (PCBs), Polybrominated diphenyl ethers (PBDEs), and Methylmercury which can increase risks of cancer, infertility, and toxicity to the central and peripheral nervous system to name a few (PCBs in Fish and Shellfish, 2013; Hites et al., 2004).


HEALTH

Farmed Salmon, Science Explains, Is One of the Most Toxic Foods in the World

Feb 27, 2018 Carly Fraser Save For Later Print

Last Updated: Jan 06, 2020

Figure 13: Example of Journal Article Acknowledging Toxicity Claims (Amir, S., 2021)

The problem of the ‘toxic salmon’ controversy goes beyond its impact on human health. Detractors have raised concerns around the impact of farm waste and chemicals including antibiotics and pesticides that are aimed at ensuring healthy fish but can pass through the cages into surrounding waters with impacts on surrounding ecosystems (Ex: Figure 13). In Norway, investigations of the farmed salmon industry have resulted in serious claims about the content of salmon and their impact on surrounding marine environments.

“Farmed salmon contains much more pollutants, you can see the numbers as well as I can” (Fillet Oh Fish”, 2014)

“They didn’t ask if [the chemical] was safe; they just figured they wouldn't start a problem" (Fillet Oh Fish, 2014)

"Before it was good… but suddenly, we find fish that is full of pesticides and mercury… it's just not the same anymore, so the message has to be different" (Fillet Oh Fish, 2014)

The controversies around salmon as being toxic are present in Europe, and they have also been discussed in Canada (Fillet Oh Fish, 2014).

"Clearly [the farmed salmon producers] know that there are issues and that's why they won't let anybody in" (Salmon Confidential, 2013)

"Yes, they say they're using the best practices… I see disease all over them…whatever these 'best practices' are, they're not working" (Salmon Confidential, 2013)

The concerns around the chemical impact of salmon farming practices has drawn attention to a pesticide called 'Slice'. Slice is a chemical treatment containing emamectin benzoate which salmon farmers use to control sea lice. Although Slice is used to treat farmed salmon in some areas of British Columbia and 80% of these fish are marketed to the U.S, the U.S.'s Food and Drug Administration has recommended that Slice "should not be used on fish destined for dinner plates" ('farmed salmon get more lice, lose omega-3, 2018). The Canadian Association of Agri-Retailers (CAAR) believes the salmon farming industry needs to, "use better technology that eliminates the risks of disease and parasite transfer as well as fish escapes, label fish as 'farmed' so consumers can make informed choices, reduce and eliminate the use of chemicals, antibiotics and pesticides in fish farming, and ensure contaminants in farmed fish don't exceed levels deemed safe by international standards" (Defend our Salmon, 2020).

Despite these concerns raised by some groups, producers such as Blue Circle Fish are trying to change the narrative around farmed salmon. They have pointed to the benefits of eating farmed fish arguing that "salmon can be clean, nutritious, and raised in a way that protects oceans and wild fish stocks" (Blue Circle Foods, 2022) (Figure 14).

Figure 14: Blue Circle Fish; easing the minds of consumers

Given the conflicting evidence, consumers will no doubt be confused by the range of health claims and concerns around farmed salmon. Becky Mansfield's analysis of farmed fish and the confusing messages consumer receive ranging from "EAT MORE FISH!" to "DO NOT EAT FISH!" is especially relevant in this context (Mansfield, 2011; 413). Concerns from mercury, microplastics, and genetically modified foods are only a small portion of the anxiety (Dave Little & Richard Newton; 2019). The uncertainty around salmon as a potentially toxic food has encouraged advertisers to promote omega-3 supplements that do not contain fish. The message is that there are abundant omega-3s available in the plant world, so that "you don't need to risk eating any more fish" (Figure 15). In this way, consumers are encouraged to consume omega-3s for health reasons, but not by consuming farmed salmon.

Figure 15: Alternatives for Omega-3 Health to Prevent Possible Toxicity (Amir, S., 2021)

This second controversy around salmon and omega-3s lends itself to analysis through the methods of controversy mapping. In the sections that follow, I use the same methodology beginning with 'debates to actors' and progressing until the last stage of the analysis, 'locations to timelines.'

2.4.1 Debates to Actors

I again use Sankey and Scopus for both the Google searches and academic searches respectively to identify the actors behind these statements and debates. Within the second Google search, the numbers between each actor was fairly consistent. Analyzing the top 20 URLs suggests that the discussion about farmed salmon and toxicity is dominated by journalism, research, and an equal number for industry/consultants and NonProfit/Community/Justice Groups. The NonProfit/Community/Justice Groups including Surfrider Foundation, The Global Aquaculture Alliance, and Safe Salmon. These organizations are also concerned with the impact of farmed salmon beyond omega-3 and toxicity to include other impacts with humans, species, and the marine environment. There are overlaps between this controversy and the one around declining

levels of omega-3s with similar organizations featuring including Safe Salmon, UK Research and Innovation, FCRN, and Global Aquaculture Alliance. As before, journalism is an important source of information for consumers around toxicity and is a primary source for 'anxious consumers.' In addition, some of the websites presented in Industry/Consultants and NonProfit/Community/Justice Groups websites appear in both searches, showing some more overlap between the concern of what is actually in our fish, and if it is still acceptable to eat despite the circumstances and controversies.

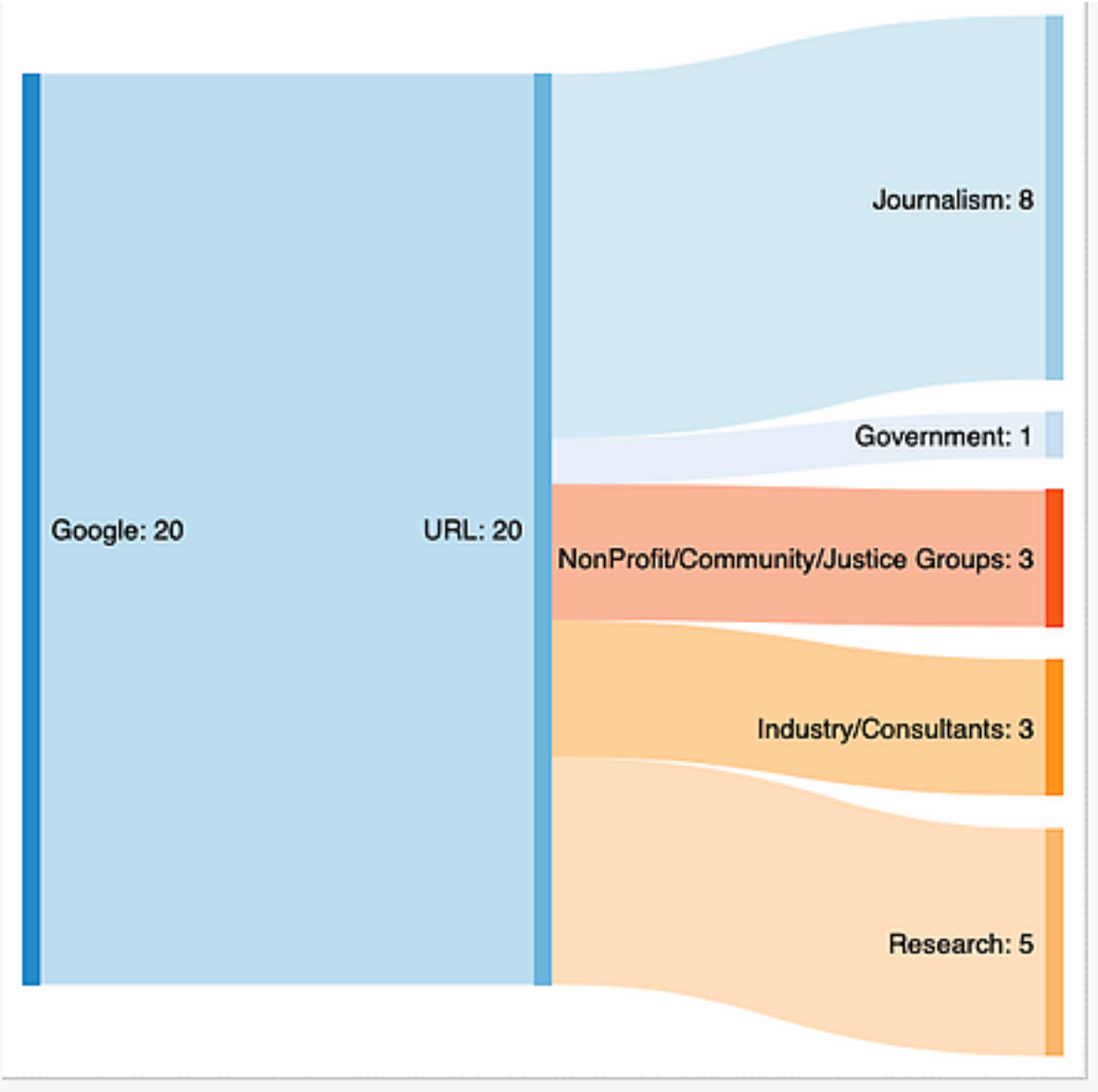


Figure 16: Sankey Diagram of Google Search “Aquaculture” and “Omega-3” and “Toxic”

A key theme that has emerged in this controversy map, and the previous one, is the relative absence of government and formal regulators on the topic of farmed salmon and its apparent toxicity. Since this dispute seems to be between researchers and industries and community groups, the role of government regulators of aquaculture and food safety is absent, creating a vacuum for consumers seeking impartial knowledge and providing another potential reasoning behind consumers seeking alternatives for omega-3s outside of salmon.

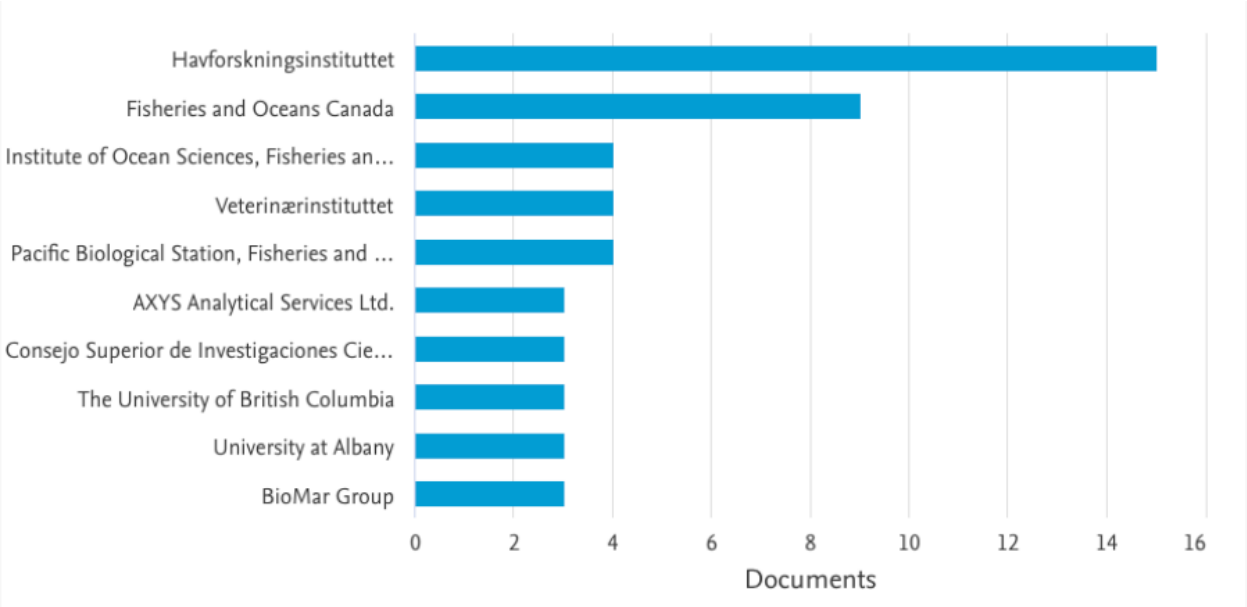


Figure 17: Scopus Diagram of Google Search “Aquaculture” and “Omega-3” and “Toxic”

Using the same two search terms as was used in Google to create both data sets, I analyzed the affiliations of the top academic search results in Scopus. The academic search led to debates and actors that were, unsurprisingly, scientific and located in countries that are major salmon producers. We can see that universities like Havforskningsinstituttet located in Norway, with other locations in Canada (e.g. Fisheries and Oceans Canada, University of British Columbia).

Google searches resulted in more journalism, industry and community/justice groups and articles. It can be hard to see how these two types of information and actors overlap as many of the debates and actors seem detached; however, they are more affiliated than at first glance.

Despite journalism being the most explicit actor involved with the debates presented, several of the articles pulled from the academic search were directly affiliated with the controversy. It came as no surprise to see the affiliations between both European and Canadian Universities between both controversies as the majority of the categories from the Google search were in these locations. More specifically, the academic searches are affiliated with Norway and British Columbia in regard to toxicity controversies. A couple of researchers that have been involved in going through the toxicity controversy can include Jerome Ruzzin who is at the University of Oslo, with previous affiliations at Havforskningsinstituttet (Jerome Nicolas Marius Ruzzin, 2020). Another is Dr. Lawrence M. Dill who has previous affiliations at the University of British Columbia and is now researching at Simon Fraser University (Webmaster for Academic Computer Services).

2.4.2 Actors to Networks

The Snowball Analysis has the same connections as previously analyzed with omega-3s decline. However, in this case, there were no connections displayed by Harvard Medical School, leading to fewer connections with community websites.

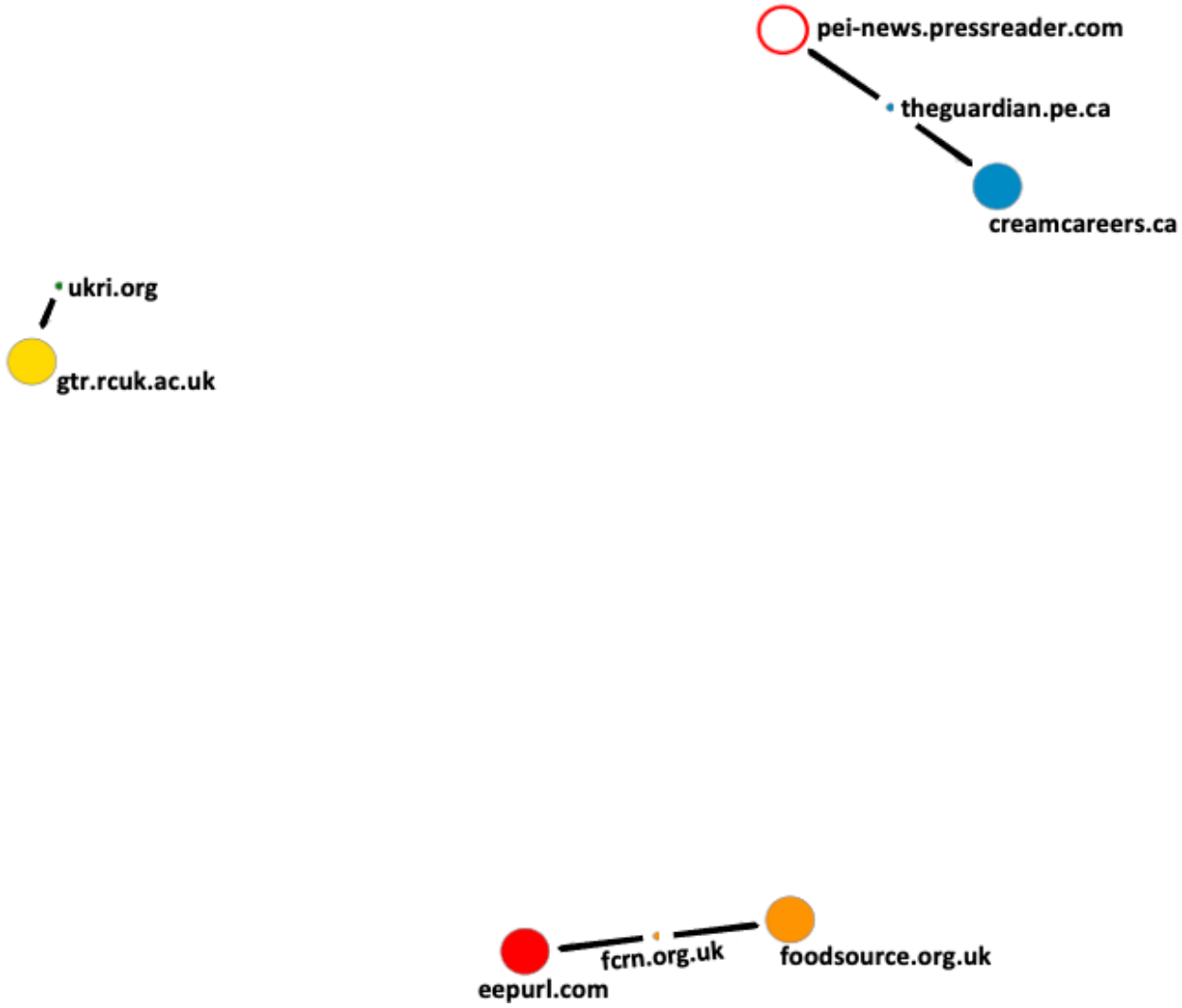


Figure 18: Snowball Analysis of “Aquaculture” AND “Omega-3” AND “Toxic”

When using the inter-actor analysis, it presented a ‘no network’, meaning, no websites were connected to one another. Sometimes this can occur with certain software that does not recognize certain URLs, so I wanted to use another software, like Issuecrawler, to be fully certain that no networks were presented. Through the use of the software IssueCrawler however, it presented incoming links. This means that these were the only websites that showed links to other websites. This included FCRN (23), Aquaculture North America (52), BBC (89), CBC (114),

Bluecircle Foods (30), and Grieg Seafood Canada (8) were the only ones that presented a network. This is indicated with the numbers present in the brackets; those that have a “0” present, mean there is no connection to those websites. Although this form of software does not show the results in a visual like the snowball analysis, it does determine that there is several links between these six websites alone.

ID	NAME
1	Fcrn.org.uk
2	Aquaculturenorthamerica.com
3	Bbc.com
13	Ukri.org
5	Cbc.ca
10	Safesalmon.ca
4	Bluecirclefoods.com
6	Griegseafoodcanada.com
7	Mercola.com
8	Nature.com
9	Organicconsumers.org
11	Surfrider.org
12	Theguardian.pe.ca
15	Youtube.com
14	Wa.gov

INDEGREE	TOTAL KNOWN PAGES	CRAWLED PAGES	STATUS	LAST MODIFICATION DATE
0	420	23	IN	2020-04-14T17:50:56.283Z
0	608	52	IN	2020-04-14T17:50:56.232Z
0	1880	89	IN	2020-04-14T17:50:56.328Z
0	0	0	IN	2020-04-14T17:50:58.536Z
0	2197	114	IN	2020-04-14T17:50:57.094Z
0	0	0	IN	2020-04-14T17:50:58.047Z
0	100	30	IN	2020-04-14T17:50:56.929Z
0	79	8	IN	2020-04-14T17:50:57.155Z
0	0	0	IN	2020-04-14T17:50:57.513Z
0	0	0	IN	2020-04-14T17:50:57.544Z
0	0	0	IN	2020-04-14T17:50:57.576Z
0	0	0	IN	2020-04-14T17:50:58.091Z
0	0	0	IN	2020-04-14T17:50:58.185Z
3	12	0	IN	2020-04-14T17:50:58.670Z
0	0	0	IN	2020-04-14T17:50:58.600Z

Figure 19: Hyphe Analysis of “Aquaculture” AND “Omega-3” AND “Toxic”

2.4.3 Networks to Locations

With the debates surrounding the internet and academic searches, the debates surrounding toxicity for salmon as a commodity and the impact of farming salmon within and surrounding environments, its potential controversy maps are around the locations in both Europe and North America. However, when geo-locating the URLs using the GeoIP, the information of the controversies is located in these particular areas from the websites, the URLs are 'located' elsewhere. With this in mind, the location of the URLs can be misleading again with overlap of some searches such as NonProfit/community organized groups, and journalism.

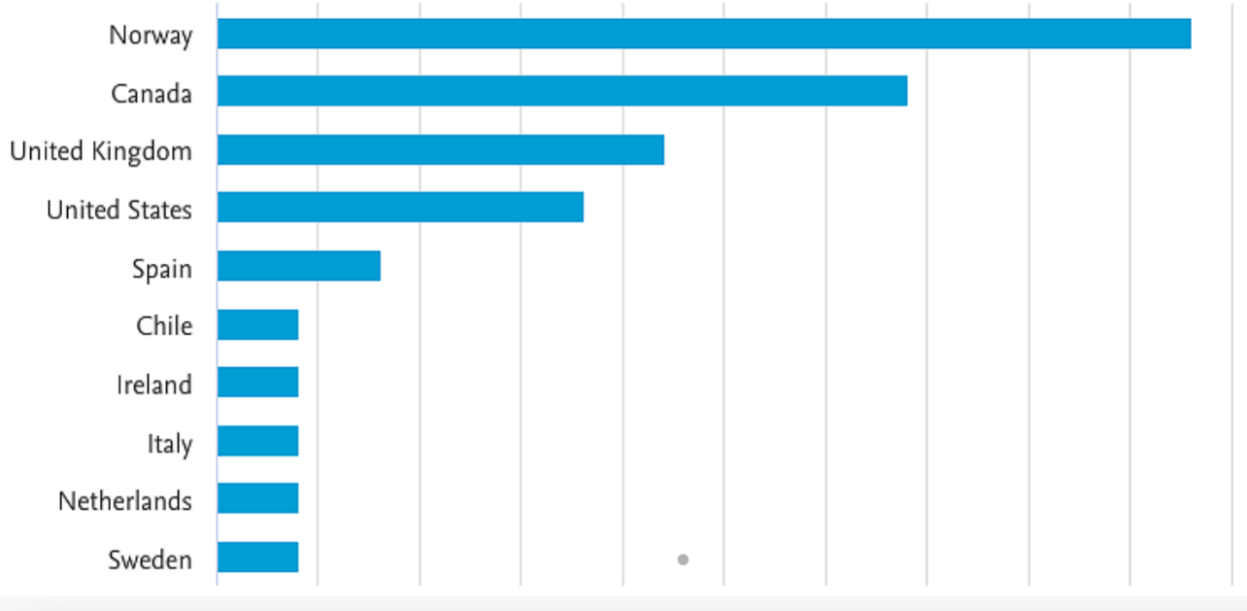


Figure 20: Scopus research of Locations “Aquaculture” and “Omega-3” and “Toxic”

Despite such discrepancies between the URL locations and the real locations, the results do however show the concentration of activity in areas like Canada, including previously discussed actor Alexandra Morton who was previously discussing her opinion on toxicity within farmed

salmon and toxins leaking into the Pacific Ocean. In conclusion, although the research, journalism, etc. are discussed in particular locations, there is no 'one site' that has a debate(s) specifically

While the main debates, actors, and the networks connecting these actors seem to be located in areas such as B.C and Norway as previously discussed, when digging a bit deeper into the websites and academic articles, it again becomes quite clear that the networks involved in omega-3s and toxicity are both national and international. In this sense, the “location” of networks has many meanings. Although we can see through both websites and academic research that it seems to be heavily involved in areas in the UK, the information extracted from those locations and studies has to be interpreted in many other ways and forms elsewhere.

2.4.4 Location to Timelines

The timeline analysis shows that the controversy emerges in the late 1990s and early 2000s and then is sustained to the present. It is difficult to draw additional conclusions from this analysis apart from suggesting that the controversy around aquaculture and omega-3s continues to be part of the discussion of farmed fish and human health. It is also difficult to determine whether the concern is around human health or the marine environment, as toxic in this controversy refers to both. At the same time, media attention on salmon farming appears to be more focused on concerns around the marine environment. Future research on this controversy may be able to distinguish between a fish that is considered to be toxic for humans and ocean ecologies.

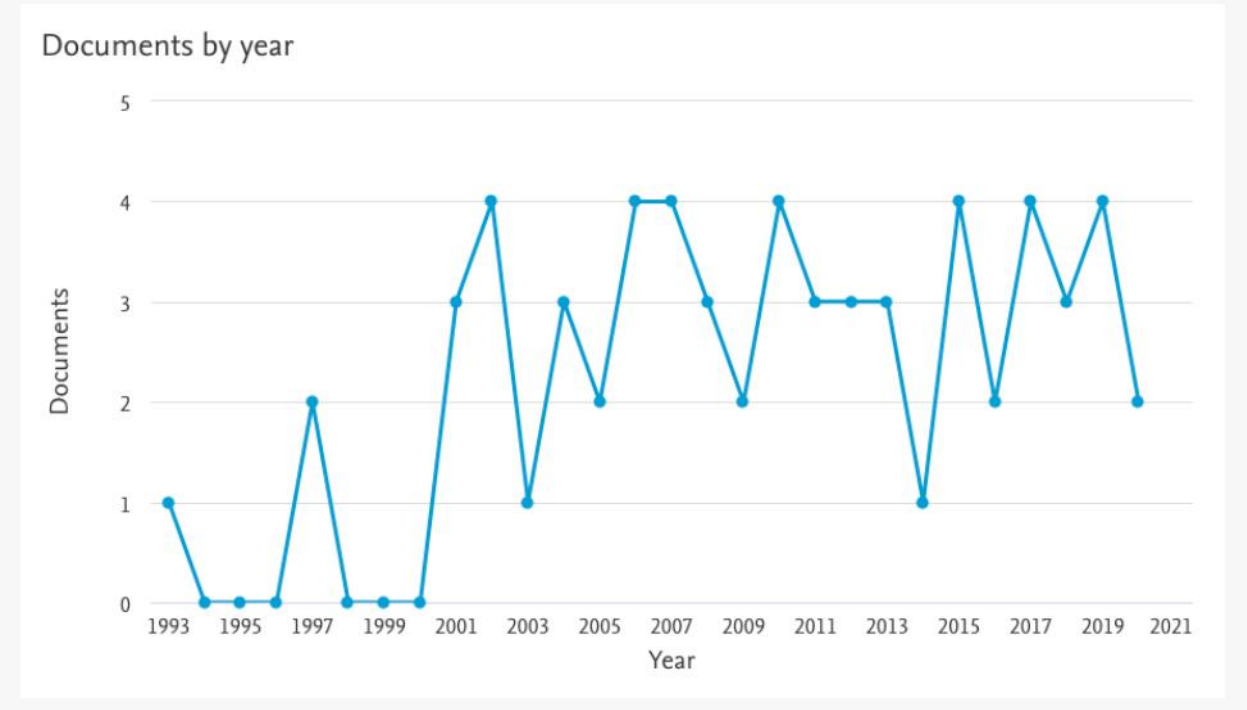


Figure 21: Scopus research of Timelines “Aquaculture” and “Omega-3” and “Toxic”

2.5 Discussion: Omega-3 Controversies

The preceding analysis has focused on two controversies associated with salmon farming and omega-3s. Although the controversies are about farmed salmon and omega-3s, they focus on different matters of concern. The first controversy is about the decline in the levels of omega-3s in farmed salmon, revealed initially in research conducted by scientists at the University of Stirling. In this controversy, the problem is that the nutritional promise of farmed salmon has declined substantially. The second controversy is the concern that farmed salmon is a toxic fish in the sense that it contains toxins that are harmful to humans, and in the sense that production practices lead to harmful impacts on marine ecosystems. In this controversy, farmed salmon should be avoided by consumers, and alternative sources of omega-3s should be found.

While the controversies are different, the exercise of mapping these controversies reveals a number of shared characteristics. First, and most obviously, both are controversies in the sense that they have promoters and detractors. In the case of omega-3 levels in salmon there are actors who are concerned, for a range of different reasons, about declining levels of this important fatty acid in this farmed fish. For other actors, the problem of declining omega-3s can be solved through eating more fish, or through counter claims that the amount of omega-3s in farmed salmon remains sufficient for human health. Similarly, when it comes to salmon and toxicity, there are actors who are very concerned about the problem of toxicity and are recommending that consumers find alternative sources of omega-3s. For others, farmed salmon remains a healthy and clean source of protein. What controversy mapping does is to bring these different positions down to earth by identifying actors, networks and locations through which these controversies develop and unfold.

A further characteristic shared by the two controversies is that the origins of both are in the domain of academic research. The concern associated with omega-3 levels in farmed salmon emerged out of research conducted by scholars at the University of Stirling. Their findings were then picked up and spread by the media and a range of other agents and groups. Similarly, the concern around salmon as a toxic fish emerged through scientific analysis of farmed salmon that found high levels of a range of different toxicants. The results were published in highly regarded academic journals including *Science* and the *Journal of Nutrition*, and then also distributed through media outlets and other non-governmental groups. Through controversy mapping it was possible to identify the actors and networks through which the controversy spread. While the scientific research may be regarded as objective, the analysis of the actors and networks shows

how the scientific findings were adapted and used by different groups. Environmental non-governmental organizations opposed to salmon farming drew on the scientific findings to bolster their case against this form of animal production, while industry representatives aimed to deflect criticism of both declining levels of omega-3s and concerns around toxicity. There was, perhaps not surprisingly, significant overlap between the two controversies in regard to the different actors and networks that were built around the controversy.

The analysis of locations and timelines provided additional insights into the two controversies, although not in an entirely unproblematic way. As I discussed in some detail, the problem with locations is that the URLs do not necessarily reflect where the organization is based. It is possible, as was the case with media outlets such as the Guardian and the BBC, for the location of the URL to be outside the United Kingdom. While controversy mapping as an exercise needs to pay careful attention to this potential challenge in identifying locations, the location analysis for both controversies did correspond to major salmon farming producing countries such as the United Kingdom (Scotland), Norway and Canada. These locations were evident for both wild web searches and scholarly searches. I have similar concerns around the timeline analysis: while the timeline provides a sense of when the controversy emerged, it is more difficult to interpret what the data show beyond this. For example, in the two controversies analyzed here, the timelines appear to show a consistent interest in the issue – declining levels of omega-3s or a concern with toxicants in farmed salmon. Yet the data do not tell us whether the terms of the controversy are shifting or how and why it is being sustained by which actors or networks. Further analysis would be required to answer these questions.

As I noted on several occasions, one of the key advantages of controversy mapping is to bring the controversy 'down to earth' by identifying actors and networks. What is especially notable about the two controversies was not only who participated in the controversy, *but also who was absent*. It is very surprising that no government agencies were involved in either controversy, in spite of the fact that government is a key player in the regulation of food and food safety for consumers in the United Kingdom, Canada and the United States, where the controversy played out. To end this discussion, I engage with Canada's Food Guide, which was recently substantially revised. What can we learn about how regulators view omega-3s and farmed salmon through Canada's Food Guide? Is there any evidence of the controversies that have enveloped farmed salmon?

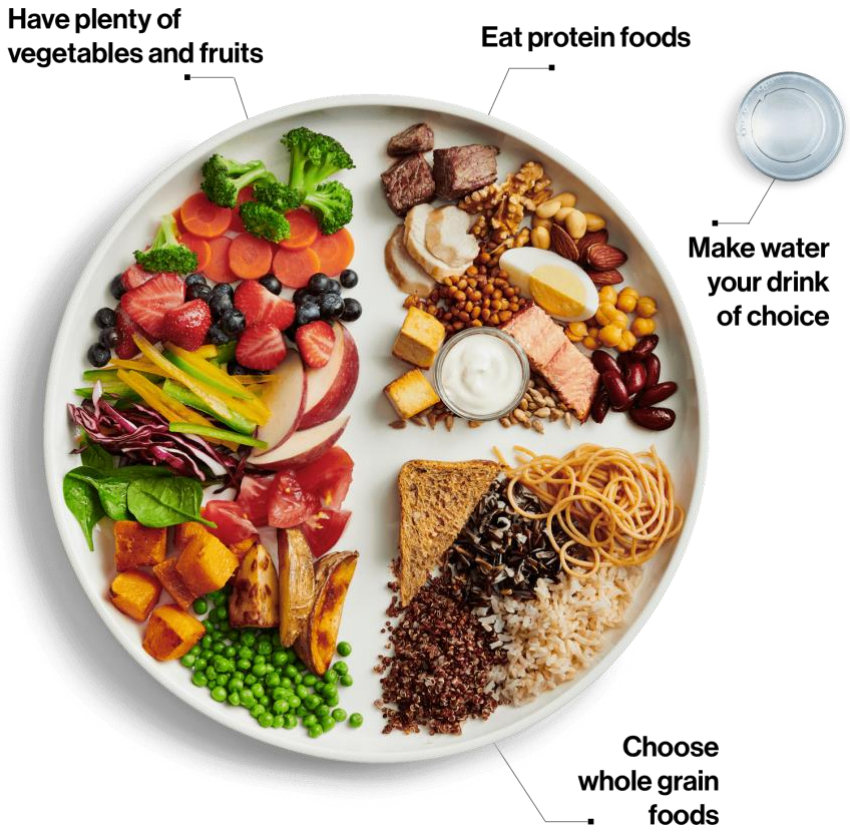
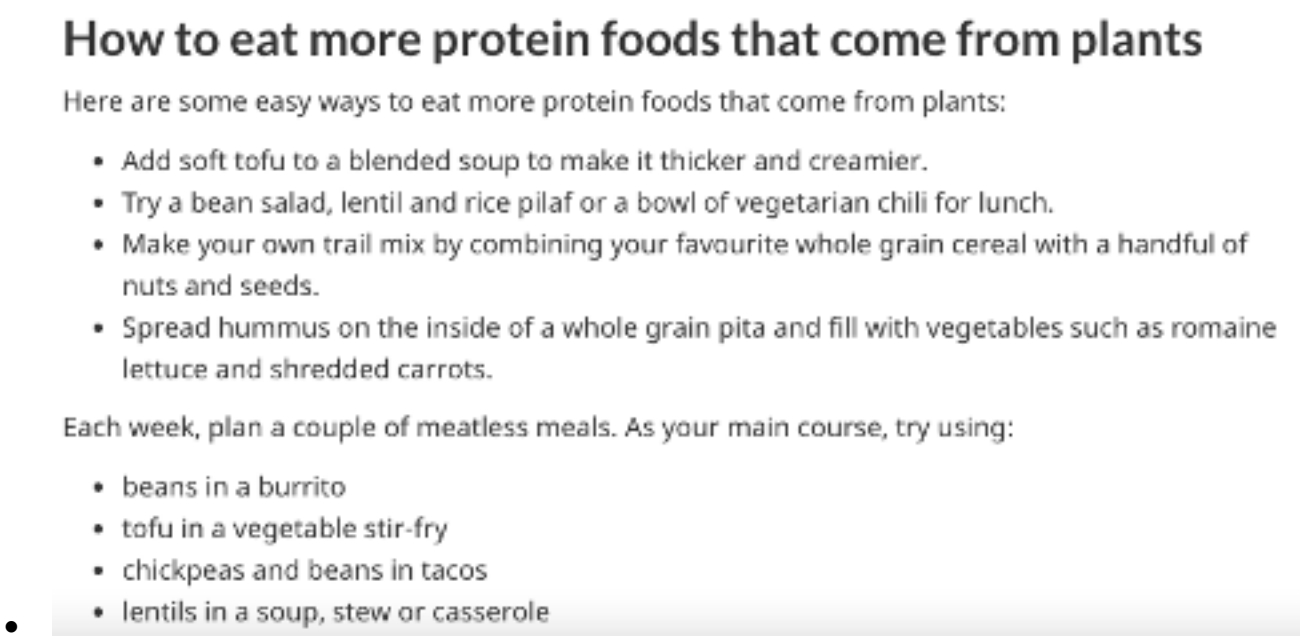


Figure 22: Picture of Food Presented on Canada's Food Guide, 2019

Canada's Food Guide was revised substantially in 2019 and received much media attention. The new guide placed an "emphasis on a plant-based eating and protein sources, while making water the drink of choice" (Oasis, 2019; 1). More notable changes from previous versions include:

- Encouraging Canadians to comprise half of their daily diet with fruits and vegetables and split the remaining half between whole grains and proteins (Oasis, 2019; 1).
- Modify protein food groups to include dairy and meat as well as plant-based proteins like beans and tofu (Oasis, 2019; 1)
- De-emphasize meat-based proteins and instead encourage Canadians to "consume proteins more often" (Oasis, 2019; 1)

With these notable changes alone, what can this mean for omega-3s? We can see that although there is a portion of wild caught salmon (more specifically, Arctic Char) (Sara Frizzel and Katie Toth, 2019) in the presence of the Canada's Food Guide picture, there is no acknowledgement of promoting omega-3s in the diet. Despite seeing a piece of wild caught fish on the Food Guide, is there a particular reason for the portion being so small? Is this to protect consumers from potential toxins? And if that is the case, where should I be getting my omega-3s? Could this link to the previous journal article of seeking omega-3s from other foods? (see Fig. 10). Bringing forward the previous acknowledge of both Greenland Inuit and Japanese populations being connected to nutritional science, they are another population in which is of connection to the settler colonialism in Canada when discussing Canada's Food Guide. Nutritional experiments were conducted on "Indigenous children in residential schools… without their informed consent or knowledge… being directly connected to Canada's Food Guide" (Tennant, 2021). Indigenous populations were a "major player in setting nutritional standards and policy in Canada… like what the daily recommended intake for different vitamin and minerals should be (Tennant, 2021). This sets a prime example for the real world of omega-3s and why we do consider them a big part of our lifestyle, through evidence of power and uneven geographies. On the other hand, the previous study conducted in 2016 recommended eating two portions of fish instead of one to make up for the loss of omega-3s. How would consumers know this based on Canada's Food Guide? Do consumers, like Canadians, know how to judge accordingly when picking meat proteins? With that being that, is there more involvement in these considerations, what this mean, or change within the controversy mapping?



How to eat more protein foods that come from plants

Here are some easy ways to eat more protein foods that come from plants:

- Add soft tofu to a blended soup to make it thicker and creamier.
- Try a bean salad, lentil and rice pilaf or a bowl of vegetarian chili for lunch.
- Make your own trail mix by combining your favourite whole grain cereal with a handful of nuts and seeds.
- Spread hummus on the inside of a whole grain pita and fill with vegetables such as romaine lettuce and shredded carrots.

Each week, plan a couple of meatless meals. As your main course, try using:

- beans in a burrito
- tofu in a vegetable stir-fry
- chickpeas and beans in tacos
- lentils in a soup, stew or casserole

Figure 23: The Government of Canada's Recommendation from Canada's Food Guide, 2021

Canada's Food Guide provides only limited insights into how consumers might use it to navigate the two controversies I have examined in this chapter. In the absence of government recommendations, consumers are faced with having to make decisions on controversies that are difficult to navigate, and without the advantage of the tools of controversy mapping, which provides a sense of the actors and networks that shape controversies.

So, what does this mean for omega-3s as a whole? Some of the remaining questions we are left with can include "are consumers still getting what they expect out of salmon in terms of omega-3s?" "Are declining levels of omega-3s leading to additional challenges associated with the consumption of salmon?" "Is salmon becoming a fish that is known to become damaging to the environment, human health, and with low levels of nutrients?" Through such unanswered questions and the controversies unravelling, people are trying to reckon with these problems; what happens next?

As previously intended, controversy mapping is not designed to give consumers the right or wrong answer toward a particular debate, but rather to open up the conversation to where these debates are headed, and how we, as consumers, can become more aware of the debates at hand. It is up to us however, how to make the decision we see fit for ourselves and our daily lives.

2.6 Conclusion

Controversy mapping is an emerging approach to mapping debates, identifying actors, networks, locations, as a way of bringing controversies "down to earth" (Lepawsky et al., 2019; 438). It addresses the problem of 'floating statements' about controversies that seem truthful but have no apparent author or location. While controversy mapping does not provide citizens with the means by which to make decisions about consumption (e.g. farmed fish) or disposal (e.g. electronic waste) it does nonetheless provide a map of the actors, networks and locations through which statements become truthful. In the context of food geographies where, as Jackson had argued, consumers are increasingly anxious about what they eat (Jackson, 2015). Controversy mapping is an interpretative approach to analyzing debates, actors, networks, locations and timelines. This includes particularly, but not exclusively to, those involving issues of "public concern and those generated around science and technology" (Lepawsky et al., 2019; 438). As we have seen, members of the public are thrown into the middle of various controversies. Finding ways of making sense of these debates is important. In this chapter, two common debates described as public disputes in the world of omega-3s, were brought "down to earth" (Lepawsky et al., 2019; 438). Bringing these debates down to earth allows to see the origins of the controversies and how these were shaped through different actors and networks. It provides a way of grounding these debates and bringing them into sharper relief as is the case with all mapping exercises.

Controversy mapping does not provide anxious consumers on what to do or what to eat when it comes to farmed salmon and omega-3s. Instead, it provides a stronger understanding of the positions contributors (or actors) make in their debates and how we can make our own decisions. With omega-3 decline and toxicity with farmed salmon, the various discussions about actors, locations, and how they connected, or not connected, through networks plays an important role in developing understanding and awareness of this controversy. As Sarah Whatmore has presented, controversy mapping, "helps to present a proposal intended not to say what is or is not correct, but to provoke thought; it requires verification in a way to enable to 'slow down' reasoning and create an opportunity to arouse a slightly different awareness of the problems and situations mobilizing us" (Whatmore, 2009; 587).

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Chapter 3: More than food geographies of omega-3s

3.1 Introduction:

Omega-3s are widely recognized as a crucial fatty acid for human health and development. Years of scientific research has shown, for example, that omega-3s can improve eye health. This includes reducing the risk of macular degeneration, one of the world's leading causes of permanent eye damage and blindness (Hjalmarsdottir, 2018). Omega-3s are also recognized as playing a role in improving various forms of mental illness and disorders (Hjalmarsdottir, 2018). Finally, and perhaps more importantly, omega-3s have been made known to promote brain health during pregnancy and early life, and reduce the risks of heart disease (Dusheck, 1985; Jeromson et al., 2015; Hjalmarsdottir, 2018). As I discussed in chapter 2, during the current pandemic omega-3s have been considered to have anti-inflammatory properties that may help reduce morbidity and mortality from the COVID-19 infection (Asher et al., 2021).

Despite the positive impact of omega-3s on health and development, recent research reveals a number of challenges associated with this important nutrient. First, "unequal geographical distribution of omega-3s globally has led to the identification of omega-3 deficiencies in some populations in North America, the Middle East, India" (Hamilton et al., 2020; 59) A second challenge is that foods that are often publicized as having high levels of omega-3s are showing dramatic declines in omega-3 content. As discussed in Chapter 2, this is particularly a problem when it comes to farmed salmon. It means that consumers who are eating foods with omega-3s are potentially at a risk for not receiving sufficient amounts of omega-3s (Norwegian Seafood Council, 2015; Ghosh, 2016; Holmyard, 2016). Finally, the "imbalance of omega-6s in relation to omega-3s in the typical Western diet - often associated with highly processed foods - is leading to health problems for consumers" (Greenberg, 2017; 14). Given these challenges

associated with omega-3s, researchers are now offering solutions to the problems of access, omega-3 content, and the imbalance between omega-3s and omega-6s often seen in Western diets. Two prominent solutions have been presented, which I discuss in turn below.

The first solution to the problems associated with omega-3s is Paul Greenberg's call to shift to an "Omega-3 World". Greenberg is a well-known Ted Talk presenter and American best-selling author. In his book, *An Omega-3 World,* he develops a possible solution to ease the shortages and uneven accessibility of consumers to omega-3s. Greenberg begins by discussing the origins of the problem before considering the possible solution: "We industrialized both grain and meat production and tilted ourselves to a way of eating and farming that is making us and our planet sick. But today, we stand on the verge of another revolution—a revolution that will take us out to sea and, in a way, back to the very beginning" (Greenberg, 2017; 179). Contemporary patterns of farming, he argues, is leading us down an unhealthy path away from omega-3s, and toward processed food products, which contain higher levels of omega-6s. Greenberg further explains, "this imbalance between omega-3s and omega-6s affects not just humans but is affecting the animals we consume through the processing and feed consumption" (Greenberg, 2017; 112). Greenberg continues on to suggest that, instead of a drastic emphasis from one form of unevenness to another, "a balance should be built along with the Mediterranean Diet, with a stronger significant source towards the sea and "work with it"" (Greenberg, 2017; 14). With the current industrial land foods being tipped so excessively in one direction, slowly raising the prominence of ocean foods to lift the burden off the land and bring the system into equilibrium is recommended. In this way, Greenberg proposes a shift and a new balance in what we might call an 'Omega-3 World'.

A second proposed solution to the challenges involved with omega-3s involves a systems approach. The solution to the geographical uneven access to omega-3s, for Hamilton et al. (2020), requires an emphasis on using omega-3s more efficiently. To this end, they "seek to provide an improvement to the overall resource efficiency to help meet the human demand for omega-3s by identifying the opportunities and challenges involved in meeting the demand system-wide" (Hamilton et al., 2020; 59) Although fish stands as a primary dietary source of omega-3s (EPA/DHA), "fish is becoming less efficient at producing omega-3s due to feed changes, increased food wastage and the uneven distribution of omega-3s geographically, and this is where solutions need to be targeted" (Hamilton et al., 2020; 59). Hamilton et al. also note that "for this system to be proven effective, the digestibility, bioavailability and efficacy of omega-3s in products need to be better understood" (Hamilton et al., 2020; 61). In this *Systems World* to the problem of omega-3s, the focus is on identifying efficiencies in the existing distribution and production systems for omega-3s and improving our understanding of the metabolic mechanisms through which omega-3s are produced. In approaching the problem of omega-3s as a systems challenge, Hamilton et al (2020) point to solutions that involve improving the efficiencies through which humans access omega-3s around the world.

The interventions by Greenberg and Hamilton represent two different solutions to the omega-3 problem. Greenberg (2017) proposes an approach that rebalances the worlds of land and sea when it comes to food and fatty acids. Hamilton et al (2020) on the other hand propose efficiency improvements in how omega-3s are produced, distributed and used. While the proposed solutions are different in both approach and philosophy, both are pointing to a world that uses omega-3s in a way that improves the health of humans globally. Given this similarity, I propose to call the two solutions an *Omega-3 World* and a *Systems World*, where in both worlds the

global population receives sufficient omega-3s with the health benefits that this fatty acid promises.

The solutions proposed through the *Omega-3 World* and *Systems World* present promising solutions to the challenges identified in omega-3s. At the same time, it is possible to identify a number of gaps, challenges and uncertainties in both proposed worlds. For example, while Greenberg is proposing a global food production system that provides a better balance between food sourced from land and sea, he provides little in the way of details of how large companies, producers and retailers will play a role in this 'rebalancing'. In a food system that is increasingly concentrated and dominated by global multinational corporations, what role will they play in his 'Omega-3 World'? Similarly, while Hamilton et al (2020) provide key insights into some of the inefficiencies in how omega-3s are distributed, and how they are produced, their analysis is abstracted from the complex geographies and networks associated with the production and distribution of omega-3s globally. In other words, their approach assumes that commodities can move seamlessly, and that space and friction do not affect how omega-3 is produced and distributed around the world. A key problem for both of these proposed 'worlds' is that they do not have a good understanding of the 'real world' of omega-3s in the global food economy.

Michael Goodman's (2016) critical engagement with the 'more-than-food' approach to food geographies provides a useful set of methodological prompts for mapping what we might call the *Real World* of omega-3s. Through a detailed critique of 'more-than-food' approaches he argues for the need to address three key questions: first, he asks "what is the role of powerful actors on the global foodscape that have a socio-economic stake in manipulating our visceral reactions to food (e.g. health agencies, the media, food multinationals)?" (Goodman, 2016; 261). Second, he

is concerned with how more than food approaches address "other bodies, beyond the consumer, along the food chain such as those who labour over, stack, and prepare our food" (Goodman, 2016; 261). Third, he is concerned with how the approach "addresses the violence of hunger and deprivation as well as lower-level stress caused by the inability to buy the 'right' kind of 'good' food for one's family" (Goodman, 2016; 261). While these questions and concerns are directed at 'more than food' approaches, they are equally relevant to my goal to map the *Real World* of omega-3s, and thereby to critically assess the gaps and assumptions made by Greenberg and Hamilton in proposing an *Omega-3 World* and a *Systems World* respectively.

The remainder of this chapter is organized as follows. The first section provides a detailed description and analysis of the 'more than food' approach in geography in order to situate and provide the context for Goodman's questions that I later use to map the *Real World* of omega-3s. In the second and subsequent sections I pose Goodman's 3 questions to examine what is revealed about the industries and powerful players that are associated with the production and distribution of omega-3s. In this way I present the *Real World* of omega-3s and raise critical questions about the worlds and solutions presented by Greenberg and Hamilton et al.

3.2 Literature Review

Michael Goodman has recently argued that "geographers have begun to approach food as 'more-than-food'" (Goodman, 2016; 258). His argument is that when it comes to food "it is impossible to separate out the notions of culture, space, economy, politics, and materiality with which it is so thoroughly imbued" (Goodman, 2016; 258). In other words, 'more than food' means that the food we eat is not simply made up of protein, fats and carbohydrates, it is also economic, political, cultural and social. The idea of 'more than food' is then a way of "stitching together the

deeper meanings and multiplicity of sites along food networks; from production, consumption, and to everything in between" (Goodman, 2016; 258). For Goodman there are two critical themes in this work: first, what he calls the vital (re)materializations of food geographies and second the visceral nature of eating and politics. For the purposes of this discussion, I restrict my discussion to the visceral nature of eating and politics as this is where his three critical prompts emerge that are relevant to my analysis of omega-3s.

For Goodman a key shift in food geographies has been a focus on the visceral, or "the sensations, moods, and ways of being that emerge from our sensory engagement with the material and discursive environments in which we live" (Goodman, 2016; 259). In terms of food geographies, Jessica and Alison Hayes-Conroy have made key contributions. They have argued that a visceral approach to food allows food geographers

> to make a powerful link between the everyday judgements that bodies make (ex: preferences, cravings) and the ethico-political decision-making that happens in thinking through the consequences of consumption (Hayes-Conroy and Hayes-Conroy, 2008 in Goodman, 2016; 259)

Viscerality, then, when it comes to food is about understanding our everyday judgements, and the expected or anticipated consequences. To begin considering real life examples of visceral geography it helps to think about our own personal choices when it comes to food. Are you, for example, craving something sweet or salty? At the end of a bad day, do you have a guilty pleasure food that you really want? What are you looking for and where do you go? Your favourite local cafe? A particular franchise? Or how about a place your parents or friends told you about that you now rave about with others? When thinking about the answers to these questions, your moods and feelings shape the type of food you pick, the places you go, and more

specially, your way of life. These are some examples of what it means to consider the viscerality of food.

Goodman provides additional useful insights into what it means to study food as a visceral object. First, he writes, "visceral geography advances a greater understanding of the *agency of physical matter* both within and between bodies" (Goodman, 2016; 259). In other words, it is about the effects of the foods we consume on the body itself. Below I discuss how Goyrgy Scinis' work on nutritionism – or the idea that how we consume foods is about its nutritional content rather than the food itself – fits into viscerality (Scrinis, 2013). Second, Goodman argues, "visceral geography also moves beyond static notions of the individual (body), and toward more contextualized and interactive versions of the self and other…" (Goodman, 2016; 259). Here Goodman is referring to the way our consumption patterns are shaped by how we relate to other consuming bodies. For example, is your body obese, thin, etc. compared to other bodies? And lastly, "visceral geography encourages skepticism of boundaries – e.g. mind/body, representation/non-representation – not through a complete dismissal of such dualisms but through insistence on the imagining and practicing of our (political) lives in, and beyond such tensions" (Hayes-Conroy and Hayes-Conroy in Goodman, 2016; 259). Here we see a tension between the body and the politics of what is involved in going into our body. Goodman acknowledges that while the ideas involved in visceral geography are "difficult to pin down", it can nonetheless help to understand some of the complex ways in which we (and our bodies) relate to the foods we ingest (Goodman, 2016; 259).

The interest in viscerality by some food geographers is connected to a broader literature on food studies, that has provided key insights into the changing nature of food consumption, and in

particular the rise of new diets connected to a better understanding of the nutrients in foods. In the last 40 years a key shift has involved understand food as made up of a range of different 'good' and 'bad' nutrients. This has been particularly evident in diet guidelines that focus on a single, isolated nutrient within food (Scrinis, 2013) to reaching the idea of simplicity involving "communicating with numbers" through counting calories (Blitekoff et al., 2014; 17), and developing a diet composed of 50% carbohydrates, 30% fat, and 20% protein, all while maintaining a relevant Body Mass Index (BMI). This shift to what Scrinis (2013) has called nutritionism has played a key role in providing insights into the food's viscerality as it relates to the human body. Rather than thinking about food as object (e.g. an apple), the shift to nutritionism opens the way for thinking about food in terms of its various macro-nutrients (fats, carbohydrates, protein).

Changes in the food system, and especially new knowledge linked to the food we eat, provide insights into how viscerality may be examined. Labelling, for example, now includes detailed information on what is in the food we eat, and we can assess its likely impact on our bodies. Figure 2 below provides an example of a label that provides very detailed information on what is in the product, and it confirms the point made by those proposing viscerality that we can see and assess the agency of what we are eating. In the example, the food has a specific number of calories, fats and vitamins, all of which we can assess in regard to its impact on our body. This is what Goodman means when he writes about 'the agency of physical matter' (Goodman, 2016; 259). The 'Fruit Loops' package also tells us that this cereal is an important source of fibre and is a source of 'seven essentials nutrients.' In this way the promotional material tells us what we can expect from eating this cereal and the impact it will have on our bodies. This is one component of the 'visceral turn' in more than food geographies.

Nutrition Facts

1 serving per potato

Serving size 1 potato (148g/5.3oz)

Amount per serving

Calories **110**

	% Daily Value*
Total Fat 0g	**0%**
Saturated Fat 0g	**0%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 0mg	**0%**
Total Carbohydrate 26g	**9%**
Dietary Fiber 2g	**7%**
Total Sugars 1g	
Includes 0g Added Sugars	**0%**
Protein 3g	
Vitamin D 0mcg	0%
Calcium 20mg	2%
Iron 1.1mg	6%
Potassium 620mg	15%
Vitamin C 27mg	30%
Vitamin B_6 0.2mg	10%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Figure 24: Example of a Nutrition Fact Label

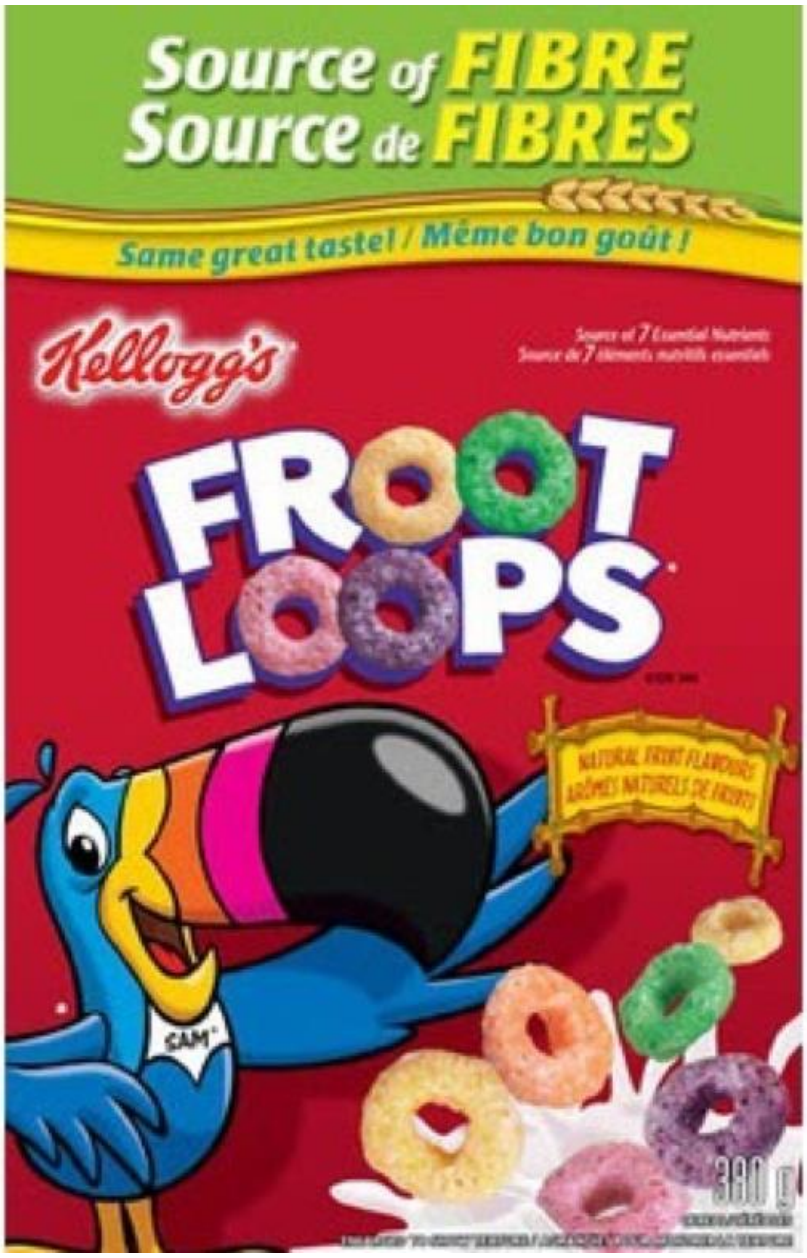

Figure 25: Example of a Nutrition Fact Label

While the visceral approach to food has drawn on nutritionism as a way of exploring new relations between food and bodies, it has also questioned the apparently straightforward relationship between what is in food and its impact on our bodies. Biltekoff et al. (2016) for example, explain that nutrition is “far from simple” and that the assumption that all bodies will respond similarly to particular foods and nutritional content in the same way is incorrect

(Biltekoff et al. 2016; 17). Foods that have vitamin and mineral content, in addition to calories, are not tangible or visible to the eye and depend on expert knowledge to truly evaluate their presence. Therefore, these "specific orders and values on food can hold so much sway into our daily choices and lives" (Blitekoff et al., 2014; 18) Viscerality can also be complicated by confusing messages about the impact of food on our bodies. Becky Mansfield, for example, has shown that the benefits that omega-3s can bring through fish consumption may also lead to illness through contamination (see also chapter 2). The resulting messages are confusing for consumers who are encouraged to 'eat more fish' because it has health benefits or 'do not eat fish' because it will make you sick or ill. As Mansfield writes, "eat more fish because it is a wonder food, and yet, eat less fish because it is toxic" (Mansfield, 2011; 414). The visceral approach to more than food geographies highlights the way in which the agency of food as a physical source can be both positive and negative to consumers and their bodies.

While the visceral turn in food geographies is playing an important role in building what Goodman calls a 'more than food geographies', he nonetheless provides several critical questions about this approach. In particular he is concerned with "what is gained but also lost through this overtly body-centric and 'eater'-oriented approach to food geographies'" (Goodman, 2016; 260). In other words, while focusing on the more than food impacts on the body, what do we gain in terms of understanding and what is lost in terms of analysis? He is particularly concerned with a shift in focus on the body itself and away from how other bodies in production and consumption chains matter when it comes to food. Goodman articulates his concerns through three specific questions:

1. "Is there room in this perspective to understand the other seemingly very powerful actors on the foodscape that have a socio-economic stake in manipulating our visceral reactions to food (e.g. health agencies, the media, food multinationals)?" (Goodman, 2016; 261). In other words, Goodman is asking how powerful organizations can fit into viscerality and its use in understanding the relationship between food and bodies.
2. "What about the relational visceralities to other bodies along the food chain such as those who labour over, stack, and prepare our food?" (Goodman, 2016; 261). What Goodman is suggesting here is the importance of acknowledging other bodies other than our own in the context of this turn to viscerality in food.
3. "How might this framework provide insight into the visceral violence of hunger deprivation as well as lower-level stress caused by the inability to buy the 'right' kind of 'good' food for one's family?" (Goodman, 2016; 261). In this question, Goodman is pointing to areas of potential hunger and deprivation in the context of research on viscerality that has tended to favour consumption in rich developed world contexts rather than situations where food insecurity and hunger are prevalent.

These questions are significant for the analysis of omega-3s and especially the omega-3 worlds presented by Greenberg and Hamilton. They help, I will argue below, to reveal the *Real World* of omega-3s. One way of illustrating what Goodman is calling for is evident in an analysis of omega-3s by Abrahamsson et al (2014). They argue that nutrients like omega-3s do not exist on their own, and suggest that we need to see them not just a fatty acid, but to see them in the context of how it "interacts within particular bodies, across spaces, and in particular contexts" (Abrahamsson, Beroni, and Mol, 2014; 416). In this way, Abrahamsson et al point to the

broader connections between omega-3s and bodies beyond those that are involved in the consumption of this important nutrient. This chapter aims to build on this work using Goodman's three questions about viscerality.

The problem for Goodman is that in focusing on the consuming body the visceral approach ignores or discounts the other "bodies" that contribute to our understanding of the foods and systems around us. In raising the three critical questions about viscerality, Goodman is hoping for an approach that can "contribute to a more integrated and less reductive understanding of the healthfulness of food, (while at the same time) acknowledging how we have lost sight in these other bodies" (Goodman, 2016; 263). With the help of Goodman's three questions, a broader understanding of more than food geographies emerges, including for omega-3s. And for the purposes of this chapter it provides a way of revealing the *Real World* of omega-3s.

3.3 Question One: Acknowledging Actors

To begin to understand what is going on in the *Real World* of omega-3s, I want to begin with the question of: "*Is there room in this perspective to understand the other seemingly very powerful actors on the foodscape that have a socio-economic stake in manipulating our visceral reactions to food (e.g. health agencies, the media, food multinationals)?"* (Goodman, 2016; 261). In examining the role of powerful agents in the foodscape of omega-3s, I examine the role of two organizations: The Global Organization for EPA and DHA Omega-3s (GOED) and Cooke Aquaculture.

3.3.1 GOED

The Global Organization for EPA and DHA Omega-3s, or the GOED, has as their mission "to increase consumption of EPA and DHA omega-3s, regardless of the source, and to ensure that members produce quality products that consumers can trust" (GOEDa, 2022). Through their membership and the networks they have established, the GOED "aims to support global education efforts for consumers, the media, and food 'influencers' around the benefits of omega-3s" (GOEDa, 2022). GOED's activities have involved global market surveys around attitudes to health and wellness activities, with a view to promoting the benefits of omega-3s. They have also undertaken analysis of market dynamics and they have encouraged new product development for food categories that contain omega-3s across several regions of the world. On the basis of this work, the GOED claims to be at least "partially responsible for an EPA and DHA consumer product market, which is projected to grow by 6.1% for 2020-2021" (GOEDb, 2022). GOED annual reports suggest that these analyses and promotional efforts can play a critical role in enhancing positive messaging for consumers around omega-3s messaging. Finally, GOED has a played a critical role through media outlets, claiming to be able to provide positive messaging to between 300 and 500 million consumers from 2018 to 2019 through outlets such as Microsoft Network (MSN), Reader's Digest, and Huffington Post. For the growing membership of companies and organizations involved in GOED – "increasing at a rate of 4% a year according to their own data – this work ensures that producers food and other commodities containing omega-3s can be confident that their products will be positively received in the market" (GOEDb, 2022). Beyond the role it plays in representing individual companies, the GOED is playing a key role in promoting the consumption of EPA and DHA omega-3s in both region and product distribution (see Figure 26 and 27).

For companies that join the GOED, they benefit from its promotional efforts on omega-3s, and they benefit from being part of a larger network of companies that are identified around this particular macronutrient. As the GOED itself explains, by being a member not only are you "supporting global education efforts for consumers, the media, and healthcare professionals about the importance of EHA and DHA omega-3s", but "your company gains market value by aligning with GOED" and "you can expand your business connections by leveraging [the] extensive member network" (GOEDc, 2022). There are three levels of membership within the GOED (Leadership, Plus, and Base), each giving various benefits, and more benefits as the level increases. One of their highest-ranking members in the Leadership category is DSM Nutritional Products. Located in New Jersey, USA, they are the "world's leading supplier of vitamins, carotenoids, and other fine chemicals to feed, food, pharmaceutical, and personal care industries" (GOEDc, 2022).

In the context of omega-3s, and in relation to Goodman's concern to critically examine the role of powerful agents in the food system, we can see that the GOED is a large and powerful player representing interests connected to omega-3s. How is the GOED shaping the consumption of omega-3s, and how does it relate to my concern around the *Real World* of omega-s? First, it is important to note that while the GOED claims to be global, the companies it represents are located in specific regions of the world: North America, parts of South America, parts of Europe and a small number of companies located in Africa. Regionally, most companies are located in North America and Europe. In this way, its membership is highly skewed towards North America and Europe with limited representation elsewhere. Note also that the types of products produced by GOED members are geared to people who are much less likely to be food insecure. Anchovy concentrates, for example, are used mainly as an ingredient for farmed fish feed

including salmon and other finfish aquaculture. Refined anchovy finds its way into fish sauce products that are used to enhance pastas and stews. These and other products produced by GOED members are not geared to people in the global south who may also want to benefit from omega-3s. Clearly, the GOED is representing companies who are responding to the *demand* for omega-3s in mainly developed countries by making bigger networks – a demand that is created in part through GOED's own efforts – rather than the *need* for omega-3s, which is arguably global.

The GOED plays another critical role in promoting omega-3s. While omega-3s are widely considered to be important for human health, there are debates around its effectiveness and there is ongoing research suggesting that the benefits of omega-3s are overstated. GOED has played a very important role in attempting to shut down or contest studies that raises questions about the benefits of omega-3s. For example, in a blog post on GOED's website in 2015, Adam Ismail, Executive Director stated, "once again the role of omega-3s in health is being called into question…I feel compelled to try to remind people that we need to look at the overall…science before drawing conclusions based on one single study" (Starling, 2015). In a subsequent discussion titled "The Bias Against Seafood and Omega-3s" the GOED highlighted "... new dietary guidelines for Americans were released last week…from our perspective, they continue to reinforce the important role of seafood and omega-3s in the diet…" (GOEDd, 2022). In representing companies producing omega-3s, the GOED also ensures that studies that raise questions about omega-3s as a health elixir are contested.

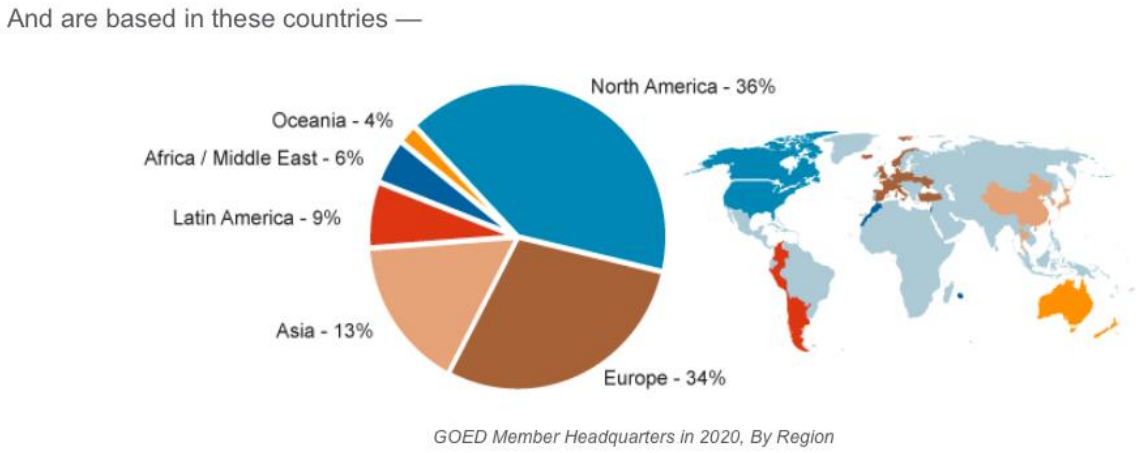

Figure 26: GOED Member Headquarters in 2020, By Region (GOEDc, 2022)

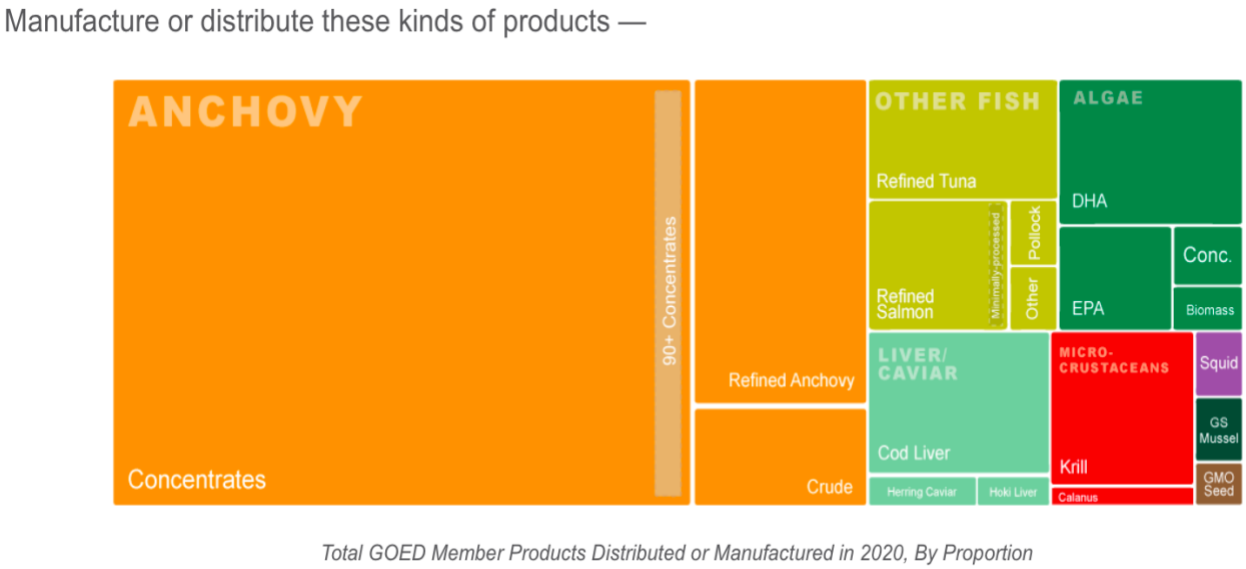

Figure 27: Total GOED Member Products Distributed or Manufactured in 2020, By Proportion (GOEDc, 2022)

The GOED is an example of what Goodman identifies as a 'powerful actor on the foodscape' with direct relevance to omega-3s. It provides a first illustration of why answering this question may be useful to constructing what I am calling the *Real World* of omega-3s. The organization represents companies producing omega-3s by promoting the benefits of omega-3s through the media, but its efforts are limited geographically to North America and Europe, and the products it supports are for specific uses where consumers are unlikely to be located outside of these two regions. The GOED is one powerful actor in the omega-3 foodscape; we now turn to a second actor that is equally powerful in this foodscape.

3.3.2 Cooke

Cooke Aquaculture describes itself as a company with "vertically integrated salmon farming operations in Atlantic Canada, the United States (Maine, Washington), Chile, and Scotland, as well as seabass and seabream farming operations in Spain" (Cooke Seafood, 2022). Cooke is also one of the largest producers of farmed salmon in Canada and supplies farmed salmon to markets in both Canada and the United States. Significantly, for the discussion here, Cooke has recently secured quotas for menhaden, a small oily fish that is found in the Northeast Atlantic. Menhaden have historically been harvested as fertilizers, animal feed, and bait. While direct consumption of menhaden has not been popular due to their taste, they have nonetheless played a key role in supporting food production through "enhancing the soil and through feeding of livestock including chickens and pigs" (Franklin, 2007 in Cuker, 2020; 96). More recently, however, because of their high levels of omega-3 fatty acids, they have been used to develop human supplements (e.g., omega-3 capsules) and for the same reason they have become important in manufactured fish feed for farmed salmon (NOAA, 2021).

The menhaden commercial fishery is the one of the largest fisheries on the East Coast of the United States. Historically harvest levels have been above 700,000 tonnes, but the stocks have been under pressure in recent years with harvest levels ranging from between 50,000 and 125,000 metric tonnes (Cuker, 2020). The decline in menhaden stocks has been a concern for environmental groups and sportfish anglers given the key role this fish plays in the ocean ecosystem. Menhaden play an important role as a source of food for sportsfish that are caught recreationally and for food including striped bass, for a range of bird species and for dolphins (Cuker, 2020). They also, importantly, play an important role in 'cleaning' estuaries of excess algae through filtering ocean water of plants and other suspended material. As Franklin argued, menhaden act as "colossal submarine vacuum cleaners…purging suspended particles that cause turbidity [thereby] allowing sunlight to penetrate [which] in turn encourages the growth of aquatic plants that release dissolved oxygen while also harbouring a host of fish and shellfish" (Franklin, 2007; 8). In this way, menhaden also prevent the development of harmful and algae blooms, which can have a dramatic impact on aquatic ecosystems. This 'most important fish in the sea' (Franklin, 2007; 8) thus plays a key role in sustaining aquatic environments and food systems that rely on the sea.

The quotas for this important stock are almost exclusively controlled by one company, Omega Protein. In 2017, Omega Protein was acquired by Cooke Aquaculture for obvious reasons: by securing Omega Protein it effectively secured the menhaden fishery on the East Coast of the United States, and a key source of omega 3s for its salmon farming operations in Canada and the United States. However, Omega Protein has faced substantial challenges and controversy given the decline in menhaden stocks, pressure to reduce quotas and the clear environmental impacts

that have emerged as menhaden stocks have declined. The most evident environmental problems have emerged in Chesapeake Bay where hypoxia and other environmental problems have worsened, arguably in part because of the decline of menhaden (Franklin, 2007). In spite of these environmental problems, Omega Protein announced that it would be exceeding the quota set for Chesapeake Bay, to the dismay of regulators, anglers and environmental groups (Franklin, 2007).

The acquisition by Cooke of Omega Protein in 2017 was clearly an effort to ensure that its farmed salmon are able to maintain high levels of omega-3s, and to potentially combat claims that farmed salmon have increasingly lower levels of this important fatty acid (Franklin, 2007 in Chapter 2). Yet its control over menhaden – a stock that is clearly under pressure in spite of its key role in ocean ecosystems – shows how powerful organizations like Cooke are able to control and distribute omega 3s in particular ways to particular consumers in the United States and Canada (through fish or capsules), but with considerable environmental consequences. The case is relevant to Goodman's question about the powerful agents in the food chain are acting around omega 3s, and it provides some insight into the *Real World* of omega 3s. It also, significantly, raises questions about the omega 3 worlds being proposed by Greenberg and Hamilton. Powerful agents in the food system are ensuring that the flows of omega 3s are not being distributed more efficiently (Hamilton's *Systems World*), and these agents are not interested in providing a better balance between land and sea (Greenberg's *Omega 3 World*). Instead, in the *Real World* of omega 3s, this important fatty acid is shaped by the powerful actors in the foodscape. In the case of GOED, it means that the companies producing omega 3s for specific consumers are supported, and debates around the value of omega 3 capsules (Logan, 2003; Swanson, Block & Mousa, 2012; Kirby & Jackson, 2010) are contested, while in the case of Cooke we see how omega 3s are sourced to ensure that salmon have sufficient levels of this important fatty acid, but

with important environmental consequences. In the next section, I turn to focus on Goodman's second question to consider the role of other bodies in the chain.

3.4 Question Two: Relating to Other Bodies

Goodman's (Goodman, 2016; 261) second question is: "what about the relational visceralities to other bodies along the food chain such as those who labour stack, prepare and well our food?". This question comes from a place of concern for responsibility and acknowledging the people and animals that are responsible for ensuring that we have access to the food we need. It is a way, as Goodman argues, of allowing "geographers to make [a] powerful link between the everyday judgements that our bodies make and the decisions that happen from the consequences of the consumption" (Goodman, 2016; 259). In the context of this research on omega-3s, the other bodies that need to considered include workers involved in salmon production as well as salmon bodies that are farmed to produce food with omega 3s. By focusing on these issues, we are able to situate Goodman's question in the world of omega 3s: specifically, what happens when we consider other bodies beyond the body that eats food with omega 3s? And how does this relate to the worlds proposed by Greenberg and Hamilton, and is it relevant to what I am calling the *Real World* of omega-3s? In what follows I consider two examples of worker and salmon bodies. In the first example, I discuss the events surrounding a video that was released on a processing facility owned by Cooke Aquaculture showing graphic details of animal abuse. In the second example, the discussion shifts to Chile where I explore the labour conditions facing salmon workers in that region.

3.4.1 Working Bodies

In late 2019 a video appeared of Cooke Aquaculture workers mishandling farmed salmon at a processing site in Bingham, Maine (CBC/Radio Canada, 2019). The video was posted by a non-governmental organization called Compassion over Killing and was widely distributed. It showed graphic and disturbing images of fish being thrown into posts and stomped on by workers. The video also showed fish with spinal deformities and fungal growths. Not surprisingly, the video led to widespread condemnation of the specific event and fueled the concerns of anti-salmon aquaculture groups opposing this form of industrial food production. As Compassion Over Killing argued, the "ground breaking video takes you beneath the surface of the factory farming of fish, revealing putrid conditions breeding disease and parasites as well as widespread cruelty to fish intensively crowded in barren tanks" (CBC/Radio Canada, 2019). Cooke, for its part, apologized for the events saying that "as a family corporation, we place animal welfare high in our operating standards and endeavour to raise our animals with optimal care and consideration of best practice (CBC/Radio Canada, 2019).

The release of the video led to a formal review of the events by the Maine Animal Welfare Program ('Bad Techniques' to blame for fish mishandling incident at Cooke hatchery, 2019). The results of the formal review found that "poor training, not ill intent," is behind the mishandling at Cooke (Probe says poor training, not ill intent, behind fish mishandling at Cooke, 2019). The review continued by suggesting "… what is revealed here in terms of staff attitudes, if true, is shocking… I would strongly advocate frequent audits in US aquaculture operations as a step in ensuring high animal welfare standards, transparency, and consumer confidence in responsible farming standards…" (Mayer, 2019). In response to these allegations, Cooke's announced how they were responding to the problem: "we are immediately updating our

facilities Health Management Plan and enhancing procedures and training for handling protocols… like most, we respect anyone's dietary choices… we encourage employees to speak up when they have any questions or concerns, or if they feel that practices are not being adhered to" (Mayer, 2019).

This first example points to the intersections between workers and salmon bodies that are ultimately responsible for providing food rich in omega 3s. In this case salmon bodies were treated terribly, but there were clearly problems with how the workers were or were not being trained and the formal report on the incident also found that there were human resource problems in the Cooke facility. In addition, Cooke invested in new more humane fish killing equipment following the release of the video and the formal probe by the Maine Animal Welfare Program. If they were concerned with animal welfare, why had they not invested in this equipment earlier? In other words, this was not a straightforward situation of workers mishandling fish – there were problems with training, equipment and the treatment of workers. In considering this first example, I have come to consider some of the potential contextual reasons that might help explain this misconduct and its effects on salmon bodies. One issue is that employment in aquaculture does not seem to be popular: recruitment and retention is a serious problem for the industry even in rural areas where employment is low (Rigby et al, 2016; Knott and Mather, 2021). At the same time, problems of recruitment should not excuse companies like Cooke whose workers reported becoming 'desensitized' by how the fish were killed. In addition, there are clear occupational health and safety regulations that should avoid this situation from occurring. For example, Occupational Health and Safety Regulations also require "an employer shall develop and implement a written procedure for checking the well-being of a worker

assigned to work alone or in isolation and the procedures for working alone in an environment in Newfoundland and Labrador (Digital Government and Service NL, 2020). This raises the question about whether the company followed these regulations, and whether not following them contributed to the incident. If followed, it seems as if these regulations could have potentially prevented this incident and others. If standard working hours, days of rest, daily maximum hours, and resting period protocols were followed, this also could prevent this said desensitization in the job of taking care of animals (RSNL chapter L-2 – labour standards act). Treating human bodies with the respect they deserve may be crucial to how salmon bodies are treated in production sites.

3.4.2 Workers and Salmon Communities in Chile

My second example has to do with workers and salmon bodies in Chile, an important site for global salmon production. In Los Lagos Region in southern Chile, the salmon industry has grown rapidly over the last three decades. By 2008, Chile had become the second largest producer of salmon in the world next to Norway. However, the industry was devastated by an infectious salmon virus outbreak affecting production of Atlantic salmon in the country, lasting four years (2007-2011). Not only did this result in “closures of production centers, mass redundancies, and high rates of unemployment, but revelations of various other crises and concerns have been on the rise since” (Bustos-Gallardo and Irarrazaval, 2016; 1). Bustos-Gallardo and Irarrazaval go on to say that “although the official story of the salmon industry in Chile is a tale of pioneers and modernization” says Bustos-Gallardo and Irarrazaval, “it is tainted with several crises that could have [and should have] raised alarms” (Bustos-Gallardo and Irarrazaval, 2016; 7).

One of the crises that have been acknowledged, since the early 2000s, was the demand for better environmental and labour regulations. These concerns were raised by environmental non-government organizations (such as Oxfam, Terram, or WWF) who began campaigning against the salmon industry. Bustos-Gallardo and Irarrazaval explain that "producers claimed that they were the only industry with a specific environmental framework, but critics quickly pointed out the loopholes of the regulation… reports were only once a year by consultants hired by firms, only measuring conditions without checking other criteria…" (Bustos-Gallardo and Irarrazaval, 2016; 7). This led to a possible reasoning behind the virus crisis in the 2000s. Furthermore, according to three major groups (salmon industry workers, independent artisan fishers and women in communities) in southern Chile, their "experience in the context of salmon development points to the negative impacts of salmon industry growth" (Barrett, Caniggia, and Read, 2002; 1956). Surplus labour, low wage levels, and poorly enforced or non-existent health and safety standards are "conditioning factors in the success of salmon farming in southern Chile" according to Barrett et al. (2002; 1956). In other words, the industry relies on low wages and poor working conditions. For example, processing workers in locations like Quellón and Tenaun normally worked a 48-hour work week, with up to an additional 10-12 hours a day with overtime pay in the high season, but at very low wages. In addition, "replacing permanent workers with temporary ones further eroded wages" (Barrett, Caniggia, and Read, 2002; 1957). When discussing health and safety, the most common complaints were raised by women. From no washroom facilities for women, to no place to change into dry clothing after working in cold, wet, and unhygienic areas, and no chairs to sit down on during long shifts, a union organizer said the following:

> There are no washrooms for the women. They work long hours a day on the platforms (i.e. of salmon cages). The men's "washroom" is over the side of the boat. Many women

> complain of cystitis, however companies do not treat this as a work related problem. They work outside in wet weather all day. After five to six years workers do not want to do this anymore. The health conditions, and according to law they have a responsibility to deal with diseases related to the job, but there is no enforcement of these laws (Barrett, Caniggia, and Read, 2002; 1958)

Since the crisis however, the industry as a whole has been trying to improve its production practices. This has included but may not be limited to a new sanitary regulatory framework that increased regulatory procedures, sanctioned state powers, and authorized oversight and professional staff for state agencies responsible for the industry. With this, it has "forced them to better understand salmon virology, assimilate in their work better sanitary practices, and share knowledge between firms to collectively secure realization of capital for each firm" (Bustos-Gallardo and Irarrazaval, 2016; 14). Similar to the situation with Cooke, but at an industry wide scale, companies in Chile have attempted to improve conditions for workers while addressing the concerns around salmon diseases.

While the industry has been attempting to improve conditions, they are nonetheless facing the long term impact of the crisis. The "financial impact of the crisis led to job losses estimated at between 15,000-30,000, which had a severe negative impact on the relationship between industry and rural communities of Chile" (Bustos, 2015; 1371; Bustos-Gallardo, 2017; 1). Although Beatriz Bustos-Gallardo explains that, "linking rural communities with global centers of consumption, and connecting central cities with rural areas [provide] labour for this industry", she continues on to say that "this has profound consequences for rural communities because the institutional arrangements sustaining the industry's existence… have disciplined communities… prioritizing salmon farming over economic practices" (Bustos-Gallardo, 2017; 1). This branched into several other concerns involved in the industry and areas of Chile.

The loss of jobs was not the only problem affecting community – salmon industry relations in Chile. While the industry promised many jobs, it also led to local exclusions and preference was given to outsiders for higher paying jobs:

> In general, the people that arrived to work in aquaculture were young professionals with little experience who spent lots of time at the sites, thus, there were issues with connecting with the local community that were not resolved for the better. I mean, they earned a reputation for being arrogant, which generated a certain reaction, but it also allowed local people to earn a salary – Government Officer (Bustos-Gallardo and Irarrazaval, 2016)

Problematically, one of the outcomes of the crisis was internal restructuring with further loss of jobs and shifts of production to more remote areas of Chile:

> That happened with the ISA virus, we had an enormous invasion of fishermen that were never fishermen getting into the sea. But as I've said, 'a man's gotta do what a man's gotta do'. We all are going to do what it takes to keep our women and our children provided. That affected us in a bad way, because the (fish) prices were on the floor… because the artisanal fishing sector is the 'mattress' for the regional and national unemployment. Anyone who is let go from a job will come to work in the sea because we have so much geography, so much sea, and so much coastline. There cannot be a watchdog every hundred metres, it's ridiculous. Piracy, then, is part of the everyday here. Piracy affects us in order to sell resources". – Fishermen Union, Calbuco (Cited in Bustos-Gallardo and Irarrazaval, 2016)

The scholarship on aquaculture development in Chile, in the wake of the ISA crisis and beyond, suggests that while the salmon industry was considered to be 'the poster child of success', for working people it exposed all of the "failures and contradictions neoliberalism can hold [like] volatility, geographic inequality, and resource dependence" (Bustos-Gallardo and Irarrazaval, 2016; 2).

3.4.3 Working bodies, salmon bodies and the worlds of omega-3

In answering Goodman's question about the other bodies involved in the production of food I have focused on both salmon bodies and the bodies of workers that are involved in salmon

aquaculture. These are the bodies that ensure that consumers who eat salmon can get the omega-3s that are so important for human health and well-being. Yet these bodies, the real bodies that are responsible for salmon meals, are absent from the Hamilton's *System World* and Greenberg's *Omega-3 World*. In the world of systems, humans and fish do not feature; instead the focus is on the flows of omega-3s that need to be made more efficient and that need to be distributed more widely. Yet how this shift might happen is not considered or, more importantly, through which means these laudable goals can be achieved is not specified by Hamilton et al. (2020). In the world of systems there are no fish and there are no humans. While Greenberg's *Omega 3 World* does consider fish like farmed salmon, and he is concerned with the power of some large companies, he too provides little analysis of the *Real World* of salmon and worker bodies in places like Maine and Chile. In the examples I have examined here, salmon bodies and human bodies are connected in fundamental ways, and mistreatment of one appears to lead to the mistreatment of the other. In Maine, the source of the problem was how workers were treated and a lack of adherence to occupational health and safety regulations. In Chile the ISA virus disaster of the early 2000s exposed an industry that was poorly regulated with impacts on both human workers and salmon. The long-term effect of the outbreak was lost jobs, deep restructuring and industry concentration with a worsening of relations between community and salmon industry. As it relates the salmon and human bodies, this is the reality of the *Real World* of omega-3s. In the next section, we turn to considering Goodman's third and final question on the problem of being able to secure the right food for one's family.

3.5 Question Three: The Stress of Food

Goodman's final question is: "how might this framework [i.e. visceral approaches] provide insight into the visceral violence of hunger deprivation as well as lower-level stress caused by the inability to buy the 'right' kind of 'good' food for one's family?" (Goodman, 2016; 261). Here, Goodman is questioning whether the visceral approach can be used in contexts not only where food is seen as containing key nutrients for health for people who are already well fed, but also in contexts of hunger and deprivation. A key problem with the visceral approach is that it tends to emphasize the concerns of consumers who are able to choose foods that are more nutritious including functional foods, which Clapp and Scrinis argues are typically targeted at *wealthier* consumers who are concerned about specific health issues and/or nutritional needs, rather than with just achieving an adequate diet and avoiding nutrient deficiencies (Clapp and Scrinis, 2016). In some cases, this means that people who can access pills full of the right nutrients are in a very different relation to food than people who have no other choice than to consume food lower in nutrients: "Wealthy mothers can buy differentially branded omega-3 fish oil capsules for themselves, their children, and even their pets. However, working-class mothers may be at best able to afford omega-3 enhanced bread" (Probyn, 2016; 135-36).

Research on fish as food has tended to focus on the nutrients or the risks of consuming particular fish species without necessarily considering *who* can choose. Becky Mansfield's research on the risks associated with farmed fish, for example, focuses on the dilemma facing consumers who want omega 3s, but may be concerned about the risks of contamination in the same farmed fish (Mansfield, 2011). These consumers are faced with a difficult choice: eat farmed fish or choose

an alternative source of omega 3s. Companies like Blackmores, who produce health supplements, advertises itself as being "passionate about natural health and inspire people to take control of and invest in their well-being" (Blackmores, 2022). However, who is able to 'take control' and who is not? In this section, I examine two sites where nutritious fish are extracted for fish feed and then fed to farmed salmon. The sites are the coast of Peru, the site of the largest source of pelagic fish for fish feed, and the coast of West Africa, an emerging site for fish feed production. The chains of extraction and production that allow fish feed companies to produce nutritious feed for farmed salmon from these two sites, simultaneously remove nutritious fish from places where people face problems of food insecurity. Examining this transfer of nutritious fish from one site to another provides a way of answering Goodman's concern with visceral approaches; it shows how people who are unable to buy the right food for one's family, and the stress that comes with food insecurity. As before, answering Goodman's question is also relevant to the worlds proposed by Greenberg (2017) and Hamilton et al (2020): to what extent do the *Omega-3 World* and *Systems World* consider the problems of global chains that transport fish feed across the world and the unequal access to omega 3s that follows?

3.5.1 Pelagic fish and omega-3s

Historically, pelagic fish like sardines and anchovies have been important as food for human consumption. In the case of sardines, as Probyn (2016) argues, they emerged as an important source of food in the United States in the 1880s. The importance of sardines intensified in the twentieth century in the context of two World Wars because they were "Cheap, nutritious, and easy to carry", which made them "the perfect war fodder". (Probyn, 2016; 133). Given that sardines were relatively cheap, they were considered to be a good source of food for poorer

people. While pelagic fish were important for human consumption, from the early 20th Century pelagic fish were also increasingly used for animal feed – initially for land-based livestock production and later on for aquaculture, especially salmon aquaculture. Producing fish meal from pelagic fish through reduction fisheries is an energy intensive process:

> The process of reducing fish to meal or oil isn't pretty or straightforward. It has to be cooked, pressed, dried, and ground, and along the way it produces a strong smell of rotting fish. It also uses a lot of energy as modern-day factories dry the meal at five hundred degrees Celsius (Probyn 2016; 134).

Probyn's analyses the problem of fish feed within the context of "Peru, a relatively small country with a substantial class divide between rich and poor and a GDP of just over eleven thousand dollars per capita" (Probyn, 2016; 144). One of the key problems facing Peru is chronic malnutrition especially for children under the age of 5. "Recent statistics show that the national malnutrition rate for children under 5 is as high as 18% while in the rural Indigenous areas in the south it can be as high as 43%" (Páez 2011 in Probyn, 2016; 144). At the same time, Peru is one of the world's largest sources of pelagic fish – in the form of the small and oily anchovy – that are reduced to produce fish meal. Probyn traces the emergence of this industry from the 1950s in Peru:

> The first reduction factory was established in 1959, and by the 1970s there were more than 14,000 boats catching as many as 13 million tonnes of anchovies that were processed into fish meal and fish oil…The process feed was initially used to feed land-based livestock, but with the rise of salmon aquaculture the majority of processed anchovies went to the burgeoning salmon farming industry in Norway, Canada and later Chile. Anchovy stocks are notoriously variable due to environmental factors including El Nino" (Probyn, 2016, 142-43),

The key problem for Probyn with this system is that nutritious fish off the coast of Peru are used to feed salmon and other farmed fish when they could be used for local consumption and to

address the problem of food insecurity and malnutrition in Peru. She cites an earlier paper by Wintersteen, who encapsulates the problem:

> In this system, nutrients are removed from the marine ecosystem and the local food chain is then transferred *en masse* to distant markets and, eventually, distributed to consumers who are disconnected in every way from the socioenvironmental conditions of its production (Wintersteen 2012, cited in Probyn, 2016; 144).

In order to examine what alternatives are possible, Probyn follows the work of an environmental activist in Peru, Patricia Majluf. Over the last few years, Majluf has attempted to divert anchovies away from fish meal factories and to the stomachs of poor (and not so poor) Peruvians. Her efforts focused on two issues: first finding a source of fresh anchovies, and second persuading people to eat them. Her overriding concern, as Probyn (2016; 144) writes, was to "intervene and resolve the interrelated problems of malnutrition, pollution, poorly paid jobs, and overfishing by getting people to eat anchovies". According to Majluf, "even a half of a kilogram of anchovies a week would provide complete protein needs but instead, children are fed a high carbohydrate diet with food such as potatoes" (Probyn, 2016; 144). While Peruvian anchovies continue to be a major source of fish feed for aquaculture and livestock production, "there has been an important change in local consumption of anchovies which increased from 10,000 tons in 2006 to 190,000 tons in 2010" (Probyn, 2016; 146). Part of the success of her work was to shift the focus from wealthy consumers to those who require fish for nutrition and food security:

> This little fish may be rejoined into a wider fish-related metabolic intimacy that helps to feed the poor and not just the wealthy omega-3 eaters of capsules (Probyn, 2016; 157).

3.5.2 West Africa – an emerging site for fish meal

While Peru's role as source of fish meal dates back to the middle of the twentieth century, the rapid growth of aquaculture and its demand for fish meal has led to the development of new sites for pelagic fish, including West Africa.

According to the article "Feed a Monster...", "virtually all FMFO in West Africa is exported for the benefit of other sectors… this practice not only under[mines] food security in coastal communities… but is also depriving people… of one of their most essential sources of proteins" (Greenpeace, 2022; 5). As was the case with Peru, the impact of this approach is to "essentially transfers nutrients around the globe, [but], in the process, removing them from local supply chains and redirecting toward international supply chains [for] great financial value" (Luyckx, K., Sinclair-Taylor, J., & O'Sullivan, C., 2020; 26). With an approach such as this one, local communities suffer. As one West African coastal resident complained, "You are looking for a profit, we are looking to live! Your investments are killing us in silence" (Luyckx, K., Sinclair-Taylor, J., & O'Sullivan, C, 2020; 25). Women are traditionally responsible for smoking, salting, drying, and selling the fish to local markets, fishermen, and the population of the sub-region who "depend on fish for their animal-protein intake" (Greenpeace, 2022; 7). With the lack of small pelagic fish locally, this impacts the livelihoods, food and job security, and revenue in the West African region, and of course, the women. With this being said, NGOs have brought forward these considerations that "the exposure of West African populations to food insecurity poses a much deeper ethical problem than the dichotomy between poor and rich countries...in reality, it is about a resource being overfished from the region and exported to feed animals in third countries which is completely unacceptable considering that coastal communities are deprived of their most essential source of protein" (Pikitch et al., 2012; 9).

By bringing these problems forward, we see that a critical issue remains apparent: equitable access to good nutrition. As we can see, with limited nutritional resources being available to the global population, bringing back the question of “who eats what” is vital. Aquaculture companies are deemed to take fish from places where they could be sold on local markets. By doing so, this could instead be supporting local livelihoods and good nutrition. As NGOs have stated, “adopting a global food security lens, we need to ensure that there is equitable access to nutrition provided from marine resources' (Feedback, 2022; 4). To consider the covid-19 crisis in this situation, NGOs also state that the pandemic “only exacerbates the impacts of this broken food system” and “calls to reflect in the current situation of local communities in West Africa that are struggling more every day to earn a living” (Pikitch et al., 2012; 13). One way of addressing the problem is to put pressure on consumers of salmon and other farmed fish: if “final consumers of products derived from the fish meal [understood] that they are part of the problem, and...by paying attention to their choices, they can help turn this broken food model around for the benefit of all” (Pikitch et al., 2012; 13). By having these considerations, we hope that ideas become actions “to make best use of the nutrients available to us and ensure that people are nourished fairly, all food taken from the ocean should be intended for human consumption” (Pikitch et al., 2012; 13).

The problems raised in the two examples of Peru and West Africa are relevant to Goodman’s concerns about the stress of providing the right kinds of food. It makes obvious sense that local consumers should be eating what is on their doorstep, in this case nutritious pelagic fish. But they are not, and in the process reducing the fish-to-fish meal and transporting it many miles away to be fed to salmon and other farmed fish is disastrous. As illogical as this system seems,

this is the *Real World* of omega-3s. In contrast to Hamilton et al's *System World,* which ignores space and distance, this is not an efficient way of getting omega-3s from one place to another. In fact, it does the opposite, removing the 'right kind of food' from those who really need it to place and people who are probably getting enough omega-3s in their diets. While Greenberg acknowledges some of the problems associated with the fish feed industry, it is difficult to see how his *Omega-3 World* provides any solution to the problems raised through a focus on fish feed, and in response to Goodman's third question.

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Chapter 4: Conclusion

In this thesis, my aim was to examine recent controversies around omega-3s. Widely considered to be a crucial component for human health, omega-3s are usefully understood as a 'charismatic nutrient', a term coined by Kimura (2013) in the early 2010s. The thesis focuses on two inter-connected issues associated with omega-3s: first, the apparent decline in the levels of omega-3s in farmed salmon, a key and largely accessible source of food for consumers in industrialized western countries. The controversy is made more complex with claims that farmed salmon not only have lower levels of omega-3s, they may also contain toxic chemicals that are bio-accumulated in salmon feed. I explore this controversy through the method of controversy mapping. The second issue is connected to the first in that it is also concerned with how humans can access omega-3s. In this second issue the focus is on declining levels of omega-3s globally and within the global food system. I examine 2 recent proposals for addressing this problem through critical engagements with more-than-food approaches in human geography, which allows me to critically assess these proposals and provide an alternative analysis of the problem of omega-3s. In this concluding chapter I summarise the results of these chapters and I assess their significance in the context of debates on charismatic nutrients and more-than-food approaches.

For chapter 2, I followed the methodological approach to controversy mapping proposed by Lepawsky et al. (2019). Controversy mapping is an approach to controversies in science and technology that generate a great public concern and debate. The mapping of controversies as proposed through this approach begins with a floating statement – in my case, "salmon contains nutrients for overall health and wellness such as omega-3 fatty acids…increased consumption of

[farmed salmon] provides excellent nutrition for a healthy lifestyle". Controversy mapping as a methodological approach allows the researcher to bring this floating statement down to earth by mapping the actors, networks and locations through which statements become truthful. The importance of what is happening, who is involved, and where it can be seen allows various controversies, like the two I have chosen, be brought "down to earth" in the world of omega-3s and allow spectators to see the realities that are being faced (Lepawsky et al., 2019; 441).

Two key insights emerged from the controversy mapping of declining levels of omega-3s in salmon. The first relates to how scientific facts are used and mobilized in different actor networks. The origins of the controversy were two researchers based at the University of Stirling who found significant declines in the level of omega-3s in farmed salmon. Declining levels of omega-3s in this fish were explained by lower volumes of fish meal and fish oil in salmon diets, and their replacement with vegetable proteins and oils. The mapping of this controversy revealed how this 'scientific fact' was interpreted in different actor networks. In one actor-network, the problem of declining levels of omega-3s was not a problem, and could easily be solved by doubling the portion size of salmon to satisfy recommended omega-3 intake suggested by national and international health organizations. For a second actor-network, declining levels of omega-3s provided additional justification for not consuming a fish that is produced in ways that damage ecosystems and may also include toxins such as methylmercury. In other words, declining levels of omega-3s provided existing anti-aquaculture groups additional evidence to convince consumers not to eat farmed salmon. The two actor networks were different in terms of actors, networks and locations. The second finding of the controversy map is not so much who is present in the actors, but who is absent. The actors in the controversy included journalists, who

remain a key source of information for consumers. They play a key role in transmitting knowledge produced by researchers in universities and other sites where information on food is generated. For non-governmental organizations (NGOs), who are also well represented in this controversy, the controversy is understood differently depending on their approach to farmed salmon.

One surprising yet important result of this research is the absence of government actors as promoters of healthy diets for their citizens through food guides and other dietary advice. Why were national nutrition authorities not active in these debates? This question led me to consider Canada's Food Guide. With the notable changes that were made in 2019 to Canada's Food Guide, what does it tell us about the status of omega-3s and how this charismatic nutrient features in a recommended guide for consumers in Canada? Interestingly, the guide does include a small portion of fish, but it appears to be a wild-caught salmonid, possibly Arctic Char given that it is mentioned in earlier guides as a recommended source of protein. The fish appears in a group of foods containing protein, but there is no mention of the importance of omega-3s in the diet. I consider questions such as: Is there a particular reason for the portion being so small? Where should I be getting my omega-3s? Could this link to the previous journal article on seeking omega-3s from other foods? Canada's Food Guide, however, provides only limited insights into how consumers might use it to navigate the two controversies I have examined in this chapter. These findings are necessarily tentative but they suggest that national food guides like the Canadian one may be reluctant to weigh in on controversies associated with something like farmed salmon, and prefer instead to provide recommendations that are more general for human consumers.

Controversy mapping as a method provides a crucial tool in revealing the contours of a controversy. But crucially, and especially in the case of food, it does not provide anxious consumers with the advice they may be looking for in terms of what to eat. In other words, while the mapping method provides a way of bringing the controversy down to earth, it does not provide a simple and straightforward answer to the question: should I be eating farmed salmon and is it still a good source of omega-3s?

Chapter 3 analyzed the more-than-food worlds of omega-3s. I began this chapter by looking at two prominent but very different solutions to the problem with omega-3s. One solution, the *Omega-3 World*, is Paul Greenberg's proposed solution to ease the shortages and uneven accessibility of consumers to omega-3s by lifting the burden of our food system off the land, and by relying more on ocean sources of food. This approach to bringing our food production systems into better equilibrium promises to shift the emphasis away from omega-6s, and to provide humans with more access to nutrient rich omega-3s. Hamilton et al. (2020) provide a different solution to the problem of omega-3 deficiencies in human diets in various locations around the world. I call their approach the *Systems World*, and it calls for producing and distributing omega-3s more efficiently, and thereby providing better access to those who need this important nutrient. However, I found problems with both of these solutions. With Greenberg, I suggested he provided only limited information on how large companies will play a role in this 'rebalancing' of the global food system. Hamilton et al.'s analysis of systems and efficiency is problematic in the way that it is abstracted from the complex geographies and

networks associated with omega-3s globally. These shortcomings led me to the goal of outlining what I call the *Real World* of omega-3.

The *Real World* of omega-3s becomes evident through Michael Goodman's recent assessment of the emerging field of more-than-food geographies. In critically assessing this work he asks three key questions: What role do powerful organizations play in more-than-food networks?; Are more-than-food approaches concerned with the bodies – human and nonhuman – that are responsible for food that contains omega-3s; And are more-than-food approaches sensitive to questions of huger and deprivation, and the stress that comes from having to feed families the right food? While Goodman uses these three questions to assess more-than-food approaches, they are also very useful for my own concern to critically assess the two proposals for addressing shortages and deficiencies in omega-3s for humans. I use each of these three questions to build what I am calling the *Real World* of omega-3s.

Goodman's first question is about powerful agents in food chains and to address this issue I focus on two companies: Global Organization for EPA and DHA (GOED) and Cooke Aquaculture. Both are powerful organizations and I show how they play a role in shaping the flows of omega-3s from fish to consumers. These flows are not necessarily efficient or determined by need, but instead are determined by profit motives and to supply omega-3s to consumers who have the means to pay. The GOED for example is an vertically integrated corporation that represents major producers of omega-3s, mainly in the developed world, who produce omega-3s largely for consumers in the developed world. Many of the companies they represent are involved in the production of supplements that contain omega-3s rather than food

products. These supplements are typically expensive and geared to wealthier consumers looking for the benefits of omega-3s in their diets. Cooke Aquaculture produces farmed salmon and in this way is involved in the production of food rich in omega-3s. Obviously they play a role in giving consumers access to omega-3s through salmon. Yet at the same time, their role in controlling a key source of feed for salmon – in the form of Atlantic menhaden – shows how they too are involved in controlling the flows of omega-3s in ways that not only emphasize demand rather than need, but are also environmentally destructive. This monopoly corporation's exclusive control of menhaden stocks, which are then fed to salmon demonstrates how the flows of omega-3s are privatised and controlled for specific uses. These real world examples of the flows of omega-3s raise critical problems for Greenberg and Hamilton et al's proposal for addressing deficiencies in omega-3s globally and they represent the first step in building what I have called the *Real World* of omega-3s.

Goodman's second question relates to the bodies, both human and nonhuman, that are responsible for producing food. As noted earlier, he asks: is there room in more-than-food approaches for the people and animals that labour to produce the food we eat? In drawing attention to the role of humans and non-humans involved in food production he raises the concern that more-than-food approaches in human geography are overly concerned with food and its effect on human consumers.

In order to answer this second question – and as a way of further building a view of the *Real World* of omega-3s – I consider farmed salmon and worker bodies associated with salmon aquaculture. I chose to emphasize the worker and salmon communities in Chile, an important

producer of farmed salmon globally and therefore of omega-3s. My analysis focused on the apparent success of the Chilean farmed salmon industry, a description contested by researchers: "The Chilean salmon industry was the 'poster child' of success… then exposing all the failures and contradictions neoliberalism can hold [like] volatility, geographic inequality, and resource dependence" (Bustos-Gallardo and Irarrazaval, 2016; 2). Chilean scholars such as Beatrice Bustos-Gallardo have discussed in detail the problems associated with this industry for both workers, fish and the environment. Drawing on a review of the broader literature on salmon aquaculture in Chile, I discuss problems with the treatment of workers (especially women), the impact of the industry on fishing communities, and the effect of salmon aquaculture on the ocean environment. The problems associated with salmon aquaculture in Chile – an important source of omega-3s for the people who consume farmed salmon – are rarely evident to consumers. These problems are also not considered by Greenberg or Hamilton in their proposals on how omega-3s can be provided more efficiently or more effectively to humans who may need this important nutrient. The bodies both human and non-human that are responsible for providing people with a key source of omega-3s are, however, key to what I am calling the Real World of omega-3s.

Goodman's third question has to do with the pressure that people and families face in having to eat or provide the right food: as he writes, how does more-than-food approaches help us understand "hunger deprivation as well as lower-level stress caused by the inability to buy the 'right' kind of 'good' food for one's family?" (Goodman, 2016; 261). In answering this question, I focus on the sourcing of small oily fish by fish feed companies that are used to produce fish meal and fish oil for aquaculture. These fish are rich in omega-3s and so are a key and critical source for fish feed, but they are also crucial to coastal consumers in countries like Peru and in

regions like West Africa where they play a key role in food security. This situation where fish that are important for human nutrition are processed for other fish to eat is according to some NGOs part of a 'broken food model' and points to a need "to make the best use of the nutrients available to us and ensure that people are nourished fairly, all food taken from the ocean should be intended for human consumption" (Pikitch et al., 2012; 13).

The use of small oily fish for fish meal and fish oil provides a stark answer to Goodman's third question about hunger and deprivation, as well as the pressure faced by families and communities to provide the 'right food'. As NGOs have shown, these fish are crucial to food security in developing country regions such as West Africa, but they are increasingly being harvested to supply fish meal factories with raw material. They are much coveted by fish meal companies and by aquaculture because they provide a key source of omega-3s for farmed fish like salmon. Indeed, as I discussed in chapter 2, one of the reasons why omega-3 levels in farmed salmon have been declining is because of lower levels of fish oil in aquaculture feed. Shifting food rich in omega-3s from regions of the world where food insecurity is a problem has been condemned by environmental NGOs and nutritionists. The use of food rich in omega-3s from humans to fish also provides a third set of challenges to the proposals by Greenberg and Hamilton et al. In Greenberg's case, these examples do nothing to put the global food system back in balance and instead they appear to do the opposite by taking fish away from those closest to it. For Hamilton et al., the use of oil fish for feed when it could be used for human nutrition points to the dramatic *inefficiencies* in the food system that cannot be solved by calls for efficiency or more rational use of resources. Instead, the case of aquafeed provides a dramatic

illustration of the *Real World* of omega-3s that involves the global transfer of this nutrient from sites where food insecurity is a problem to the industrial culture of fish.

My research revealed that both are not considering the way things are controlled and the way the market works for omega-3s (controlled chains), and flows are not being decided based on efficiency (Hamilton), nor are they providing a better balance (Greenberg). Can we, as salmon eaters and the public, continue to trust the powerful actors behind the controlled chains? Will they continue to promote the potential benefits omega-3s have to offer?

My thesis has aimed to provide insights into omega-3s as a charismatic nutrient, in Kimura's (2013) terms. In defining the term, she points to the importance of identifying the 'socio-political networks' that support nutrients that have 'charisma'. The thesis contributes to an understanding of the socio-political networks around omega-3s through two separate but closely inter-linked interventions. The interventions suggest, on the one hand, that controversy is likely to follow charismatic nutrients, and that one of way of bringing these controversies down to earth is through controversy mapping. At the same time, the socio-political networks that support omega-3s are: a) controlled by large companies profiting significantly from this nutrient; b) they may involve systems of production that are exploitative for both humans and non-human animals; and c) they may involve the export of nutrients that are crucial for food security. In this way the thesis provides an important contribution to our understanding of omega-3s as charismatic nutrient.

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