Opening up Containment:

Making Space in Newfoundland Salmonid Aquaculture

by

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A Thesis submitted to the

School of Graduate Studies

in partial fulfillment of the requirements for the degree of

Master of Arts

Department of Geography – Faculty of Social Sciences and Humanities

Memorial University of Newfoundland

November 2019

St. John's, Newfoundland and Labrador

Abstract

Studies in geography and STS looking at containment-in-practice have shown that thinking about containment as a hermetic closing off of a definite space is not suitable for this world, which is characterized by leakages, overflows, excesses, movements, and borders being crossed, contested and drawn again. However, renderings of containment still play an important role in the practices that make and break our worlds. This thesis attempts to open up containment by thinking through how containment is done in two different cases in sea-based salmonid aquaculture on the south coast of the Canadian island of Newfoundland. Based on insights from poststructuralist geography, material-semiotic STS, and animal geography, containment is approached as an ongoing spatial practice that needs to be constantly done and done again. This thesis respectively explores the provincial *Code of Containment* and the making of the rearing environment for farmed fish in and around the net-pen, and articulates containment as a (bio)political way of creating, holding together, and unmaking realities, including industrial salmonid aquaculture and the way animal lives and deaths are valuated.

Acknowledgements

I did not write this thesis alone. I did not complete my master's degree alone. Throughout my research project and my master's degree more broadly, I have learned and experienced that researching, writing, and learning are collective efforts. They are done together. I am indebted to many people who accompanied me along the way and made my journey possible and more enjoyable.

I thank my informants for generously making time available to talk to me and show me around. Without their time, efforts, and help, I could not have collected any of the materials that I use in this thesis.

I thank the Ocean Frontier Institute for the generous funding I received, which enabled me to do my research project and present my research at a number of conferences in Canada and abroad.

I thank Charlie Mather for being a more patient, encouraging, and inspiring supervisor than I could have ever wished for. Our conversations about my research project, academic life, writing, thinking, but also more personal matters have left an everlasting imprint on who I am, how I think, and who I aspire to be. It was Charlie who taught me the important lesson of not trying to be the first in something as this is colonial, and the fact that all writing is a collective process.

I thank my second supervisor Mario Blaser for generously sharing ways of thinking, arguing, and reading. I think back with gratitude on classes, supervisions, and other conversations which showed me new worlds, opened new avenues of thinking, and sharpened my mind. Mario's ability to critically assess and deconstruct arguments and writing, is always followed by invaluable suggestions to reorient, recompose, and strengthen that writing.

I thank Carissa Brown, Arn Keeling, Yolande Pottie-Sherman, Sarah Martin, Dean Bavington, Cecile Badenhorst, and other professors for sharing their knowledge and personal experience.

I thank Valarie James, Pam Murphy, and other support staff of the MUN Geography Department, especially for making Newfoundland feel like home right from the first day I stepped into Valarie's office.

For their support, suggestions, and encouragement, I thank the members of the Eating Bodies family in Amsterdam and elsewhere, members of CLEAR, members of OFI research module M3, conference friends – before I started my graduate degree I could not even begin to suspect this was a thing – and all other people that I had the honour to discuss my research with at different occasions. In particular, I thank Christine Knott for the weeklong period we spent together in the Coast of Bays Region collecting materials for our respective research projects.

I thank my fellow students Nelson Graham, Caitlynn Beckett, Jack Daly, Grace Akese, Donny Persaud, Marie Louise Aastrup and other graduate students, whose bright minds and joyful personalities helped, inspired and accompanied me both inside and outside the campus walls.

I thank Ben Misiuk, Marilynn Guay Racicot and all my other human and non-human roommates for making me feel at home when I was at home.

I thank Camilla Enns, Maude Blanchet and all other non-academic friends in Newfoundland for the many fun times we have had.

I thank my friends in the Netherlands who kept in touch even though I decided to move to 'Eindhoven aan Zee'.

I thank the members of NDP Newfoundland that welcomed me to their campaign and taught me so much about Newfoundland and practicing ideals and social change.

Papa en mama, I thank you for always being there, full of love, understanding, and encouragement, whenever I am in need of it, whether I know that or not. I am full of love, admiration, and gratitude for what you have shown and given me. No one meets the world as open and interested as you do, and no one is as caring and sincere as you.

Alex Zahara, vriendje-maatje, without you I don't even know if I would have been able to complete this. I am full of gratitude for what you have given me, your patience, encouragement, help, queer companionship. My admiration for your creativity, intelligence, sharpness, patience, kindness, fire, and love is endless. A library full of books of admiration and thankfulness would not be enough to do justice to what I feel. Let alone this thesis or even this single small paragraph.

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List of Abbreviations

ASF:	Atlantic Salmon Federation (environmental NGO)
CBC:	Canadian Broadcasting Corporation (public national broadcasting corporation)
CNS:	Centre for Newfoundland Studies (part of Memorial University)
The Code:	*Code of Containment for the Culture of Salmonids in Newfoundland and Labrador*
DFLR:	Department of Fisheries and Land Resources, formerly Department of Fisheries and Aquaculture (Newfoundland and Labrador provincial government department)
DFO:	Fisheries and Oceans Canada (federal government department)
MUN:	Memorial University of Newfoundland (provincial university of Newfoundland and Labrador)
NAIA:	Newfoundland Aquaculture Industry Association
SCNL:	Salmonid Council of Newfoundland and Labrador (environmental organization)

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Chapter One

Introduction and Overview

1.1 Introduction

It is Tuesday, September 20th, 2016. Ian Bradbury, scientist at the federal department of Fisheries and Oceans Canada (DFO[1]), gives a presentation at an international aquaculture conference in St. John's, Newfoundland (Quinn, 2016). After the "escape of ~20,000 sexually mature, domestic Atlantic salmon from a single aquaculture net-pen", the same amount as the estimated number of wild salmon that live in the southern Newfoundland waters (Wringe et al., 2018, p. 2), his department started a research project on the genetic impact of 'escaped salmon' on wild salmon populations in southern Newfoundland. Bradbury tells his audience that his department has found evidence of interbreeding between wild salmon and farmed salmon that had 'escaped' from aquaculture net-pens on the south coast of the island of Newfoundland, either during the most recent big escape or during one of the multiple earlier escape events. According to the CBC article written about Bradbury's presentation, more than 750,000 salmon had already disappeared from their net-pens since the beginning of the salmonid aquaculture industry in Newfoundland (Quinn, 2016). Bradbury specifies the research findings by

[1] This is a part of the federal government, responsible for "safeguarding our waters and managing Canada's fisheries, oceans and freshwater resources. We support economic growth in the marine and fisheries sectors, and innovation in areas such as aquaculture and biotechnology. We help ensure healthy and sustainable aquatic ecosystems through habitat protection and sound science" (Fisheries and Oceans Canada, 2019).

saying that hybrids were found in 17 of the 18 rivers that were sampled, and made up almost a third of all salmons found in the rivers (see also the published results of Bradbury and colleagues (Wringe et al., 2018)).

According to the Atlantic Salmon Federation (ASF), an environmental NGO whose mission is to "conserve and restore wild Atlantic salmon and their ecosystems" (Atlantic Salmon Federation, n.d.b), "[t]his is the first time that we have actually had confirmation that it is happening in Newfoundland" (Quinn, 2016, para. 14). This finding feeds into the debate around salmon aquaculture in the province, which media often illustrate by juxtaposing the ASF, which opposes open net salmon farms, with the Newfoundland Aquaculture Industry Association (NAIA), the body that represents and supports industrial salmon aquaculture (see for example Roberts, 2019b; Undercurrent News, 2016). This opposition between ASF and NAIA illustrates the more general controversy around salmonid aquaculture in Newfoundland, in which industry – largely supported by the provincial and federal government – rapidly develops open net-pen aquaculture on the south coast of the island, while these developments are contested by a coalition of environmental groups, in which recreational anglers and the protection of vulnerable wild salmon stocks play a big role (see Young & Matthews, 2010 for more on the controversy around aquaculture in Canada). The executive director of NAIA declared a "war" on these "naysayers" during an industry conference I attended in St. John's in September 2018, while many of the opponents see the only viable future for salmonid aquaculture in closed-containment facilities on land (e.g. White, 2019).

In this controversy and in the practices of aquaculture in general, different renderings of containment play an important role. According to opponents of sea-based aquaculture, it is not just the salmon themselves that are not contained. Besides the salmon, the net-pens do also not contain their parasites and viruses, their feed, and their waste and excrements well enough (Haya, Burridge, & Chang, 2001; Milewski, 2001; Morton, 2015). Furthermore, the net-pens do not contain other risks and 'crises' that come with the industrial and intensive practice of salmonid aquaculture, such as disease outbreaks and massive die-offs – such as in Newfoundland during the fall of 2019 (G. Barry, 2019) – which can cause those crises to 'spill over' into the environment, with harmful effects that are not all fully known. Flows from the net-pens intrude, influence and even change the environments or 'outsides' of the net-pens. For other opponents, the logic of containment itself forms part of what is problematic about aquaculture in general. Bavington (2010), for example, argues that "cod farming" - but this could as well be applied to the farming of salmonids - "exemplifies an expanded level of human arrogance by seeking to engineer natural and cultural systems to fit them into the logic of global markets through unending economic growth and managerial control" (p. 105).

On the other side of the controversy, versions of containment also play an important role for proponents of open net-pen aquaculture, such as salmon farmers themselves. Industry spokespersons often claim that "we never want to lose fish, that's for sure" (Tobin, 2018, para. 6), although this is disputed on political-economic grounds (Volpe & Shaw, 2008). Indeed, sea lice infestations "infect hundreds of millions of farmed fish and cost the global industry upwards of $1 billion each year" (De Sousa, 2018, para. 4); predators such as seals and blue shark attempt to make their way into the cages (Kemper et al., 2003; Riise, 2019); and the loss of salmon to the wild often leads to strong opposition from environmentalists and the loss of license or even a ban on marine-based finfish aquaculture, such as recently happened in Washington State (Treviño, 2018).

Renderings of containment do not only seem to play a role in salmonid aquaculture in Newfoundland, but the issue also seems pressing in other areas, as people, toxicants, wildfires, ideologies, ideas, money, water, mines, and more are trying to be contained with the help of walls, fences, nets, but also policies, rhetoric and other means. However, this world could as much or maybe even more so be characterized by leakages, overflows, excesses, movements, and borders being crossed, contested and drawn again. Thinking about containment as a hermetic closing off of a definite space does not seem to be suitable for this world, and might not even have been apt in the first place. But, how then could containment be rethought?

1.2 Research aim and questions

In my thesis, I aim to explore what it means to contain something. I use the problem of containment in the aquaculture of salmonids in Newfoundland to think through this question. The stakes are high in practices that have to do with containing: these practices enact possible worlds and futures, ways of living and dying. So, it matters *how* containment is done. Particular forms of life, ways of living, landscapes, and industrial and capitalist constellations emerge through these containment practices. It is through these practices that worlds come into being, hold together or fall apart. To tackle a big question as 'what is containment', I need a more specific lens to look at the practices that make up containment in my case study. I will approach containment as a particular spatial constellation that is enacted through different practices. My research question is as follows: What does the production of spaces through containment practices in salmonid aquaculture in Newfoundland teach us about what it means to contain something?

In the two empirical chapters of my thesis I focus on two different sites of containment and approach them as sites where spaces are made, remade and contested. The first site is the *Code of Containment for the Culture of Salmonids in Newfoundland and Labrador* and the different ways in which this Code and its associated versions of containment are enacted (chapter two). The second site are the cages at the salmon farms on the south coast of Newfoundland and the different practices that I encountered through visits to the farm and the stories that people told me (chapter three). These practices and stories create worlds: not only a world in and around the net-pens themselves, but also a world of the global industrial production of salmonids. I focus on 'The Code' and 'the cage' as sites of spatial politics to formulate lessons about the role that containment plays in "the constant and conflictual process of the constitution of the social, both human and nonhuman" (B. Anderson, 2008, p. 232). I answer the following questions in my respective chapters:

- How is containment enacted through the *Code of Containment for the Culture of Salmonids in Newfoundland and Labrador*?
- How do containment practices related to the creation of a rearing environment for farmed fish enact life and death in and around the cage?

The Code of Containment and issues around the valuation of animal life and death emerged as important aspects of containment practices in salmonid aquaculture in Newfoundland and Labrador. Although I could also have chosen other elements to focus on, these two topics presented the opportunity for a productive exploration of how to think about containment and the issues that are at stake in doing and thinking containment, such as the politics of life and death and the ways in which industrial capitalist projects are held together. In articulating containment as respectively a political device and a way of valuating animal life and death, I contribute to geographical and STS literature related to containment, space-making, and biopolitics.

1.3 Context

In 2017, the Newfoundland salmonid aquaculture industry 'harvested' 18,822 metric tonnes of fish, mainly Atlantic salmon, and some steelhead trout, worth $209 million according to the provincial department of Fisheries and Aquaculture (Newfoundland and Labrador, 2018; see Figure 1). Whereas in the late seventies only about 19 metric tonnes of fish were 'produced' – just under one metric tonne of Atlantic Salmon, and eighteen metric tonnes of trout (Rigby, Davis, Bavington, & Baird, 2017, p. 20) – by 1997 ‘production’ had already grown to almost 1,000 metric tonnes (Newfoundland and Labrador, 1998). In 2022, the department expects the production to exceed 50,000 metric tonnes, “as industry further develops and expands salmonid operations in the province” (Newfoundland and Labrador, 2018, p. 20). This boom of salmonid aquaculture has primarily happened in the part of the south coast of the island of Newfoundland, the so-called Coast of Bays region, which I primarily focused on during my fieldwork.

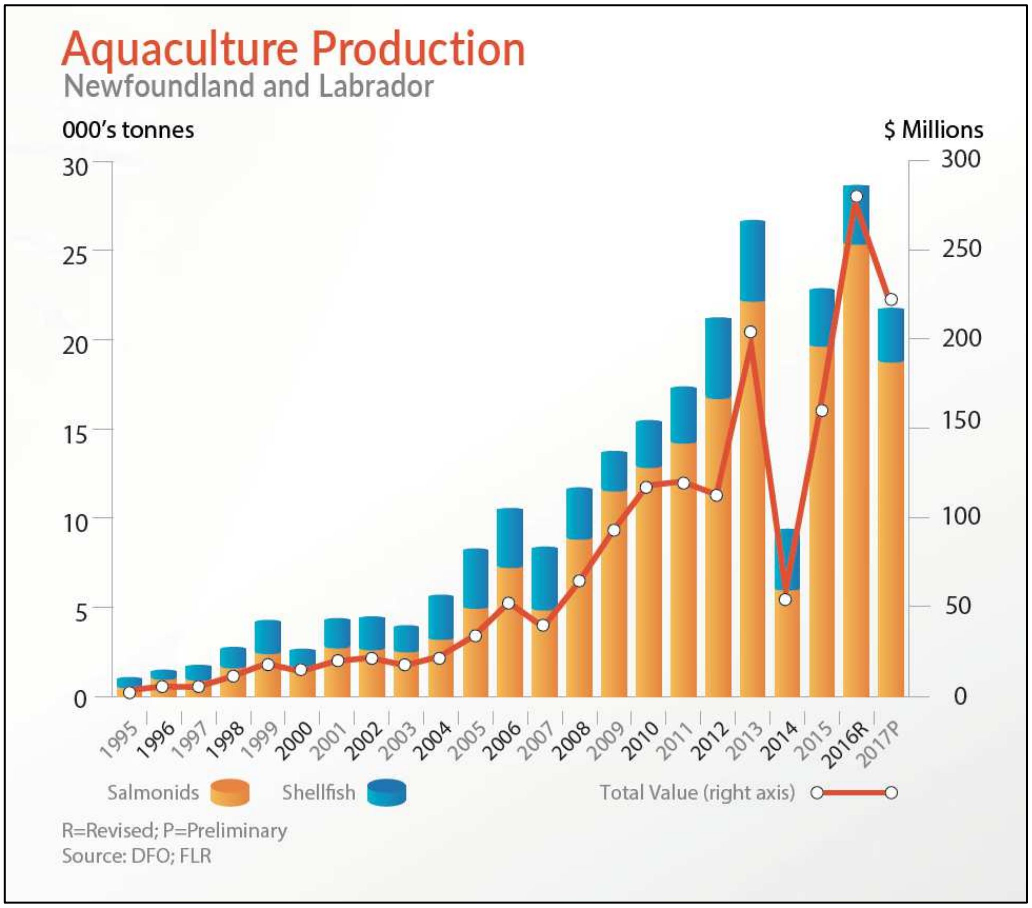


Figure 1: Production of farmed species in Newfoundland and Labrador (Newfoundland and Labrador, 2018, p. 19)

The salmon aquaculture industry is a relatively recent phenomenon in Newfoundland. Whereas aquaculture techniques have been used since the late nineteenth century for the introduction of different species of salmonids and the enhancement of Atlantic salmon fisheries on the island (Couturier & Rideout, 2018, p. 310), it was not until the 1970s that the production of salmonids – initially primarily trout – was attempted commercially (ibid., p. 312-313). Early on, the Coast of Bays Region was looked at as the primary location for the development of a provincial finfish aquaculture industry. Memorial University of Newfoundland (MUN) was very involved in selecting sites and conducting necessary research on the growth and rearing of the finfish (ibid., p. 313). Couturier and Rideout (2018) write that "the Bay D'Espoir Development Association … encouraged family-owned and -operated grow-outs of the juvenile fish", which "led to the establishment of the Bay D'Espoir Salmon Growers Cooperative (Apold et al. 1996) for joint feeding, purchasing, processing, and marketing (Newfoundland and Labrador, 1998a)" (ibid., p. 314). Nowadays, two big seafood companies own all grow-out sites in the province and control the production of salmonids, i.e. MOWI from Norway and Cooke Aquaculture from Canada, while a third Norwegian company (Grieg NL) is establishing itself in more easterly Placentia Bay. The history of aquaculture in Newfoundland has been plagued by disease outbreaks and controversies over the introduction of 'non-native' strains of salmonids, partly because native strains of Atlantic salmon mature earlier than other strains which compromises the profitability of their growing process (ibid.). Government support and investment have played a significant role in the continued development and growth of the aquaculture industry, in spite of challenges (Couturier & Rideout, 2018; Rigby et al., 2017).

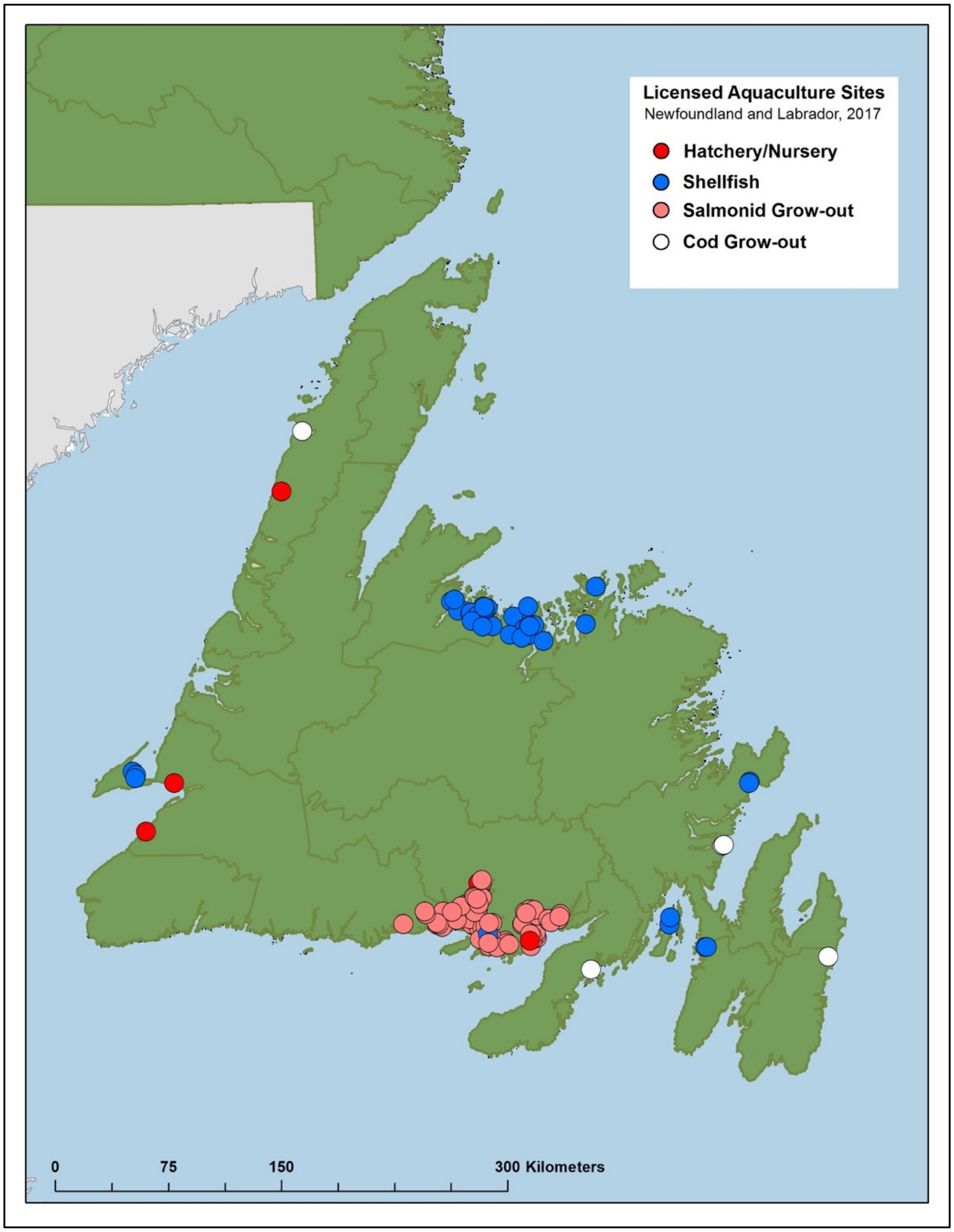


Figure 2: Licensed aquaculture sites in Newfoundland in 2017 (Newfoundland and Labrador, 2018, p. 54)

In 2006, the provincial minister of aquaculture and fisheries predicted that the Coast of Bays area would soon be the "aquaculture capital" of the province (Hunt, 2006). It seems safe to say that this prediction has become true. In 2017, 88 sites, most if not all of them along the Coast of Bays coastlines, were licensed for the installation of net-pens to put juvenile salmonids in and fatten them to 'market size' (see Figure 2). These licenses covered 2,500 hectares of sea in total (Newfoundland and Labrador, 2018, p. 20). There is also a hatchery in the region and a large part of the farmed salmon is processed in the region. Even though it depicts less than the 88 sites of 2017, the detailed part of the map from 2014 shows that the licensed sites in the north of the region, where the water is brackish, are mostly destined for steelhead trout, and a few for arctic char, while in the saltwater along the rest of the coastline the sites are used to farm Atlantic salmon (see Figure 3).[2]

[2] A license does not mean that there are currently fish in the water in each of the sites. When doing fieldwork, many of the sites licensed for trout and Arctic charr were not in use.

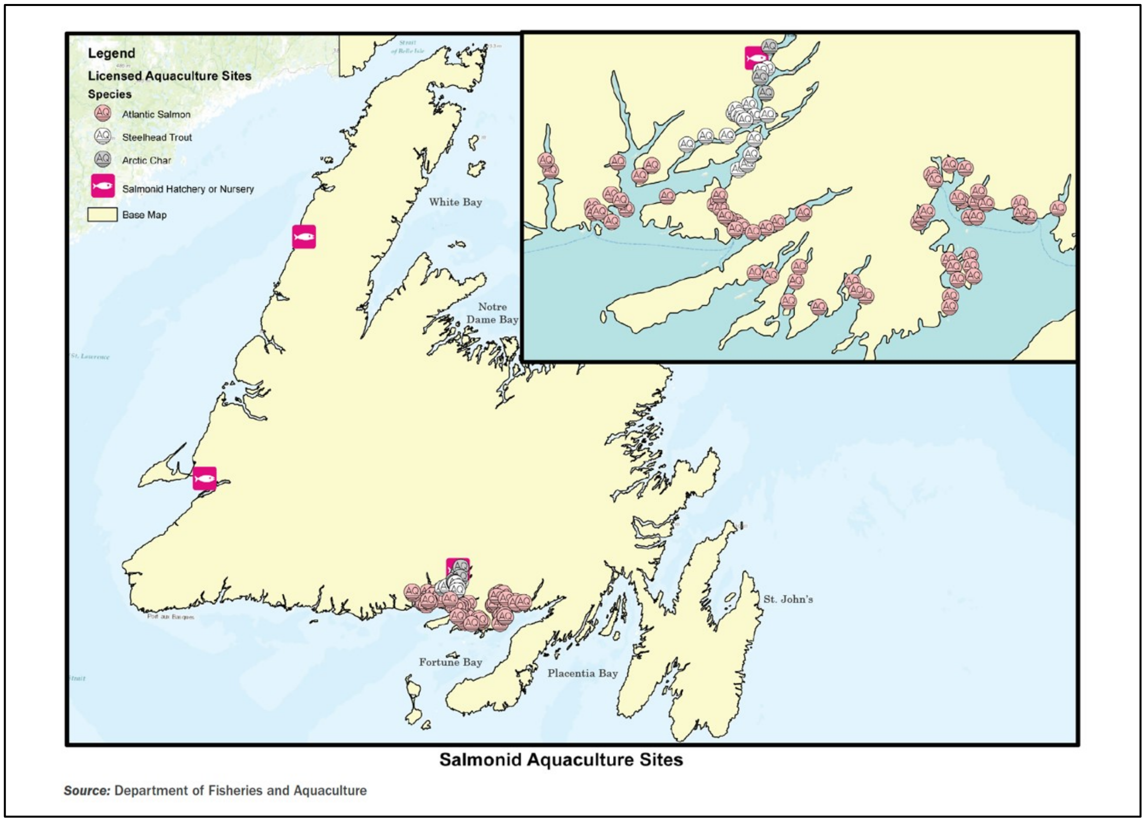


Figure 3: Licensed Aquaculture Sites in Newfoundland in 2014 (Newfoundland and Labrador, 2014)

For a 'capital', this region is relatively remote and sparsely populated. Although millions of salmon swim in the water, only just more than 7,000 people live in the about twenty communities from MacCallum in the west to Rencontre East in the east. The three largest communities are St. Alban's, Harbor Breton and the Samiajij Miawpukek Reserve with respectively 1186, 1634, and 956 inhabitants in 2016 (Statistics Canada, 2017). Whereas a town like St. Alban’s has historically been dependent on trading and logging, and more recently on the presence of a large hydro generation facility, most other communities are historically largely involved with wild capture fisheries.

The promise of employment and ‘sustainable’ development that often comes along with aquaculture growth, seems to fit well with a province and a region that have struggled with the collapse of the cod fisheries and other struggles for fishermen, decreasing employment, and people leaving to work and live elsewhere. In a recent sector work plan, the provincial government and the industry association NAIA stress job creation as one of the central benefits of a growing aquaculture sector: “Aquaculture has increased employment in rural communities throughout our province, and has the potential to grow” (Newfoundland and Labrador & Newfoundland Aquaculture Industry Association, 2017, p. 2). Consultant Gardner Pinfold states in a report for DFO, that, measuring in 2010, aquaculture has created a total of 779 full time equivalent jobs (558 direct jobs, 138 indirect jobs, and 53 induced jobs) in the Coast of Bays area (Pinfold, 2013, p. 10). Even though this number might be exaggerated and does not include any information about the character of the jobs, this number seems significant and highly impacting for an area with a population of 7,000 people. At the same time, Rigby et al. (2017) write that according to fisheries geographer Bavington, the “growing support for aquaculture in Newfoundland must be contextualized within the history of failures to manage the cod fishery sustainably” (p. 21). The subsidies and investments in the aquaculture industry, both from public institutions and by private capital, grew significantly after the collapse of the cod fisheries in the beginning of the 1990s, when “the demise of cod was presented as a profitable business opportunity” (Bavington, 2010, p. 92), and “industrial aquaculture was framed as a more predictable and lucrative alternative to the inescapable flux and uncertainty of wild fisheries" (Rigby et al., 2017, p. 20). It is important to take this provincial context into account, as well as the socio-economic context of for example the Coast of Bays region, where the aquaculture industry now shapes and mediates the livelihood of a relatively large part of the population.

The coastal landscape of the Coast of Bays region is also found biophysically suitable for the production of salmonids in open net-pens. When the salmon in the land-based hatcheries are big enough and ready for the marine environment, they are transferred to so-called grow-out sites, net-pens hanging in the sea (see chapter three). To be a suitable location for grow-out sites, landscapes need to meet certain biophysical requirements. For example, the salinity of the water must be high (32-35‰) (for Atlantic salmon); the water must be at least 5 meters deeper than the net; the average current flow must be about 3 cm/s up to 40 cm/s, the oxygen concentration must be high (higher than 80% saturation); the temperature must be right (under 18 °C); the water must be clear enough to observe the fish; and the water exchange must be strong enough to flush out nutrients (e.g. leftover feed pellets, fish feces) from the cage and bring oxygen in (Purser & Forteath, 2012, pp. 327–331). Furthermore, the sites need to be far enough from colonies of predators, such as seals (ibid.), and the bottom of the seafloor needs to have the right substrate (ibid.). Also, the ice situation in the winter needs to allow for overwintering salmon or there need to be suitable overwintering sites, in case not all the locations are suitable for year-round salmon presence. The website of DFO says that "[t]he marine environment of the Coast of Bays presents ideal conditions for farming finfish and shellfish. For example, sheltered bays and inlets offer protected areas for finfish cages and suspended shellfish gear culture" (Fisheries and Oceans Canada, 2016, para. 5). Recently DFO started a research project to better understand "the physical oceanography of [the Coast of Bays]" to "help manage and ensure the sustainable growth of the aquaculture industry" (Donnet et al., 2017, p. ix). The attempt to contribute to the (sustainable) development of salmonid aquaculture in the area by determining a baseline of geographic, hydrologic, and oceanographic knowledge of the area, and recommending to also look at "other relevant study areas to the sustainable development of the aquaculture industry such as ice cover, inter-annual variation in the hydrology or oceanography, air temperature, wave climate and climate change" (ibid., p. 44) indicates the importance of the biophysical landscape for open net-pen aquaculture.

The possibility of the provincial aquaculture boom, is not a natural given; a space for aquaculture needs to be *made*. This space consists of different flows or trajectories that hang together in a coordinated way, influencing, changing, and enabling each other in the process. Multiple heterogeneous relations between biological, physical, geological, social, financial, regulatory, and other elements make this space hang together and give shape to the different flows and trajectories. This aquaculture space enables the provincial salmonid aquaculture industry to exist, grow, and have effects.

It is not just the biophysical landscape that makes aquaculture possible. Work needs to be done to open up a certain area for the development of aquaculture (Silver, 2013). In

Newfoundland, this work has largely been done by an intertwined combination of industry, university, and the federal and provincial government. Couturier and Rideout (2018) list a number of publications that indicate the significant involvement of scientists at the only university in the province, MUN, in activities that focus on the scientific and technological possibilities of managing, controlling, manipulating, adapting, and selecting aquatic species, to make them as suitable and enrollable as possible for commercial and industrial production. Practices include the selection of desired traits in broodstock, attempts to genetically modify salmon, manipulating the development of salmon using light and temperature, experimenting with the consistency of food, and the development of vaccines (p. 307).

Governments and corporations have played an important role in making space for aquaculture, not only in financing research, but also in other aspects of developing the industrial farming of finfish in the province. As Rigby and colleagues (2017) write, it is a "complex assemblage of government agencies, applied researchers, corporate interests and industry associations that have been actively involved in the development and expansion of the sector" (p. 21). Subsidies, investments, and loan guarantees, regulatory support, and applied knowledge from the federal government (including DFO), provincial government, and government-funded research institutions such as MUN, have all been involved in attempts to stimulate the development of a provincial aquaculture industry. One example of the huge provincial involvement with aquaculture is the 1998 takeover of the then biggest aquaculture company, SCB Fisheries. This company was taken over by the province, as it had huge financial and structural problems. According to the provincial minister of Fisheries and Aquaculture, the company was taken over in order to save 200 jobs, the company, and even the future of the Newfoundland and Labrador salmonid aquaculture industry (Whiffen, 1998a, 1998b). After significant federal and provincial investments, the provincial government then even restructured the industry from inside a company, while at the same time arguing for different regulations and the lifting of a ban on importing 'more suitable' strains of salmon (ibid.). This is an example of the active work that has been put into making the Coast of Bays into an 'aquaculture capital'.

Rigby and colleagues (2017) argue that the history of the development of the salmonid aquaculture industry in Newfoundland is "emblematic of the state of environmental regulation within a neoliberal policy environment, where the state and state-funded institutions such as universities have become such pivotal players in financing and promoting the growth of private industry and are often reluctant to do anything that could potentially curtail that growth" (p. 25). However, the growth of the aquaculture sector is not uncontested. Anglers, environmentalists, artists, academics, some politicians, and other concerned citizens are actively questioning, protesting, and contesting industrial aquaculture as the taken-for-granted road for the development of the province. The recent die-off of over two million salmon has fueled this contestation, and even led the provincial government to suspend a number of aquaculture licenses (CBC News, 2019c).

1.4 Theory

In my thesis I combine poststructuralist geographical thinking on spaces, material-semiotic approaches within science and technology studies (STS), and animal geography. Through this combination, I conceptualize containment as a situated and relational practice that enacts spaces through a network of humans, non-humans (animal and other), objects, and technologies. By using this approach, I open up what it means to contain something and what differences certain containment practices make in relation to making and unmaking realities.

Through poststructuralist approaches within geography, we learn that space should not be seen as a closed-off container, in which things and processes are placed. Instead, Massey (2005) argues, we should approach space as itself (1) a product of interrelations, (2) a sphere of coexisting heterogeneity, and (3) always under construction. In this thesis, I approach containment practices as specific and situated ways of negotiating such spaces and places. I understand spaces and places as fundamentally made up of relations. Massey (2005) defines places as “temporary constellations of trajectories” (p. 153). Furthermore, she argues that in order to understand space and places better, and to be able to come to a more progressive politics of space, those places should be seen as “events” that “require negotiation” (ibid.). B. Anderson (2008) formulates Massey’s message as follows: “any space or place, from the intimate space of a body to the space of the globe, are precarious achievements made up of relations between multiple entities. Spaces have to, in other words, be made and remade because relations are processual” (p. 230). Using this approach to space to approach containment opens up the spatial practices of containment to see *how* containment is done and what difference the specific and situated practices make in relation to "the constant and conflictual process of the constitution of the social, both human and nonhuman" (Massey, 2005, p. 147).

Throughout this thesis, I take inspiration from material-semiotic versions of STS, "in which materials and meanings are woven together" (Law, 2017, p. 31). In particular, I have used sensibilities that emerged out of (post-)actor-network theory to guide me during my project. Actor-network-theory approaches the world as being "radically relational" (ibid., p. 141), meaning that every object, actor, or space for that matter "is shaped in its relations" (ibid.). Scholars working with (post-)actor-network theory and similar material-semiotic sensibilities, attempt to describe how these objects and actors take shape. Law (2017) describes what such a focus entails:

> [I]f we follow [actor-network theory's] logic, we need to study relations, networks, and webs of practice. We need to look at how webs assemble themselves to stage effects such as actors and objects, and binaries such as nature and culture, human and nonhuman, or indeed macro and micro. But this is a profound methodological shift, because with it STS moves from explanations (like social interests) which lie behind events to attend instead to methods for assembling. Whatever is going on is seen as an expression of strategies or tactics. Indeed the case studies of ANT and its related projects can be seen as a list of methods for assembling, stabilizing, or undoing realities. (p. 42)

In my thesis I articulate different versions of containment as something that has to be brought into the world. I focus on the methods of space-making, on how containment is done, through what kind of networks and to what effects. In doing so, I explore how in the practices of containment that I analyze realities are assembled, stabilized, and undone.

Through looking at the spatial containment practices of the ‘production’ of farmed *fish*, I also engage with animal geography. This subfield of geography focuses on “the complex entanglings of human—animal relations with space, place, location, environment and landscape” (Philo & Wilbert, 2000, p. 4). Rogers and colleagues (2013a) state that it does so “in ways that seek to counter anthropocentrism for both political and ethical reasons. One aim of scholars in this field is to include animals in their analyses without reducing them to objects or placing them in the background of human lives” (para. 1). By exploring multiple ways of making industrial salmonid spaces in aquaculture, I contribute to this realm of scholarship by articulating how a variety of non-human animal lives and death become part of and change through the making, unmaking, and remaking of space.

1.5 Methods

At the beginning of the project, I attempted to get some basic knowledge on how aquaculture is done. To do so, I read handbooks on the technical and economic aspects of salmonid aquaculture (such as Asche & Bjorndal, 2011; Cardia & Lovatelli, 2015; Purser & Forteath, 2012), an ethnographic account on the everyday practices on a Norwegian salmon farm (Lien, 2015), and had conversations with people working at the Marine Institute of MUN (St. John’s, NL) and Dalhousie University (Halifax, NS). Furthermore, I extended my initial idea of salmon aquaculture in Newfoundland and Labrador by reading narrative accounts of the history and the current state of the industry in the province (J. M. Anderson, 2007; Couturier & Rideout, 2018), but also by reading government publications about the state of the provincial aquaculture sector (such as Newfoundland and Labrador, 2018; Newfoundland and Labrador & Newfoundland Aquaculture Industry Association, 2017).

Subsequently, I started gathering materials that pertained more specifically to my aim of exploring how containment practices create spaces in the case of the salmonid aquaculture in Newfoundland. The research project and the proposed methods were approved by the Memorial University Interdisciplinary Committee on Ethics in Human Research.[3] The materials that I collected, can be divided into three groups: documents, interviews, and fieldwork.

1.5.1 Documents

Documents formed an important source for finding materials and stories around containment practices in salmon aquaculture in general and in Newfoundland in particular. In my project I used a variety of different documents to gain understanding about containment practices in salmonid aquaculture, to situate my materials and analysis, and to glean stories.

Early in the project my supervisor Charlie and I found out that a so-called 'Code of Containment' plays an important role in governing the containment of fish in the

[3] Memorial University ICEHR approval number: 20190126-AR

salmonid aquaculture sector in Newfoundland (Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch, 2014b). This Code and its associated documents were an important part of the data collection process. I tried to collect as many documents related to this Code and its emergence, which I then used to think through what containment is made to be through The Code and its practices. Besides documents about The Code, I also collected documents pertaining to other containment practices in salmonid aquaculture in Newfoundland and abroad.

The Centre for Newfoundland Studies (CNS) played an important role in accessing documents for this project. The CNS is part of Memorial University and collects published materials that relate to Newfoundland and Labrador. I used their five so-called vertical files on aquaculture (divided up in five time periods) to look at the newspaper clippings, periodical articles, brochures, and government press releases relating to the development of aquaculture in the province. I went through the documents in these folders, while primarily focussing on gathering stories around containment, and the Code of Containment in particular. I took pictures of relevant documents and gathered information about and quotes from these documents in an Excel file.

To gather more information about the practices in which the Code of Containment is enacted, I collected government documents pertaining to it. This included the Code of Containment itself (Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch, 2014b), but also the annual compliance reports (such as Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture

Branch, 2016a), some of which are published online.[4] I contacted the provincial Department of Fisheries and Land Resources (DFLR) to receive other unpublished documents. After a while and a number of emails, they agreed to sending me all of the minutes of the Code of Containment Committee that they could find, a document laying out the committee's Terms of Reference, and some of the compliance reports.

Other sources for stories around containment practices in salmonid aquaculture were scientific articles and articles by general media outlets such as the Canadian Broadcasting Corporation (CBC), and more specialized platforms, such as the global seafood business platform *Undercurrent News*. These and the other documents were used to, on the one hand, understand the history and development of containment practices in Newfoundland, and on the other hand to glean stories and other materials to think through how containment is done differently in a variety of practices.

1.5.2 Interviews

Conducting interviews was another method that I used to gather materials to think through containment. Semi-structured or unstructured interviews are probably the most-used method in qualitative social scientific research (Bryman, 2012, p. 469). The method is flexible, both in terms of accommodating the researcher's practical and logistical limitations and in accommodating the interviewees for being able to take the interview in

[4] https://www.fishaq.gov.nl.ca/publications/ (accessed October 26, 2019).

different directions and bring their own viewpoints and emphases to the table. Through asking open-ended questions, allowing for sometimes awkward silences, and posing follow-up questions, the researcher enables the interviewee to come up with rich and detailed accounts of the topic of the conversation, bring up issues that might be unexpected and surprising to the researcher, and influence the direction and contents of the interview.

I created a list of potential informants by looking through relevant documents, finding out who had been members of the Code of Containment Committee (see chapter two), finding out the different kinds of informants that are involved with containment, people suggesting names, or happening to sit next to someone – a former diver – during a domestic vessel safety course I took in preparation of my fieldwork. I approached these potential informants through e-mail and sent them an information document (Appendix I). If they agreed to conducting an interview with me, I let them decide the time and location of the interview. If people did not respond, I would send them a reminder e-mail after a period of time. Not all potential informants responded. It is worth mentioning that the provincial government officials repeatedly denied and evaded a face-to-face interview even after repeated requests by e-mail and phone, and instead opted for answering a number of my questions in written form.

Over the course of my research, I sat down and spoke with sixteen informants in a more-or-less formal interview setting. This excludes the informal conversations during my fieldwork such as on boats and wharfs, around dinner tables or during an aquaculture conference (see next section). All of these informants had experience with some of the containment practices in Newfoundland salmonid aquaculture. I conducted three interviews with people working at academic institutions during the exploratory phase of my project. These conversations on the technical, practical, and legal aspects of containment in salmon aquaculture were not recorded and are not treated as formal 'data' for this project, but they did inform my thinking about the topic. The other thirteen informants included an owner of a net cleaning facility, three employees of DFO (one research scientist and two regulators), three people that were part organisations involved in the protection of non-farmed Atlantic salmon populations (ASF and the Salmonid Council of Newfoundland and Labrador [SCNL]), two former aquaculture divers, a university scientist working on the effects of the escape of farmed salmon, a manager of an aquaculture company, a representative of a trade union, and a former mayor of a local community. This mayor and at least four other informants had been part of the Code of Containment Committee, that I discuss in chapter two.

Before each interview, informants would read the consent form (see Appendix II). After being informed about issues such as the nature of the research, and the potential risks and benefits of the project, all thirteen informants decided to sign the form, having the ability to choose whether or not they agreed on the interview being recorded and transcribed, and their name and/or direct quotations to be used in publications. I then asked questions pertaining to containment practices in the Newfoundland aquaculture industry using the questions in my interview guide (Appendix III). During the interviews, which took anywhere between 45 minutes and 2½ hours, I did not always keep to the exact questions, in order to fit the questions to the role, knowledge, and experiences of the informants. Afterwards, I transcribed the interviews and sent the transcripts to informants with the possibility for them to check and potentially correct these typed-out versions of our conversations.

1.5.3 Fieldwork

Another way that I gathered materials and wrote up stories and descriptions of containment practices, is through participant observation. In this method "the researcher seeks to observe events and the behaviour of people by taking part in the activity him- or herself" (Rogers, Castree, & Kitchin, 2013b). This method enabled me to not only rely on what people *say* about practices around containment and salmonid aquaculture more widely, but also experience how these practices are *done*. Some things that I experienced through participant observation, might have been glossed over by informants as too mundane or not relevant for my research. Moreover, during my fieldwork I primarily worked with, learned from, and spoke with site workers and other employees of the aquaculture company that gave me access to their sites. This stands in contrast to the people I interviewed and led me to gather materials and stories about different aspects of containment practices and get an impression of the more everyday activities in and around the salmon net-pens. During the fieldwork periods, I also talked to site workers, managers, and other employees in more informal ways than the formal interviews. These conversations happened on boats during the shifts, over lunch, during dinners, in offices, on wharves, and at a provincial aquaculture conference. I always identified myself as a researcher gathering materials to write a master's thesis on issues around containment and net-pens in salmon aquaculture, and when possible, I informed people using an information document (Appendix IV), although this proved relatively hard in the practice of a busy workplace. I made quick notes of observations and conversations, which was sometimes hard standing on a wobbly boat or the walkway of a net-pen wearing gloves, a helmet, and steel-toed boots. Sometimes I used my recorder when I came back to my accommodation after a shift, describing my impressions of the day. I typed out some of these notes and recordings and adapted them into more narrative descriptions to be used as materials for my analysis, while I used others as a memory support of the things I had learnt during my periods of participant observation.

My supervisor Charlie and I gained permission for me to visit the farms through a manager of an aquaculture company active at the south coast, who was connected to a friend of mine pursuing a PhD in biology and his supervisor. This manager also helped arranging accommodation during my visits to the south coast. Although, I had first hoped to spend a monthlong period with an aquaculture company, we had to settle on two weeklong periods that the company could accommodate. However, I still learned a lot during my fieldwork, and the participant observation led to rich descriptions of containment practices, and many stories that I would not have had using only documents or interviews.

The participant observation consisted of three parts: two weeklong periods in communities at the south coast of Newfoundland joining daily activities in and around the net-pens, and a three-day aquaculture conference in the provincial capital of St. John's. In September 2018, I spent one week in a small community that is only accessible by ferry. I joined site workers on their daily feeding shifts, observed the deliveries of large amounts of packaged feed pellets, and joined a site manager and a site worker during a sea lice count, which consists of catching salmon with a dip net and counting how many sea lice they have on their body. During the long days from sunrise to sunset, I chatted, asked questions and listened, helped feeding and waited, and made many notes (Figure 4).

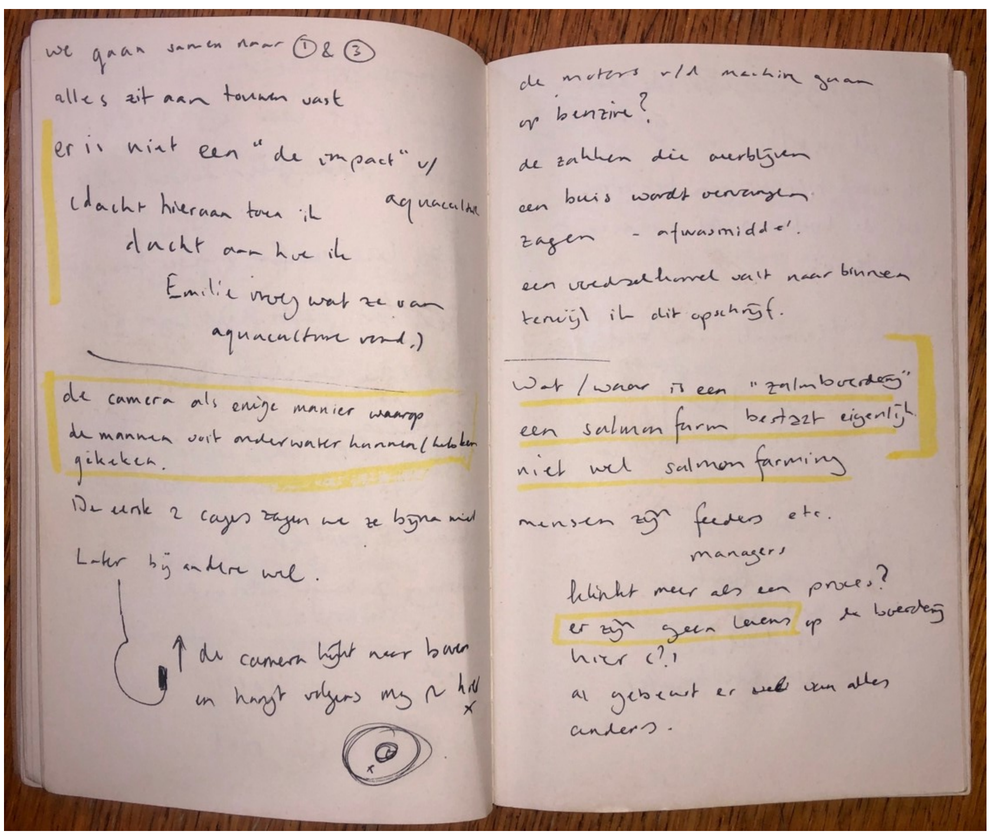


Figure 4: Author's notes (picture by author)

From September 26 to 28, NAIA organized its annual conference and trade show in the Delta Hotel in the provincial capital of St. John's. I participated in this conference through listening to speeches, papers, and panel discussions; visiting the stands of different companies and organizations participating in the trade show; and chatting with other attendants of the conference. The conference allowed me to see how people working for the government and companies in aquaculture and its service industries talk about issues, practices, and technologies around containment, and what kind of (new) containment technologies are emerging and have emerged in the field.

In October 2018, I drove down to another community on the south coast, this time not alone but with Christine Knott, a postdoctoral researcher working on the labour aspects of aquaculture. During this week, I again joined people working in and around the net-pens. This time I joined site workers working on an automatic feeder, I saw how sea lice were treated with chemicals, and joined maintenance workers changing out the huge nets of the net-pens: the so-called 'smolt net' was substituted for a 'market-size' net. Together with Christine, I visited a net cleaning facility, and interviewed several informants. We also enjoyed dinner with two managers who had granted me access to the farms, during which we chatted informally about the development and practice of aquaculture in the province. Doing fieldwork with Christine – her company, the conversations we had, and the interviews we conducted together – not only helped me think through my materials and add to my analysis, but also made my fieldwork experience more enjoyable.

1.5.4 Analysis

Based on the different documents, interviews, and field notes I started distinguishing between different ways in which containment was *done* in my materials. In analysing, I focused my attention on two sets of practices: on the one hand the Code of Containment and on the other hand the work in and around the net-pens.

Even though my analyses can be read as descriptions of how containment is done in salmonid aquaculture in Newfoundland (and partly in other parts of the world), I do not aim for – and have not in the least achieved – a complete description of all the ways in which containment is done, nor do I present a final analysis of what containment is. Rather, by articulating different ways in which different versions or modes of containment are enacted and achieved in practice, I explore different ways of thinking and doing containment. In doing so, I open up the concept of 'containment' in an attempt to make space for different and potentially better containment practices.

1.6 Overview chapters

In what follows I will start opening up containment by analyzing different containment practices in Newfoundland salmonid aquaculture. I have organized these practices around two sites of containment: 'The Code' and 'the cage'. In chapter 2, I answer the question as to how containment is enacted through the *Code of Containment for the Culture of Salmonids in Newfoundland and Labrador*. I build on literature on containment practices to analyze how containment is done through The Code and its practices, and what we can learn from this about what it is to contain something. In chapter 3 I turn to 'the cage' and explore how containment practices that are related to the creation of a rearing environment for the farmed fish, enact life and death in and around the cage. In this chapter I build on literature on non-human biopolitics to explore how space-making and life-and-death-making are intertwined in the containment practices of making a 'rearing environment'. Finally, in the concluding chapter 4, I summarize my thesis and formulate an answer to my main question that asks, what the production of spaces through containment practices in salmonid aquaculture in Newfoundland teaches us about what it means to contain something.

Chapter Two

Decoding The Code: Framing, Monitoring, and Improving Containment

2.1 Introduction

The failure of the containment of fish is a problem that seems to be a potential threat to current sea-based salmonid aquaculture. Farmed salmonids, such as Atlantic salmon, trout, and char 'escape' their net-pens and pose a threat to the aquaculture industry. Critics of marine salmonid aquaculture, articulate these events as environmental spills, and threatening 'wild' salmonids by invading ecosystems, spreading pathogens, and introducing the risk of the hybridization of wild and farmed species. Also, some companies claim that escapes decrease their profits, by the loss of expensive fish. The ways in which this containment problem is tackled, varies from area to area, ranging from proposals to move aquaculture on land and improving containment technologies to regulation through law and companies getting insurance on their fish.

The purpose of this chapter is to explore what it actually means to contain something through an inquiry into a specific way of 'solving' the containment problem. This chapter analyzes the *Code of Containment for the Culture of Salmonids in Newfoundland and Labrador* (from now on 'The Code'), which the federal government, the provincial government and the aquaculture industry jointly implemented in 1999 in the Canadian province of Newfoundland and Labrador (Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch, 2014b). They did this to prevent farmed salmonids from unexpectedly leaving their net-pens and entering the surroundings of the production sites. However, whether or not The Code works is questionable; it has not eliminated fish from leaving the net-pens through so-called ‘escapes’.

Through reading and analyzing The Code itself and other relevant documents, interviewing people involved, and listening to media items, I found that everyone involved in The Code recognizes that it is impossible to completely eliminate escapes from happening. But, if it does not eliminate escapes, then what does The Code do? And, what can the practices of the Code of Containment teach us about what containment is and what it means to contain something?

2.2 Literature review

We live in a world where people in many different ways try to contain other people, toxicants, wildfires, ideas, money, water, and other things - with the help of walls, fences, nets, but also policies, words, stories, and more. However, this world of containment could just as easily be characterized by the occurrence of leakages and overflows. In such a leaky world, thinking about containment as completely sealing off a definite space does not seem to be the most appropriate or productive. Therefore, it is important to explore what containment is and what it means to contain; other articulations of containment can make us more attentive to the practices and politics of containment.

Containment has been discussed by social scientists in a range of different ways. Practices of containment are described as an important narrative and management strategy in the way discards are dealt with, for example in pollution control (Liboiron, Tironi, & Calvillo, 2018), mine remediation (Beckett & Keeling, 2019), and other types of waste management (Gray-Cosgrove, Liboiron, & Lepawsky, 2015). Similarly, containment plays an important role in other forms of environmental management and the making of landscapes and naturecultures, such as in post-disaster environmental management (Felt, 2016; Tironi & Farías, 2015), nature conservation (Ginn, 2008; Hawkins & Paxton, 2019), and biosecurity (Hinchliffe, Allen, Lavau, Bingham, & Carter, 2013). The concept of 'containment', is also used to describe "discursive containment" (Kinsella, 2001) or the rhetorical management by governments, companies, or other institutions of what can be discussed, communicated, and otherwise done (Few, 2001; Ho & Su, 2008; Kinsella, 2001). Few (2001), for example, uses containment to refer "to the strategic management of public involvement in planning so as to minimize disruption to pre-conceived planning goals" (p. 112). More widely, containment is discussed as part of (post)carceral geographies (McTague & Wright, 2010; Turner, 2013); a logic underlying detention processes (Mountz, Coddington, Catania, & Loyd, 2013); a central philosophy, narrative, and technology of power in parts of West Africa (Douny, 2011; Warnier, 2007) and in Cold War USA (Edwards, 1996; Pieper, 2012); in relation to religion and contagion (Mayblin, 2017); and as a "social-scientific [technique] for investigating and intervening in social reality" (Lezaun, Muniesa, & Vikkelsø, 2013, p. 278).

Central in many of these accounts and analyses is what Hinchliffe and colleagues have described with Brown's term "will to closure" (Brown, 2010; Hawkins & Paxton, 2019,

p. 1017; Hinchliffe et al., 2013). In the context of livestock agriculture, which the they focus on, the authors argue that “this will to closure takes particular forms and makes for particular landscapes” (Hinchliffe, 2015, p. 533). Containment and control seem to go hand-in-hand, and with the demise of the violent and harmful illusion of (human) control, full containment also increasingly shows to be a modernist fairy-tale (Hird & Zahara, 2017). In spite of the will to closure, scholars working on biopolitics (Hinchliffe et al., 2013), but also on other topics such as discard studies (Gray-Cosgrove et al., 2015) and economics and economy (Callon, 1998), have shown that “perfect control and containment are rarely realized” (Hawkins & Paxton, 2019, p. 1017). Similarly, Liboiron and colleagues (2018) argue that management techniques such as containment “are premised on a politics of material purity that is no longer available or was never viable to begin with” and “do not address the wider social, political, military and other power structures that engender toxicity to begin with” (p. 332). However, containment and control are still used as strategies or ideals to strive after, and form a powerful “sociotechnical imaginary” which has real-world effects (Felt, 2016; Jasanoff & Kim, 2009). Within this tension between containment as never-fully-realized and as having real-world effect, it is important to think about how to understand and talk about containment.

Different approaches can be taken to studying and articulating containment practices after the problematization of the containment as completely sealing off a definite space. One possible venue is studying “leaky things” (Nading, 2017), the ways that leakages come to matter and are handled in different practices (Callon, 1998; Shildrick, 1997). Other scholars go "beyond containment" (Parsons, 2019) and "examine power relations and actions that have the potential for an otherwise" (Liboiron et al., 2018, p. 331) to formulate more ethical and more just alternatives to solely thinking through concepts like containment (Beckett & Keeling, 2019; Gray-Cosgrove et al., 2015). A third possibility is focusing on practices that do seem to reach some kind of empirical 'containment' and focusing on how this is done and what the effects of it are.

In their exploration of "provocative containment" as a technique in a particular kind of social scientific research, Lezaun and colleagues (2013) understand 'containment' in a way that is useful to study its enactment and effects:

> Containment is to be understood in the sense of confinement or restraint but also as holding. To contain something is to have it handled 'inside' a clearly demarcated space, but also to hold it stationary, or in a manageable scale and duration, to prevent it from overflowing. (p. 280)

Similarly, Hawkins and Paxton (2019) focus on predator fences and related practices "in which particular forms of nature are not simply protected but made to happen" (p. 1009). These scholars more-or-less background the inevitable leakiness of containers, to foreground the active and productive aspects of containment (see also Ginn, 2008; Sofia, 2000). Hawkins and Paxton formulate this as follows:

> This idea of containment as a technique that simultaneously holds and also rearticulates is compelling. It alludes to the ways in which containing is always a dynamic process for making worlds (Sofia, 2000). The containment device is not a neutral holder. It has effects, it reconfigures what is contained in two senses: by delineating a boundary and separating things off from the world, and also by framing and projecting them back into the world and capturing or orienting particular responses – human and nonhuman. (Hawkins & Paxton, 2019, p. 1016)

This approach looks at containment as a form of worldmaking ("a reality-generating device" [ibid., p. 1009]), focusing on what difference containment practices – however leaky they are – make in the world through separating off some things, and actively holding and transforming them.

Most of these approaches focus on containment as 'holding inside', whether this is a failed or a transformative holding. The role of containment practices in holding together certain worlds that go beyond the contained space and the things held inside, is largely backgrounded or at least only implicitly present in accounts of containment. I looked up the root of the word 'containment' in the Oxford English Dictionary: "to contain" (OED Online, 2019). In the dictionary, the many meanings of the verb "to contain" are divided in two big groups. The first group consists of most of the meanings that are still actively connected to the verb, i.e. "[t]o have in it, to hold; to comprise, enclose" (ibid.). This is also the most common way of imagining what "containment" consists of. However, the second group in the Oxford English Dictionary, consisting of the meanings that are not often used anymore, covers "[t]o hold together; to keep under control, restrain, restrict, confine" (ibid.). I propose to reactivate this second meaning of containing, and apply it to our thinking about containment as well, in order to think about containment not only as 'having in it', but also as 'holding together'.

The exploration of the making, unmaking, and remaking of "a continued imagination of control and containment" (Felt, 2016, p. 52) seems to be an approach that is well-suited to this task of focusing on the enactment and the effects of containment as not only holding inside but also holding together. The focus in such an approach can be on the discourse (Edwards, 1996), philosophies (Douny, 2011; Warnier, 2007), and imaginaries that do and sustain containment in particular ways (Jasanoff & Kim, 2009). These are not immaterial ways of doing containment, but are sustained through material practices consisting of for example laws, legislation, stories, objects, policies, technologies, and spaces. Felt (2016) for example, explores the spatial interventions that were undertaken after the Fukushima Daiichi nuclear disaster in Japan. As part of this, she investigates "how diverse actors began to design and implement a range of techno-social interventions to re-envision and sustain a continued imagination of control and containment" (p. 52). These materially enacted imaginations can have large effects. Douny (2011) dealing with "the role of earth shrines in generating and maintaining social order and cohesion in a Dogon village on the Bandiagara escarpment (Mali, West Africa)" (p. 167), argues that "by focusing on the efficacy, materiality and immateriality of land shrines, this paper has provided an account of an ontological principle of containment, through which the Dogon people act and therefore dwell in the world" (p. 176). Similarly, Warnier (2010) describes containment as a form of Foucauldian governmentality in the context of the kingdoms of western Cameroon, as he describes in his book that the "technology of power rests on the material forms of containing or wrapping" (p. 193). Even though these different forms of containment as discourse, imagination, and technology of power, are not the same, they do illustrate how containment can be imagined and enacted with powerful effects on how worlds are held together.

In this chapter I explore how to think containment as holding together through analyzing the *Code of Containment for the Culture of Salmonids in Newfoundland and Labrador* and the practices in which this Code is enacted. I follow Asdal's (2015) material-semiotic approach to analysing "documents and the work these may do" (p. 13) which recognizes that "[d]ocuments (…) take part in modifying and sometimes radically transforming issues" (ibid., p. 15). I start with a description of three recent big escapes, what problems events like those present, and what measures were proposed to solve those crisis events and the problem of containment in salmonid aquaculture more broadly. After this I will introduce The Code as a specific way of solving the problem of containment. After giving a brief description of the history of this Code, I will discuss the status and contents of The Code, and describe the different practices in which The Code is enacted and evaluated. Using this description, I will analyze The Code in terms of what it means to do containment. I will formulate three modes through which containment is done: framing, monitoring, and improving containment. In conclusion, I will argue that containment is not only about holding salmon inside a net-pen; rather, the institution of The Code and its particular way of doing containment plays a role in *holding together* the current aquaculture industry in Newfoundland, as unquestioned and self-evident presence on the south coast. Moving from understanding containment as 'holding inside' to 'holding together' helps to open up situating particular ways of containment and seeing what worlds it helps to sustain.

2.3 Containment and escapes: problems and solutions

2.3.1 Escapes as urgent problem to the industry

Escape events are a big problem of the salmonid aquaculture industry because they are so widely publicized and because of the role they play in debates around the problems with aquaculture. I will describe three examples of large escape events and the ways in which the ensuing crises were attempted to be solved; I cover respectively Washington State (USA), Chile, and Newfoundland and Labrador (Canada).

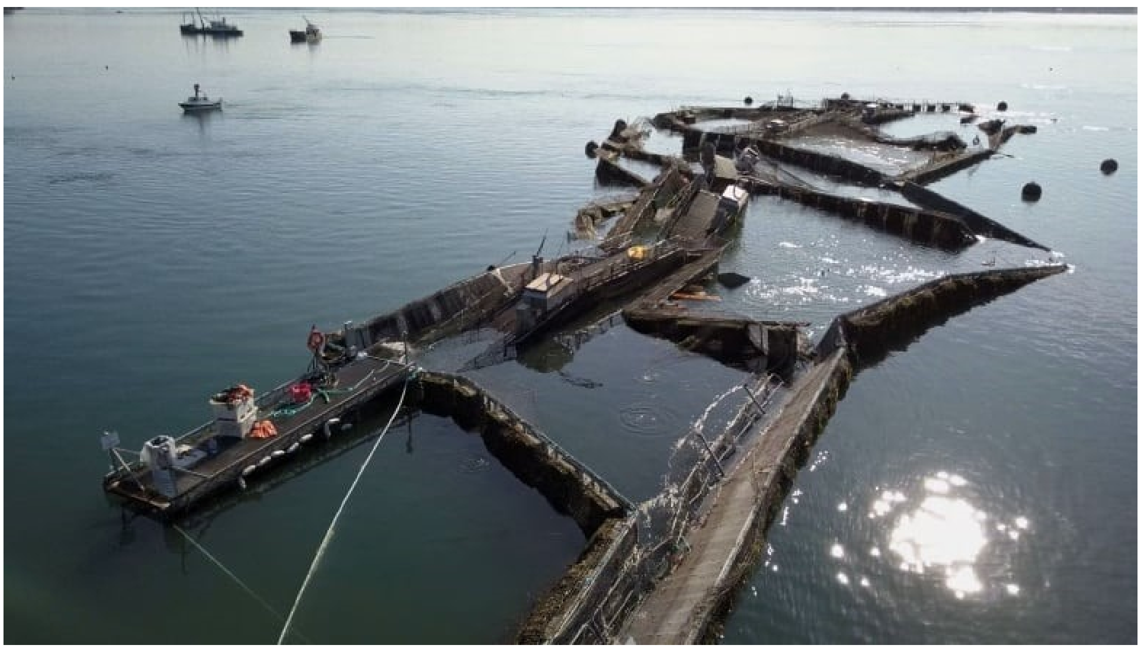


Figure 5: Collapsed aquaculture cages in Washington State facility (NB: these are steel rectangular cages; in Newfoundland the cages are circular and made of high-density polyethylene (HDPE). (picture by B. Garreau in McPhail, 2018)

In August 2017, more than 160,000 farmed Atlantic salmon escaped from an aquaculture facility in Washington State (McPhail, 2018; Figure 5). One of the net-pens on the facility broke after “an anchor pulled loose and metal walkways twisted about” (Flatt & Ryan, 2017, para. 2). Cooke Aquaculture – the company in charge of the failed net-pen – and officials of the Washington Department of Fish and Wildlife blamed the breakdown of the net-pen on high tides and currents caused by a solar eclipse, but this explanation was disputed by others, arguing that the currents and tides were not unusual or extreme for the area (ibid.). The director of a non-profit conservation organization called the event an “environmental nightmare”, as “[t]he Atlantic salmon bring with them pollution, virus and parasite amplification, and all that harms Pacific salmon and our waters of Washington” (ibid., para. 16).

This “Atlantic Salmon spill” (Mapes, 2018) or “leakage” (SouthCoaster, 2018, para. 17) immediately led to a moratorium on the establishment of new fish farms in the State (The Canadian Press, 2017), which was followed by a suspension of the lease of Cooke Aquaculture (The Associated Press, 2018). In a report, state investigators argued that the company had not only been negligent in the maintenance of its net-pens, but had also “vastly underrepresented the scope of a catastrophic Atlantic salmon net-pen spill at its Cypress Island farm in August and misled the public and regulators about the cause” (Mapes, 2018, para. 2). Eventually, the event led to a total ban on farming Atlantic salmon in the waters of Washington State, described by a State Senator as “a strong stance to ensure the protection of our marine environment and native salmon populations in the Salish Sea” (Britten, 2018, para. 5).

Another recent collapse happened in July 2018, when “[h]igh waves and gale force winds” severely damaged a 2017-built production site along the coast of Chile (Evans, 2018a, para. 1). Over 900,000 salmon were present in the damaged net-pen(s). When the weather conditions allowed the company to inspect the damage the next day, only about 250,000 salmon could be recovered. Greenpeace called it “a potential environmental disaster whose consequences for the area are to be seen, but which can be very serious”, especially because of antibiotics that were injected into some of the escaped salmon (SouthCoaster, 2018, para. 13). These antibiotics cannot be consumed by humans and could lead to antimicrobial resistance, as the course of the antibiotic was incomplete (Evans, 2018b; Reuters, 2018).

In reaction to this event and the company’s failure to recapture at least ten percent of the escaped fish, Chile’s Superintendency of the Environment charged the company for not having taken the right safety measures. The company currently risks “revocation of the farm licence, closure or a fine of up to 5.6 billion pesos (£6.2 million)” for “causing environmental damage that could not be repaired” (Editors, 2018).

In Newfoundland, a large escape incident happened in September 2013, when Cooke Aquaculture lost around 20,000 salmon from one of their net pens (CBC News, 2013b). Whereas the company claimed that the salmon did not pose any threat to the environment and would be eaten by seals, a group of DFO biologists has shown that after the escape event, both farmed and hybridized salmon were found in rivers in the region where Newfoundland salmonid aquaculture takes place (Wringe et al., 2018). Even though scientists argue that this process of hybridization poses challenges to the fitness and survival of wild Atlantic salmon populations, the company did not face any sanctions from either the provincial or federal government.

These three examples represent large escape events where the number of fish that are released, number in the tens of thousands. There are also much smaller escape incidents that are usually not reported. They involve salmon that swim through a hole in the net and go unnoticed, or fish that accidentally end up outside the net-pen while being handled, for example when taken from the net-pen to be processed or when periodically taken to be checked for sea lice or other health issues. These smaller escapes are sometimes referred to as “trickle escapes” (e.g. CBC News, 2013a, para. 7) as opposed to “significant escapement[s]” (see for example Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch, 2014b, p. 36). In the three examples, and in most other events, the salmonids that ‘trickle’, ‘leak’, ‘escape’, ‘spill’, or ‘break into’ seas and oceans present a number of different challenges. Firstly, they present some environmental risks: invasion and competition with native species, hybridization and introgression of farmed genes into the wild populations, and spreading pathogens and parasites (Glover et al., 2017; Hansen & Windsor, 2006). Secondly, escapes are presented as a potential financial loss for companies (Navarro, 2018), as the fish form their capital that is either disappearing into the wild altogether, or recaptured but not allowed to be sold as a commodity on the salmon market. Thirdly, ensuing opposition from environmentalists, and potential fines for companies and loss of their licenses present a danger to the possibility of legitimate salmonid farming altogether (ibid.)

2.3.2 Socio-technical solutions to the problem of escapes

Attempts to solve the problem of escapes take different forms. Firstly, opponents of sea-based aquaculture often propose to take the operations out of the sea and move them onto land. These land-based, closed-containment facilities would preclude fish from leaving their enclosures into seas and oceans (see for example Atlantic Salmon Federation, n.d.a).

Secondly, companies make sure they have strong insurances to cover some of the financial risks of losing fish. This strong insurance coverage could in many cases make more financial sense than the implementation of costly measures (Navarro, 2018). Some scholars even argue that losing some fish makes more financial sense to companies than trying to keep all the fish in, as "[t]he incentive for costly net maintenance declines as leaky net pens become more cost-effective—revenue lost through escapes becomes less than the labour and material costs consumed to retain them" (Volpe & Shaw, 2008, p. 141).

A third type of solution is the improvement of containment. Some of these solutions comprise of improving technologies, ranging from sturdier nets and pens to so-called 'escape-proof' net-pens and closed-containment technologies in the sea, where there is virtually no direct interaction between the water and the fish in the cage and outside of the cage (Fisheries and Oceans Canada, 2014; Jones, 2018). Sterilization of fish is another avenue taken in the improvement of containment measures, with higher and higher reported percentages of success of making fish sterile, and a growing understanding of the different nutritional requirement of sterile strains of fish (BioMar, n.d.; Tveiten, 2017).

Yet another way to improve containment is through legal means. This is done in different ways. Looking at North America, we see that Alaska and Washington State have banned salmon farming in the ocean all together, whereas Washington State before its ban allowed the farming but prohibited escapes. Other provinces and states differ from these "'prohibitory' approaches" and try to manage and control escapes "through special regulations, licence conditions and codes of conduct" (T. K. Barry & VanderZwaag, 2007, p. 71). So-called 'codes of containment' form a part of this last more managerial approach to improving containment through regulations. Versions of these codes are active in Norway (Pinfold, 2016, p. 17), the American state of Maine, as well as the Canadian provinces of New Brunswick, Nova Scotia, and Newfoundland and Labrador (T. K. Barry & VanderZwaag, 2007).

In 1999, Newfoundland and Labrador was the first Canadian province to implement such a Code of Containment (ibid., p. 65). It was hailed as a "beefed up" code that "tightens the safety net" (Wangersky, 1999, p. 4). The Code was put together by the aquaculture industry, the federal government, and the provincial government in order to fulfil a requirement to lift the ban on importing a non-sterile strain of (non-native) rainbow trout into the Newfoundland waters, and was aimed at preventing fish from escaping their net-pens (ibid.; Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch, 2014b).

2.4 The Code of Containment for the Culture of Salmonids in Newfoundland and Labrador

The Code of Containment for the Culture of Salmonids in Newfoundland and Labrador is an important document (Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch, 2014b). It was composed by aquaculture industry, and by the federal DFO, and the provincial DFLR[5]. The authors of The Code state in the beginning of the document:

> It is recognized that *effective containment of fish* is a fundamental aspect of good management practice. For this reason, the Code has been expanded to include all salmonid cage culture in all areas of Newfoundland and Labrador and is a cornerstone of the province's commitment to responsible and sustainable development. (ibid., p. 4)

Furthermore, the authors present the document as "a cornerstone of the province's commitment to responsible and sustainable development" (ibid.). The Code and its concern around "the effective containment of fish" are considered fundamental in doing aquaculture in the right way (ibid.).

Everyone who has a license to grow out salmonids in the waters of Newfoundland and Labrador, has to adhere to the contents of The Code. If a company does not comply to

[5] In 2017 the provincial government expanded the Department of Fisheries and Aquaculture and changed the name from Department of Fisheries and Aquaculture to Department of Fisheries and Land Resources (Newfoundland and Labrador, 2017).

The Code, it could be taken up as a violation of the license and lead to penalties and even losing site licenses (T. K. Barry & VanderZwaag, 2007). Even though this is a legal possibility within the province's Aquaculture Act, no aquaculture company to date has lost its license for not adhering to The Code.

The introduction of The Code in 1999 was part of an attempt by industry, and the provincial and federal government to support the struggling salmonid aquaculture industry in the province at the time. Earlier, both the federal and provincial governments had made large investments in the aquaculture industry, as part of the economic development of certain regions in the province (Newfoundland and Labrador, 1996). In the spring of 1998, the province had – initially in secrecy, but later made public after being revealed by a journalist of *The Telegram* – bought up the largest aquaculture company on the south coast, after the shareholders of the company had requested help in the face of a possible bankruptcy (Whiffen, 1998a). After buying the company, the province installed the deputy minister of Fisheries and Aquaculture as the person responsible for managing the company, and made a number of decisions to ensure a viable future for the company and aquaculture in the province. One of the central changes to be made, according to the provincial minister and industry leaders, was the introduction of strains of salmonids that could make the industry in Newfoundland profitable. According to *The Telegram*, the (sterile) strains that were allowed at the time, wouldn't "grow as large as others", which would "reproduce and grow at a faster rate to a larger size" (ibid., p. 2). These industry and government leaders argued that instead of certain specific strains of Atlantic salmon and non-sterile strains of trout, also non-sterile strains of trout and other types of Atlantic salmon should be allowed to be introduced in the industrial net-pens. Initially, the federal minister did not allow industry to introduce the non-sterile rainbow trout to the provincial net-pens, as they could form a potential risk to the 'wild' populations of Atlantic salmon. In response, the provincial minister "began lobbying DFO to change the regulations to allow the importation of strains of fish that would make the business viable" (ibid.). According to him, the future of the possibility of aquaculture in the province and even the future of an entire region of the province – the Coast of Bays region – depended on the introduction of the new strain of trout. In spite of protests by the environmental organization SCNL, the minister responsible for DFO eventually agreed with the introduction of the all-female, non-sterile strain of rainbow trout, under the condition of "the provincial government's ability to demonstrate that satisfactory containment measures can be put in place" (Whiffen, 1999, p. 4). Furthermore, the absence of male rainbow trout among the rainbow trout that would be introduced, was said to significantly reduce the risk of escaped rainbow trout reproducing and establishing populations on the expense of 'wild' Atlantic salmon (ibid.).

Government and industry came up with a "beefed up" Code of Containment to fulfill the requirement of putting in place "satisfactory containment measures" (Wangersky, 1999, p. 4; Whiffen, 1999). Initially, this new document was called *Code of Containment for use of non-local salmonid strains in sea cage aquaculture in Newfoundland and Labrador*, but by 2005 its name had changed to *Code of Containment for the Culture of*

Salmonids in Newfoundland and Labrador and applied to the net-pen aquaculture of all salmonids in Newfoundland and Labrador (Rideout, 2006, p. 126), whether native or non-native, sterile or non-sterile. At the beginning of The Code its goal of "effective containment of fish" is further specified into six different objectives (see Box 1). The Code is accompanied by a committee that meets annually (or biannually) to review the annual Code of Containment compliance reports, discuss incidents and the contents of The Code, and suggest and implement changes to The Code.

It is important to note here that the implementation of The Code played a vital role in making it possible for the salmonid aquaculture industry to be established and grow in future years. The Code was the solution to federal requirements for importing certain strains of more 'profitable' fish. This genealogy of The Code is crucial to understanding the establishment of aquaculture and how it is sustained in the province. From the constitution of The Code, it has been about more than just keeping fish in; the current aquaculture industry can be said to be co-constituted with The Code (Box 1).

Box 1: Objectives of the 2014 Code of Containment:

- "to minimize escapes of farmed salmon (consistent with the NASCO Oslo Resolution);
- to recognize the benefits, including socio-economic, resulting from the development of salmon aquaculture (consistent with the NASCO Oslo Resolution);
- to be forward-looking and seek continual improvement;
- to be comprehensive in terms of both general and site-specific application;
- to be consistent with NASCO priorities concerning the containment of aquaculture salmonids; and,
- to be as stringent and vigorous as containment codes currently existing in other jurisdictions."

(Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch, 2014b, p. 5)

The Code focuses on technologies, handling practices, and the maintenance and repair of nets. It describes different requirements and standards companies have to follow, and details the expectations that they have to meet to ensure "effective containment" and prevent farmed salmon from leaving their cages in unplanned ways. The Code and the prescribed measures are "targeted to the areas of cage culture that have the greatest potential for escapement of fish" (ibid., p. 6). Based on the "analysis of loss profiles in other jurisdictions", The Code singles out "equipment failure and (…) net failure" as the "leading cause of farmed salmon escape incidents" (ibid.). To prevent these failures, companies have to ensure that the net-pens are strong and stable enough: companies need to ensure the correct design and construction of nets and cage systems; nets should be attached with ropes with a certain minimum strength and the meshes in the nets need to be a certain size; each net should be tagged with a number and ensure that nets older than three years are tested every 18 months by a "net testing agent" and meet the stated "breaking strength" (ibid., p. 11); and companies have to send in annual "Mooring Maintenance/Replacement Plans" (ibid., p. 20). Furthermore, divers need to inspect and document the status of the nets every 90 days and repair the net if necessary (ibid., p. 11), and site workers need to complete a weekly "system inspection", which consists of looking for possible signs of breakdown or decay of parts of the cage system that is visible from above the water surface (ibid., p. 25). The handling practices that are prescribed in The Code, focus on doing things with the fish (counting, grading, harvesting, transferring) or with the nets (changing, cleaning nets, towing cages). Also, issues around predator control plans and ice protection have their own small sections, but are primarily said to be covered by the License Application Process that precedes compliance to The Code (ibid., p. 29). Finally, companies need to send in annual inventories of their nets and their fish (ibid., p. 22), and be able to report to the provincial department DFA or DFLR about the fulfillment of the different requirements, in part by filling out the forms that are part of the appendices of The Code (see also Box 2 for the responsibilities as laid out in The Code).

Box 2: Responsibilities as laid out in 2014 Code of Containment

"Industry

The operators of aquaculture licenses in Newfoundland and Labrador agree:

- to enact measures to the full extent of the Code of Containment to minimize escapes from sea cage culture; and,
- to provide information, maintain equipment standards and to employ practices as outlined.

The Department of Fisheries and Aquaculture

- provides the procedures and protocols required to meet the Code's objectives and guidelines (Appendices 1-5);
- provides the necessary monitoring and enforcement to ensure containment practices and procedures specified in this proposal are followed; and,
- coordinates regular stakeholder review and updates of the Code.

The Department of Fisheries and Oceans

- prepares, and monitors, the recapture component of the Code;
- reviews the inventory reconciliation information required by the Code; and,
- monitors, on a periodic basis, compliance with the practices and procedures of the Code. This may take the form of independent audit, site inspection/visits, or other investigations."

(Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch, 2014b, p. 8)

Even though The Code aims to eliminate escapes, it does nonetheless include provisions that must be followed in the case of an escape of salmon from a net pen:

> In the event of an escape incident where it is reasonable to believe that there may have been an estimated loss of 100 or more fish from any one cage, the incident is deemed to constitute a significant escapement and the license holder is required to commence discussions with DFO within 24 hours of the incident to determine if recapture efforts should be initiated. (ibid., p. 36)

As I discuss later, the definition of a 'significant escapement' has recently been changed from 100 to just one fish, illustrating that what is considered 'significant' in the context of containment is neither stable nor self-evident. Companies cannot recapture salmon without DFO's approval, as salmon outside the net-pens are considered to be 'wild' by law, and are subject to the same strict regulations as the recreational fishery for salmon. The outcome of discussions with DFO can lead to recapturing efforts by the companies or for example local fishermen that help out the company. But, DFO does not automatically and not always allow recapturing efforts as they also consider "the life history stage of the escaped fish, the time of year, incident-specific factors, and conservation objectives for wild fish populations" (ibid., p. 35). Every operator in Newfoundland is required to submit a "Recapture Plan and License Application describing individuals designated to conduct recapture activity, amount and location of recapture fishing gear, aquaculture sites covered under the plan, and disposal procedures for recaptured fish" (ibid., p. 38). Besides prescribing companies to report to DFO and DFLR, The Code sets out other requirements regarding recapture gear, incidental catch and bycatch, recapture licensing, training of employees, and having a disposal plan for the recaptured fish. In 2013, a new section on "Post Escape/Incident Review" was added to The Code (ibid., p. 43). In this section, DFO and DFLR are required to conduct a review of every incident that led or could have led to an escape. Growers have to submit a report after the escape or incident happened and all measures and reparations have been done. This report will be used by DFLR and DFO in order to evaluate the escape and determine if the incident was preventable or not, if the grower did not take due diligence and measures should be taken, and if the Code of Containment should be adapted. The Compliance Report of 2015 includes two of these evaluations, which are interesting to read, and they offer a glimpse into the containment practices of The Code (see Boxes 3 and 4).

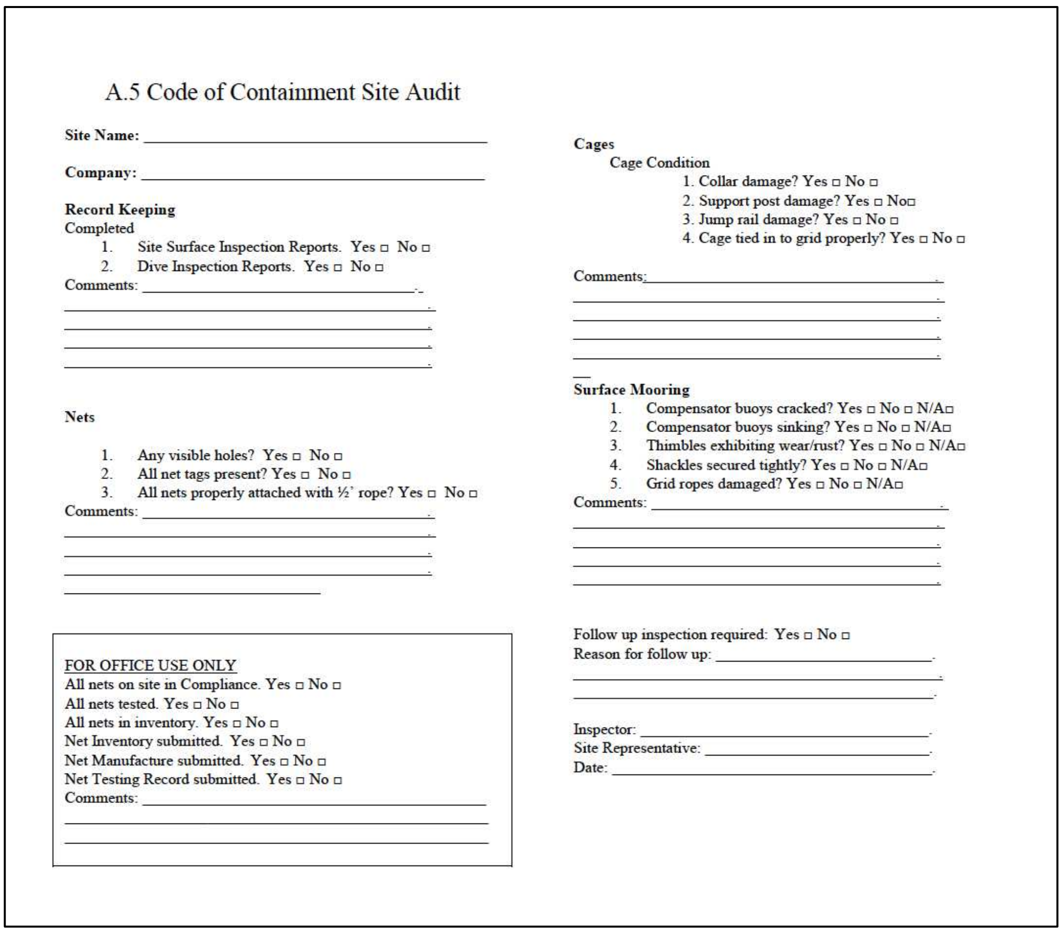
Box 3: Code evaluation 1

"There were two instances of escapes in 2015. Industry is compliant with escape reporting. Both instances resulted in a Post Escape Report being filed with DFA and Fisheries and Oceans Canada (DFO).

Incident 1)*
During fall of 2015, salmon were observed in vicinity of a farming area believed to be of farm origin. DFO discovered farm origin fish in a local river mouth near a site in Fortune Bay. There was only one farm rearing fish in that area. DFO requested the farm conduct a review of their sites to determine if an escape event occurred. Upon review of the sites records it was noted that sharks had been repeatedly observed in the vicinity of the farm. Additionally a number of holes had been found and repaired by divers in the months prior to the inquiry. Fish behavior and feeding patterns were slightly abnormal, common when predators (sharks/tuna) loiter in the vicinity of the cages, and it was determined that escapes were unlikely at that time as feeding patterns returned to normal when the predators left area. Further review of site records indicated that due to the presence of predators the salmon in the cages were spooked by their presence and crowed near the bottom of the cage. The company determined that the likely cause of escape was crowding of fish near the bottom of the net (when predator related holes are most likely to be found) prior to a sea lice treatment when the net is raised. To prevent any further escapes in the future company initiated the following actions: increasing the frequency of divers diving in the nets to twice a week on all sites, waiting until just prior to treatment to raise any nets (which would crowd fish into the direction of any holes that may be in the net), increasing the frequency of divers diving in the nets to twice a week on all sites and hole checking any net to be raised by divers to just prior to the raising The site in question has not been fully harvested (due for completion in spring 2016). Once complete, the escape numbers will be reported in the 2016 Inventory Reconciliation and the 2015 report will be updated to reflect such." (Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch 2016a, p. 23)

Box 4: Code evaluation 2
"Incident 2:
In the spring of 2015 during harvest at the wharf in St. Albans a 10 inch tear was discovered in a net, along one of the down lines. The cage in questions had been transferred to the wharf in the fall of 2014 in preparation for overwintering/spring harvest. The hole was found as the crews were pulling the net up to complete the harvest of that cage. At the time of discovery the hole was reported to DFO/DFA no fish were thought to have escaped. The Post Escape Report stated that no obvious cause could be identified. The location of the hole was near the surface of the water and it was speculated that ice could cause of the damage although the company had never experienced ice damaged holes in the past. At the time of the hole being discovered there were no observations in the bay of possible farm origin trout. Combined with the large winter morality it was reasonable to believe that the hold did not result in an escape when final harvest counts were completed. Once possible farm origin trout were observed the company was asked to provide an estimate of escape numbers. The grower has estimated the loss at 1000 fish. The grower has stated that, as preventative measures, they would continue to monitor moorings and equipment involved in containment, maintain bird netting and stands in place and ensure that the cage frames are not damaged which could lead to chaffing of the nets." (Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch 2016a, pp. 23-24)

The Code is enforced in a number of ways. DFLR performs so-called 'audits' at each aquaculture site at least twice a year, once in the spring after the fish have been put in their cages, and once in the fall or early winter. Inspectors use the form in Figure 6. The inspectors check if the weekly "site surface inspection reports" and the three-monthly "dive inspection reports" are present and complete (ibid., p. 13). They also check the condition of the above-surface parts of the cage system. In the government office, civil servants furthermore ensure that companies send in inventories of the fish in the cages, and information around the condition of nets, such as the inventory and testing records. According to The Code, DFO also "monitors, on a periodic basis" whether or not companies comply with the "practices and procedures of the Code", "which may take the form of independent audit, site inspection/visits, or other investigations" (ibid., p. 8). Adherence to The Code is a condition of licence, and the introduction, harvest and other movements of fish are only approved of if companies adhere to The Code. In the most extreme case, it is the Aquaculture Act that enables potential sanctions to companies that do not stick to The Code. Since 2002, DFLR and DFO publish annual reports that document compliance to The Code, escapes that have happened in the previous year, and potential reviews of and changes to The Code (e.g. Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch, 2016a).



A.5 Code of Containment Site Audit

Site Name: ______________________

Company: ______________________

Record Keeping
Completed
1. Site Surface Inspection Reports. Yes □ No □
2. Dive Inspection Reports. Yes □ No □

Comments: ______________________

Nets
1. Any visible holes? Yes □ No □
2. All net tags present? Yes □ No □
3. All nets properly attached with ½' rope? Yes □ No □

Comments: ______________________

FOR OFFICE USE ONLY
All nets on site in Compliance. Yes □ No □
All nets tested. Yes □ No □
All nets in inventory. Yes □ No □
Net Inventory submitted. Yes □ No □
Net Manufacture submitted. Yes □ No □
Net Testing Record submitted. Yes □ No □
Comments: ______________________

Cages
Cage Condition
1. Collar damage? Yes □ No □
2. Support post damage? Yes □ No□
3. Jump rail damage? Yes □ No □
4. Cage tied in to grid properly? Yes □ No □

Comments: ______________________

Surface Mooring
1. Compensator buoys cracked? Yes □ No □ N/A□
2. Compensator buoys sinking? Yes □ No □ N/A□
3. Thimbles exhibiting wear/rust? Yes □ No □ N/A□
4. Shackles secured tightly? Yes □ No □ N/A□
5. Grid ropes damaged? Yes □ No □ N/A□

Comments: ______________________

Follow up inspection required: Yes □ No □
Reason for follow up: ______________________

Inspector: ______________________
Site Representative: ______________________
Date: ______________________

Figure 6: DFLR audit inspection form (Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch, 2014b)

These annual compliance reports are reviewed in the yearly meeting of the *Code of Containment Aquaculture Liaison Committee* (CoCALC) that is connected to The Code. The mandate of this committee is as follows:

> The objective of the Code of Containment Aquaculture Liaison Committee (CoCALC) is to provide a forum for government, industry and identified stakeholders to monitor and communicate the effectiveness of the Code of Containment and identify options for improvement and amendments to the Code of Containment for the Culture of Salmonids in Newfoundland and Labrador. This shall be done in a positive, innovative and proactive manner that is consistent with the objectives of the code. (Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch, n.d., p. 1)[6]

The federal DFO and the provincial DFLR co-chair the committee. The members of the committee represent different so-called ‘stake-holders’. Besides the federal and provincial government representatives, these are: NAIA; the Miawpukek First Nation; SCNL; Fish, Food and Allied Workers Union; and a mayor that represents the different municipalities of the Coast of Bays region (Coast of Bays Corporation) (ibid., p. 2). The co-chairs “have final veto on establishing working groups and membership of the committee” (ibid.). The key roles of the committee (see Box 5) and the responsibilities of the members (see Box 6) focus primarily on solving problems around effective containment and improving The Code itself. According to the Terms of Reference, “[a]pproved meeting minutes and final reports generated by the committee or activities of the committee will be available to the public” (ibid., p. 3). Since 2011, DFLR does publish the reports on their website, although it is harder to come by the approved

[6] The provincial Department of Fisheries and Land Resources sent me the terms of reference of this committee, in which the mandate of this committee is listed.

meeting minutes. The Terms of Reference also set out what information is allowed to leave the meetings, in what ways and forms, and to which people (see for example the rules around confidentiality in Box 7).

Box 5: Key roles members Code of Containment Committee

According to the Terms of Reference, the key roles of the committee are:

- "To address farmed salmonid containment issues related to the objectives of the Code of Containment.
- To monitor the effectiveness of the Code of Containment and communicate this to stakeholders.
- To seek input/recommendations from stakeholders on improving and increasing the effectiveness of the Code of Containment.
- To identify and recommend solutions to technical/regulatory issues related to the effective containment of salmonids in cage culture.
- To develop, recommend and approve options for amending the Code of Containment.
- To annually review the Code and its elements to ensure effectiveness and relevance of items. To, where possible, achieve consensus on recommendations of the members of the CoCALC.
- Where issues may be outside the Terms of Reference of the CoCALC, discuss and agree by consensus whether to: (1) invite technical expert to the CoCALC; (2) form a CoCALC working group; or (3) refer issue to another forum."

(Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch n.d., pp. 1-2)

Box 6: Key responsibilities of members Code of Containment Committee

According to the Terms of References, the key responsibilities of members of the committee are:

- "Abide by the Terms of Reference.
- Work cooperatively towards improvement of the containment of farmed salmonids while respecting others' opinions.
- Attend annual meetings in person.
- Participate in conference calls as needed.
- Share information and propose agenda items/topics to the CoCALC chair for meetings.
- Take the lead or participate, as designated by the chair, in various projects, activities and working groups.
- Provide comments and input on proposed documents in a timely fashion."

(Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch n.d., pp. 2-3)

Box 7: Confidentiality rules Code of Containment Committee

The Terms of Reference set out three rules regarding confidentiality:

- "Members must honor agreements made about how the CoCALC maintains control over the release of information concerning their deliberations.
- Members' views should not be used against them or their organization.
- Deliberations on issues between CoCALC members via email, phone or meeting will remain confidential. Only approved meeting minutes and final reports will be released to the public."

(Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch n.d., p. 3)

In some of the meetings, the committee makes changes to The Code, often through reviewing escape events, recent scientific research, experiences in the industry practice, and contributions and concerns from the committee's members. Examples of recent changes are the changed definition of a 'significant escapement' from an expected 100 farmed fish to just 1 farmed fish, as suggested by the representative of SCNL (interview with SCNL representative), and the addition of a "Post Escape Reporting" section (Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch, 2014a, p. 19).

2.5 Modes of doing containment

Through analyzing The Code and the different practices in which The Code is enacted and evaluated, I identify three different modes of doing containment through The Code: framing, monitoring, and improving.

2.5.1 Framing containment

The first mode of doing containment through The Code is ‘framing’. The Code and its committee frame containment in a certain way. This point is related to what Kinsella (2001) refers to with the phrase “containment as rhetorical boundary work” (p. 171), which has consequences of what can and cannot be done in the world. I approach the “boundary work” of The Code not just as a ‘rhetorical’ process, but more like ‘discursive’ in the Foucauldian sense, or ‘material-semiotic’ as proposed by several thinkers in STS (e.g. Asdal, 2015). I focus on ways of enacting ‘containment’, with specific effects.

The practices of The Code and its committee “problematize” and “render technical” the problems (to be solved) and issues (to be improved) around containment in specific ways (Li, 2007). I take inspiration in this section from Li (2007) who uses Rose’s work to argue that:

> Two key practices are required to translate the will to improve into explicit programs. One is problematization, that is, identifying deficiencies that need to be rectified. The second is the practice I call ‘rendering technical’, a shorthand for what is actually a whole set of practices concerned with representing ‘‘the domain to be governed as an intelligible field with specifiable limits and particular characteristics . . . defining boundaries, rendering that within them visible, assembling information about that which is included and devising techniques to mobilize the forces and entities thus revealed.” (p. 7)

Li sees these two processes of problematization and rendering technical as intertwined. In the Terms of Reference of the committee they come together in two of the committee’s objectives, i.e. “[t]o seek input/recommendations from stakeholders on improving and increasing the effectiveness of the Code of Containment” and “[t]o identify and recommend solutions to technical/regulatory issues related to the effective containment of salmonids in cage culture" (see Box 5). The boundary work processes of problematization and rendering technical enfold in the committee in different ways.

Firstly, a former mayor who represented the Coast of Bays region on the committee in the past, tells me in an interview that on the committee:

> there was a lot of folks there with a background that were directly involved, whether that would, provincially or federally or industry or industries as well as government folks that were specialists with more of a science background, whereas I was more of a community liaison role, type of a, from that perspective. Less technical than everyone else.

This former mayor felt "less technical than everyone else", which shaped how he functioned on the committee. Even though DFLR told me in an email that "the committee is (…) the arena where local stakeholders have a voice", the role of this mayor representing the different communities on the south coast of Newfoundland, seems to consist mostly of listening, understanding, and communicating back to the communities. The former mayor tells me:

> My role, in the sense of a stakeholder was not involved in the science aspects, or the regulatory side of it, it was to ensure communities are aware of these issues and of course from the point of view of the information I would give, it would be more limited, more for me to understand what steps they are taking to ensure an industry is, uh, safeguards in place to make sure an industry operates in the most environmentally sound practices, and the Code of Containment Committee was a part of that, and reducing escapees and impacts to the environment and to other aspects of the region.

The way The Code and the committee performs its boundary work through problematization and rendering technical, shapes how 'stakeholders' can perform their role on the committee.

Secondly, The Code and the committee's way of functioning seems to make that only certain issues can be talked about. I asked a representative of the fishing industry whether he has felt any underlying tensions during the committee meetings. And he answered that there might be disagreements and underlying tensions between different participants on the committee, but that the committee is not the place to deal with those.

The Code and its committee frame containment as a particular problem with a particular potential solution in such ways that enable certain roles to be played by members of the committee and certain issues to be put on the table, while other roles cannot be played and other issues not raised. Even though the provincial government and the aquaculture industry present the committee as *the* place for stakeholders to be involved with and contribute to solving the problem of containment, these examples and the figures of improvement, show that this participation is fundamentally shaped by: (1) the problematization of containment as a certain kind of problem and (2) the rendering technical (and regulatory) of potential solutions.

The chair of SCNL seems to support this argument when he tells me that:

> Even though the Salmonid Council has a seat at the table, I would say that the amount of control that the Salmonid Council has in what the Code of Containment Committee does it, is virtually zero. We are there, but we are there probably more as an observer than anything else.

Even though the committee accepted his proposal to lower the threshold of what comprises a 'significant escapement' from 100 fish to 1 fish, other ideas and proposals would often not be accepted as they are not attractive to the industry. The Council's chair furthermore tells me:

> The sense that I have of the Code of Containment and the Code of Containment Committee is that it provides a forum, largely for the industry and the government to talk to each other and to put their best face, or whatever face they want on what's happening in the industry. But as a means to prevent loss of containment, it is not effective. It hasn't

> been effective. And it hasn't been effective in other jurisdictions either. If you talk to people in New Brunswick and other parts of the world, you know, these codes, … It's like the code of honor amongst thieves. That's the way I view it.

The phrase "code of honor amongst thieves" points at how important it is to take seriously the situatedness of The Code in analyzing its practices and effects. *This* is the problem of containment and *that* is not; *these* are acceptable solutions, and *those* are not. Moreover, these problems and solutions have transformative effects that seem to go beyond the isolated problems and solutions of containment.

As an unintended (or for some perhaps intended) consequence, The Code practices – together with more demanding requirements set by insurers and certification agencies – seem to privilege bigger companies over smaller companies. A DFO-official tells me about one of these consequences, without necessarily criticizing it:

> A lot of companies now, many companies are trying to pursue one of several eco-certification standards. All of those require documentation, upgrading the technology, to a far greater extent than government regulations and government policy. Government regulations set the minimal performance. The insurance industry sets another level of performance. And the eco-certification bodies, and the auditor set another level of performance. Amount of rigor required… You could criticize the rigor of some of the certification schemes, or the standards in some of the certification schemes. But not the documentation. The documentation required to achieve certification is much higher than what is required by government right now. So, all of those factors, and market pressures, are compelling industry to improve performance. and the mom and pops can't respond. The small-scale farms simply can't respond to that. They simply have no capacity to do that. So, it takes bigger industry…
> I would say Marine Harvest [now MOWI] probably controls close to… I would say at least a third of all the farmed fish swimming around on farms today.

Even though he talks here about other certification schemes as well, it does show that a certain way of problematizing and solving the issue of containment privileges a certain kind of doing aquaculture. The comment reminds me that ways of problematizing, improving, and otherwise managing an issue like containment, also has effects that go beyond just containment. These ways also enable certain scales of doing salmonid aquaculture, while making others less likely and possible.

Moreover, The Code also seems to contain practices of containment in an even more fundamental way, which makes certain trajectories possible and others impossible. The Code and its committee focus on technical and regulatory ways of ‘solving’ problems and ‘improving’ the issues presented by containment. However, for some opponents of aquaculture, the logic of containment itself forms part of what is problematic about aquaculture in general. Bavington (2010), for example, argues that “cod farming” - but this could as well be applied to the farming of salmonids - “exemplifies an expanded level of human arrogance by seeking to engineer natural and cultural systems to fit them into the logic of global markets through unending economic growth and managerial control” (p. 105). This perspective enables us to see how the practices of The Code, and of containment in general can be seen as playing a role in this process of enrolling “natural and cultural systems” into the “logic of global markets”. The Code of Containment was drafted in order to fulfil a requirement to ‘control’ newly introduced fish strains, and ultimately to make possible the rapid development of a profitable and viable salmonid aquaculture industry on the South Coast of the island of Newfoundland. Even in an imagined world without containment ‘problems’, the containing practices of aquaculture would have far-reaching effects, which Bavington points at when he claims that “[o]utside the futuristic, self-contained farms, fish and fishermen are living in a world increasingly unfit for their existence” (p. 105).

Through the mode of framing, containment is held together as a specific problem, with specific solutions, which shapes the way ‘the problem’ can be engaged with. Furthermore, the way containment is done has other consequences, such as the exclusion of smaller salmon farms and alternatives to aquaculture, and it keeps together and even strengthens aquaculture as a multinational industrial activity.

2.5.2 Monitoring containment

The second mode of doing containment is ‘monitoring’. The question of how to monitor containment is a complex one. It resonates with problems around knowing, such as knowing the movements and behaviour of fish, studying marine environments, but also issues around surveillance, control, sensing, and other epistemological matters of concern. Containment does not just exist out-there in the world, but has to be brought into existence, as the many steps that go into making a picture appear on a computer monitor. Ways of monitoring containment hold together containment as something that can be known and governed in certain ways. Containment is monitored through inspecting, calculating, noticing its failure (e.g. holes in a net), observing farmed salmon outside of their net-pens, and determining what ‘good enough’ containment is.

First, containment is monitored through inspections: inspections by aquaculture workers and divers on the farm, “net testing agents” testing the net strengths, government officials inspecting the above-surface part of the farm and the forms and reports that the companies filled out. The Code prescribes companies to make sure that their site-workers “formally monitor and inspect surface components of mooring systems, cages, nets and ropes on each site once per week and record the inspection on Form A.4” (ibid., p. 25) (See figure 7). Companies also have to “inspect nets via diver inspection every 90 days, document the dive and status of the nets, including any holes or repairs” (ibid., p. 12). In case a company is not able to do this dive every 90 days, “growers will fill out the dive report explaining why the dive inspection was not conducted and when the inspection will be completed” (ibid., p. 12-13). Companies have to keep the A.4 forms and other means of documentations “for audit and inspection … by DFA staff” (ibid., p. 25). If any damage is identified, “[t]he owner shall repair any identified damage to site equipment immediately” (ibid.).

Form A.4

NL Code of Containment Site Surface Inspection Checklist

Moorings

1. **Are all compensator buoys in good condition (no cracks/not sinking)?**
   a. **Yes ___.**
   b. **No ___.**

Comments:

2. **Are there noticeable signs of wear on the portions of the grid that is visible?**
   a. **Yes ___.**
   b. **No ___.**

Comments:

3. **Are all shackles screwed tight?**
   a. **Yes ___.**
   b. **No ___.**

Comments:

4. **Are all thimbles in good condition (no signs or rust/wear)?**
   a. **Yes ___.**
   b. **No ___.**

Comments:

Cages:

1. **Are there any visible kinks/cracks/wear in the:**
   a. **Cage Collar**
      i. **Yes ___. No ___.**
      Comments:

Figure 7: NL Code of Containment Site Surface Inspection Checklist (Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch, 2014b)

There are difficulties regarding this way of inspecting: it is hard to look underwater. The government inspectors and aquaculture site workers therefore stick with above-surface inspections. To go subsurface, you need a diver with enough breathing gas, the right equipment, enough hours that he or she is allowed to dive per day, and enough visibility underwater, to name a few things. Instead of a diver, sometimes a robot can do the job, especially since some of the net-pens are too deep to be reached with standard diving equipment and diving gas. Furthermore, not every part of the net can be looked at, at the same time, all the time. There are not enough eyes available. And, what about trust? The government has to believe the reports filled out by the companies, the regular site workers have to believe the situation that the divers describe to them, and 'the public' has to trust the industrial-government complex.

Secondly, containment is monitored through calculation. Nets cannot be looked at all the time, but what can be done is comparing the amount of fish that are put into and are taken out of the net, an alternative way of knowing containment. Every year, each company has to report the number of fish that went into and out of each of its net-pens, and send in an "inventory reconciliation including number of fish stocked, mortalities, removals and explanation of discrepancies" (ibid., p. 6). This results in companies submitting Excel-spreadsheets (see Figure 8), listing the number of fish present at the begin of the year, the number of fish put into the net-pen in that year, and the numbers that were removed, either as mortalities, commodities-to-be, as escapes, or for other reasons. In the compliance reports this results in sentences like: "Industry wide, the inventory reconciliation covered approximately 10,052,899 million fish at the beginning of the year and ended with 14,311,727 million fish at year end" (Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch, 2012, p. 3).[7] In this way, containment would be known through the difference in the number of fish that are put into the net-pen and that are taken out of the net-pen.

Table 2

Cage Number	Starting Number of fish	Year Class	Number of Fish Introduced	Number of Fish Mortalities	Number of Fish Removed/Harvest	Number of Fish Removed/Transferred	Counting Deviation	Number of Fish Escaped	Fish Remaining
1	31593	2009	0	76	29934	0	-1583	0	0
2	29138	2009	0	243	27181	0	-1714	0	0
3	30463	2009	0	163	29554	0	-746	0	0
4	30474	2009	0	167	29535	0	-772	0	0
5	30832	2009	0	113	29871	0	-848	0	0
6	32254	2009	0	221	32582	0	549	0	0
7	31686	2009	0	124	29434	0	-2128	0	0
8	17529	2009	0	155	16636	2750	2012	0	0
9	25966	2009	0	89	25876	0	-1	0	0
10	26865	2009	0	48	30143	0	3326	0	0
11	25551	2009	0	150	24340	0	-1061	0	0
12	24674	2009	0	111	25172	0	609	0	0
13	26194	2009	0	130	27751	0	1687	0	0
14	26777	2009	0	129	28083	0	1435	0	0
15	28026	2009	0	110	29735	0	1819	0	0
TOTAL	**418022**	**2009**	**0**	**2029**	**415827**	**2750**	**2584**	**0**	**0**

Figure 8: Inventory reconciliation spreadsheet (Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch, 2012)

[7] These numbers concern the amount of fish swimming around in the net-pen. The increase in the amount of fish is mostly caused by a number of fish that is newly put into net-pens that is larger than the amount of fattened fish that had been taken out to be killed and sold in that year.

However, even though the numbers presented in the compliance reports seem to be very precise, informants doubt whether these numbers are a reliable way to know containment. For example, DFLR states the following, when reporting on the annual inventory reviews that growers have to send in annually:

> [d]ata from growers indicated that there were both inventory shrinkages and inventory surpluses. Evidence of shrinkage or surplus is only experienced after a cage has been completely emptied by either harvesting or grading out (transfers). A DFA review of shrinkage and surpluses has shown that shrinkage and surpluses vary by species and year class of fish. (…) Errors are a result of *counting errors* when stocking, grading or during mort removal." (ibid., p. 11, emphasis added)

One problem is that containment could only be known after the whole cage has been emptied, as that is when the fish in the cage can be counted. Moreover, counting fish that are put into and are taken out of the cage is fraught with other difficulties as well: sometimes devices miscount the fish, i.e. sometimes one fish is counted as two or more fish or multiple fish are counted as only one; if mortalities are left in the cage too long, they can start decomposing and losing their countable individuality and eventually even falling through the meshes in the bottom of the net. The differences between what is put into the net-pen and taken out of the net-pen – also known as 'counting deviation' – are referred to as 'shrinkages' and 'surpluses'. This 'counting deviation' (see Figure 8) that – if negative and not accountable for through other means – would indicate a loss of containment and the number of fish escaped, is instead explained away as "a result of *counting errors* when stocking, grading or during mort removal" (ibid.). Figure 8 shows that this counting deviation can be as high as 12 percent. How, then, is it ever possible to know with such an exactness as in the introduction of the Compliance Report how many salmon are present in the Newfoundland net-pens? And, how can containment, escapes, and the potential number of escaped fishes be known? This question also preoccupies the Code of Containment Committee, as the minutes of the 2016 Meeting note that

> [t]here was a discussion on how to quantify and define 'Trickle losses' or 'unreported episodic escapes'. DFA [DFLR] and DFO will continue to engage with industry on quantifying these potential losses. Counting deviations and how 'in cage' counting devices could create some certainty about the counting deviations through the use of Vaki or Aqua Drum technology for in cage counting. (Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch, 2016b)

Even though these 'in cage' counting devices are currently not widely used in Newfoundland salmonid aquaculture, it could be doubted if they would lead to certain numbers and the elimination of 'shrinkages' and 'surpluses'. One informant working for DFO even told me that we have been too preoccupied by exact numbers and should think about escapes in terms of their potential environmental impact and ability to be recaptured.

Thirdly, while it might not be possible to know with certainty if containment is successful, it is possible to monitor containment through observing its failures: noticing holes, changes in appetite, and 'farmed' salmon in 'the wild'. First, sometimes aquaculture site workers or divers suspect salmon have left the net-pen. In some instances, the signs are clear, as when a big storm has damaged a cage structure. At other times, suspicions are raised through noticing a hole in the net, and a diver believing that some fish might have escaped. Suspicions of an escape event are often combined with looking at the potential changes in the amount of food that the totality of fish has been eating. If the fish suddenly seem to eat less than expected, this can signify a loss of fish.

A loss of appetite of the population can point to a loss or escape of a part of that population, but it can also be caused by a loss of appetite of individual fish, for example when there is a predator in the vicinity of the net-pens.

This 'appetite method' can also be used in combination with the second way 'failed' containment is known, through observation of 'farmed' fish in the wild. Sometimes DFO-officers or other people living and working in the vicinity of aquaculture sites notice farmed salmon swimming in the waters. One informant told me that it is easy to identify a 'farmed' salmon and discern it from a 'wild' salmon:

> The body morphology is different. Farmed salmon are gonna be much deeper, much thicker, relative to length. So, body condition factors are going to be very different. With most farmed salmon, you're going to see evidence of fin wear. Both the dorsal fins, the pectoral fins, and the pelvic fins, will all show evidence of fin wear. (…) The fins will be ragged as opposed to pointy, like Atlantic salmon fins are supposed to be. The tail fins will often have thickening on the ventral side of the fins. And that reflects cage rearing. Cage rearing and hatchery rearing. And so there is, I call it scar tissue… I don't know if it is scar tissue or not. But it tends to be thicker on the bottom. So ragged fins, different body morphology… The other way you can tell them apart is that the gill covers, the operculum, as a result of hatchery rearing practices and egg incubation temperatures, the gill covers on farmed Atlantic salmon tend to be a little shorter. So, they don't fully cover the gills themselves. So, when you see a farmed origin or if you capture a farmed origin fish, the gill covers are short. So, combined, those three factors, will help you visually distinguish between the two groups of fish.

However, in order to be sure, scale samples are often taken for further scientific identification. Yet it is still hard to determine from what net-pen the 'farmed' salmon originate from. Introducing some kind of chemical tagging of 'farmed' fish or clipping their fins, could make this process easier, as suggested by the chair of the Salmonid Council of Newfoundland and Labrador and as mentioned by a DFO-official. Knowing containment or escapes in this way depends on the differences between 'farmed' and ‘wild’ fish; these differences are not just discursive, but also material, the open net-pen aquaculture inscribes itself in the flesh of the fish. Sometimes these farmed fish show up in the counting fences that are installed in a number of the rivers in Newfoundland. Another way of observing escapees is through sampling the fish that are swimming in the ‘wild’ waters of Newfoundland, and determining genetically if they are ‘wild’, ‘farmed’/’feral’ or even ‘hybrid’. Following the big escape of more than 20,000 salmon in 2013, DFO-scientist Dr. Ian Bradbury and his lab sampled salmon out of 18 rivers on the south coast of Newfoundland, and looked at their genetic composition. They found that 17 of the sampled rivers contained “hybrid and feral” salmon, and that they formed over a quarter of all the sampled fish (Wringe et al., 2018).

Even though it might be possible to know when fish have ‘escaped’ a net-pen, these ways of knowing do not allow us to know the ‘failure’ in a complete, exact, and certain way. These knowledges are dependent on observations, sampling, visible (or otherwise observable) differences. On the other hand, even when there is no known escaped salmon, i.e. no ‘farmed’ salmon is seen, sampled, or observed in the waters of Newfoundland, the status of containment as successful would still be ambiguous and not fully known.

Another dimension of monitoring containment is through defining ‘good enough’ containment. Scientists, industrialists, government officials, environmentalists, and other involved people, disagree over how escapes matter. For example, in the documentary *Salmon Wars* about opposition against salmonid aquaculture in Nova Scotia/New Brunswick, an industry representative and a scientist working for the ASF evaluate escapes differently. The industry representative argues that, “the idea that we have pure stocks running in (…) rivers is simply not true. We have been stocking these rivers for over hundred years” (Cameron & Beckett, 2012). He mobilizes this point to mitigate the escapes of farmed salmon. According to the representative, wild salmon are not ‘pure’ or ‘wild’ anyway, so arguments about protecting ‘wild salmon’ would be exaggerated. On the other hand, a scientist working for ASF explains that, “the population that we have been trying to recover – we’ve just found out – truly is not a wild population anymore, because of genetic contamination in the past” (ibid.). He explains that through crossbreeding with escaped farmed salmon, the wild salmon population has already lost some unique alleles that are critical for survival in the wild. This scientist uses it as an argument against open net-pen salmon aquaculture: it is detrimental to the fitness of wild salmon populations.

People also discuss what makes up a ‘significant escapement’, and how we should understand, know and enact the consequences in other ways. Recently, what makes an escape ‘significant’ and required to be reported has been changed from 100 fish to 1 fish, as proposed in the committee by Leo White of the Salmonid Council of Newfoundland and Labrador. Moreover, the different words that are used in different situations in the wake of a containment failure (“trickle”, “leakage”, “pollution”, “escape incident”) and different understandings of the world-changing consequences of aquaculture more broadly, show that knowing containment is not straightforward, but always partial, uncertain, and situated (see for example Lien, 2015, pp. 148-163).

Containment is held together by different ways of monitoring it, that have different ways of bringing containment into existence in particular ways. Without these ways, it would not be possible at all to talk about and govern containment. Importantly, monitoring containment is not a straightforward documentation of a situation 'out there', but is a specific, partial, uncertain and situated affair. Ways of monitoring containment are not neutral and do not all matter in the same way. In the instance of inspections, a failure of sending in forms or not having the nets up to par can be seen as a violation of The Code, and in that sense as bad containment by a specific company, whereas the other ways of monitoring containment cannot as easily be connected to an individual company doing containment well or badly. Observing a farmed salmon in the wild does indicate a fish that left its cage, but (paradoxically) this is not necessarily a breach of The Code, or a case of bad containment.

2.5.3 Improving containment

Escapes happen in Newfoundland salmonid aquaculture. None of the people that I talked and listened to, thinks that The Code eliminates all escapes from happening. All committee members that I interviewed seem to agree that escapes will not be completely eliminated. For example, a DFO-official told me that the international goal is to bring down the amount of 'escapes' to zero. However, he adds that "the goal of zero escapes, though laudable, is unachievable, because, right now, it is technologically impossible to eliminate all breaches of containment systems. And it is impossible to accurately count inventory." It is not only impossible to monitor containment, but the DFO-official also states that it is technologically impossible to eliminate all breaches of containment. Even one of the engineers behind the new 'escape free' net-pens noted in a radio interview that the success of the cage system in preventing escapes is dependent on how the cage system is used (Quinn, 2018).

The inevitability of escapes does not make The Code irrelevant. On the contrary, it only strengthens its role in sustaining industrial aquaculture, as The Code functions through a certain logic of improvement. This is the third mode of doing containment: 'improving'. On one level, the different ways of framing and monitoring containment are at the same time also enacting certain solutions: after discovering a hole in the net, one sews it; after stumbling upon a counting deviation, one explains it through counting errors; when encountering a farmed salmon, you report it to DFO or if licensed, you try to (re)capture it, after which the fish often has to be disposed of; after proving that hybrid salmon populate the Newfoundland rivers, some parties argue for stricter containment measures; after framing the 'problem' of containment as such and in a specific way, certain 'solutions' become possible. Instead of eliminating escapes, The Code is evaluated by industry and government in terms of 'improvement'. Improving containment is what The Code is set out to do (or to not do, according to some) in the absence of the possibility of eliminating escapes. In its objectives, The Code is said "to be forward-looking and seek continual improvement" (p. 5). I see four different ways which improvement relates to containment, which could be added to the range of 'mundane' ways of doing the "will to improve", as described by Li (2007, p.25).

First, 'improvement' is performed to prove the effectiveness of The Code. The province and industry repeatedly show and claim that escapes have decreased in frequency since The Code was implemented in 1999, even if this is not fully supported by the data on escapes (see Figure 9). A certain performance of 'improvement' is used to validate that The Code is effective.

Since the Code of Containment has been in effect, escapes have decreased overall (see Table 3).

Table 3
REPORTED ESCAPES SINCE 1995

Year	Salmon	Steelhead	Charr
1990		6600	
1991		1700	
1992			
1993			
1994			
1995		31000	
1996	140000	4000	
1997			
1998	69500	93000	
1999	6300	8000	
2000	0	45000	
2001	0	0	
2002	0	0	
2003	6500	0	
2004	0	0	
2005	0	0	
2006	0	0	
2007	500	4400	
2008		39653	
2009	300		
2010		32,443	69,827
2011		12,382	
2012	0	0	0
2013	20,800	0	7513
2014	0	0	0
2015	*	1000	0

Figure 9: Table from compliance report showing the amount of reported farmed fish (Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Division, 2016a)

Secondly, improvement is how The Code operates. The breaches of containment are transformed into opportunities for improvement. There is a machinery that consists of a code and a committee, of reports, inspections and inventories, of meetings, reviews and amendments. In 2013, the committee – primarily driven by DFO and DFLR – added a "process for reporting and assessing causes of escapes" to The Code (Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch, 2016a, p. 4). The two escape incidents described earlier in this chapter form part of this new process and were published in the 2015 Compliance report. The company responsible for a (possible) escape, has to write a report. DFO and DFLR review this report and combine it with earlier reports and inspection about the particular site and company, to "determine if the incident(s) require new amendments to The Code or the adoption of other management strategies to prevent such incidents from happening again" (ibid., p. 43). A DFO-official who may have been responsible for adding this process to The Code told me in an interview that:

> the challenge with net pen aquaculture is: you got a commitment from the industry to make continuous improvements, because the market demands it. So, the idea is, to come up with a framework, a way in which you can get the industry to learn faster. So, to develop technology, or if it is operating procedures, whatever it is… where are the weak links, adjust the weak links, continually improve performance. And that is, to me, what is missing, with net-pen systems. Not that there is not a lot of effort.

Four possible consequences are described in The Code after such a process: nothing happens; the company has to submit new "prevention measures for evaluation"; The Code needs to be adapted; or the company might lose its licence in the most extreme situation, even though this has not yet happened in Newfoundland.

Even though The Code aims to be "forward looking", its logic could be described as reactive. The Code is activated when something goes wrong, and subsequently uses an escape incident to improve itself. This movement is also visible in the word "tinkering" that the DFO-official uses to describe his work with The Code over the past years.[8] This work of tinkering – adapting, evaluating, fine tuning – The Code performs a certain idea of having to continue with the aquaculture of salmonids, arguably resulting in a firmer and more normalized presence of the aquaculture on the south coast of the island. The Code is presented as the best – and only – way to govern containment, minimize escapes, and do aquaculture in a safe and sustainable way.

The committee meetings also follow this movement, as members gather annually to review the compliance report of the past year, and propose ways of doing better. Also, the Terms of References format the meetings as being about "improving and increasing the effectiveness of the Code of Containment", and "work[ing] cooperatively towards improvement of the containment of farmed salmonids while respecting others' opinions" (ibid., p. 2). The Code and its committee could be seen as a machine: whatever you put into it, there is a promise of something better coming out. Improvement is always possible within the parameters of The Code, and thus desirable to be done within the parameters of The Code.

Thirdly, The Code's character as instrument for improvement could be seen as making The Code immune to actually occurring escapes. On the one hand there is a potential for escape incidents; on the other hand, there are the means to respond to those. The

[8] He described his experience with The Code as follows: "So, from 1999 to 2015, that would have been… with the exception of a couple of gaps, but generally within that period, I would have been responsible for tinkering with The Code."

effectiveness of The Code does not seem to be affected by escapes happening or whether or not the absolute number or the percentage of escaping salmon have decreased. Rather than a moment of critique, an escape is a moment that activates The Code.

When 20,000 salmon escaped their net-pen in 2013, it was simply mentioned in the annual compliance report in a list with the two other reported escape incidents of the year:

> There were three instances of escapes in 2013:
> 1) 20,500 – An uncommonly high tide combined with a storm even caused a cage to submerge allowing for the escape of fish through the bird net.
> 2) 300 – A harvesting misstep where a brail net let go causing a spill.
> 3) 5693 – A hole was tore in a net while moving it to a wharf for harvest. (Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch, 2014a, p. 19)

In the same report it is announced that a new "Post Escape Reporting" section is added to The Code, "which includes provisions for reviewing the incident and its cause, whether the recapture efforts were successful and how/if the incident could have been prevented" (ibid.).

Even though the escape of more than 20,000 fish represented the biggest reported escape incident of Atlantic salmon since the beginning of The Code in 1999, The Code was and still is the (only) governmental means to respond to this extraordinary event. Even though in other jurisdictions – e.g. Chile and Washington State – escape incidents have triggered out-of-the-ordinary responses, no threshold of minimum size of escapes seems to (yet) exist in Newfoundland and Labrador, beyond which The Code itself would be critiqued or surpassed. The effectiveness or sufficiency of The Code lays in responding and reacting to the possibility of escapes, which means it is immune to escape incidents.

This rendering indifferent to escapes connects to a fourth way in which ‘improvement’ figures, i.e. as a way of containing and (re)directing dissent (see also Kinsella, 2001). When the director of the Newfoundland Aquaculture Industry Association (NAIA) is asked in a radio interview in 2017 to answer a question about the provincial situation around escapes in salmonid aquaculture in the current year, he immediately takes recourse to The Code and says:

> So, we have a Code of Containment Committee. Which is composed of ourselves – NAIA – the FFAW, DFO, DFLR, which is the department of Fisheries and Land Resources here in the province, as well as First Nations. And to this year to date we have no reported escapes at all. And over the last number of years, we have had very, very few. I think it was probably less than 10 salmon maybe, two years ago. So we are doing very, very well. We have invested tens and tens, if not hundreds of millions of dollars in refining the equipment that we use, and we are always looking for ways to improving innovation and technology that we employ. And we are very proud to say that we have had very few escapes in the last number of years, and we have had none reported to date this year. (Simms, 2017)

The executive director gives an answer that primarily consists of referring to The Code and continual processes of ‘improvement’. The Code works and the industry works hard to improve salmonid aquaculture with regards to containment. The Code, and The Code *only*, is the place where escapes should be problematized and solved.

In this third mode containment is held together through making it an object of improvement that can never be complete. I argue that through this mode, The Code even allows escapes to happen. This is because doing containment well is made to equal continuously improving containment. The logic of improvement presents containment and failures of containment as opportunities to do better, and as objects of improvement within a very specific frame of possibilities, while the logic at the same time renders the effectiveness of The Code indifferent to the occurrence of escapes and critique based on these escapes. This means that the loss of fish from a sea cage does not have an immediate effect on whether containment is done well or not through The Code, and enables aquaculture to go on as usual.

2.6 Conclusion

In this chapter I articulated and described three modes of doing containment in the Code of Containment that is used in Newfoundland and Labrador to solve the problems concerning the containment of farmed salmonids in their net-pens. Firstly, The Code and its practices *frame* containment as being about certain problems, certain solutions, and certain issues, while making impossible other problematizations and ways of making containment matter. Members of the committee can only engage with The Code in certain ways and raise certain issues, while other ways of problematizing containment are foreclosed, such as the fact that (big) industry is sustained and favored through The Code and comparable practices, and the different other critiques of aquaculture (and containment), such as formulated by the Salmonid Council, or even more fundamentally by Bavington (2010, p. 105). Secondly, *monitoring* containment turned out to consist of different practices, such as inspecting, counting, and observing salmon that are fraught with practicalities, uncertainties, and other complexities. Monitoring containment is always an uncertain achievement that enacts containment in particular ways. Thirdly, *improving* containment is the central goal of The Code and its practices. It turned out that it is not only fictional to monitor containment ‘completely’, but also impossible to achieve full containment. In the wake of this impossibility of eliminating escapes completely, improvement figured as a placeholding goal for The Code’s practices, in four different ways: as a proof for The Code’s effectiveness, as a mode of engaging escapes, as rendering itself indifferent to actual occurring escapes, and as a way of containing dissent. In the absence of knowing and doing full containment, ‘improvement’ becomes a ruling logic of containment in various ways.

The three modes could be seen as a story: first containment is framed, then monitored, and then improved. However, these modes happen at the same time and all work to hold containment together as a phenomenon that can be thought, and talked about, and can be governed. In turn, containment as done through these specific modes holds together certain possibilities in the world, while it excludes others. In particular, it helps to sustain aquaculture as a multinational, industrial practice in Newfoundland. Looking at containment in the way I have suggested helps to make the current practice of aquaculture less self-evident and enables different discussions about this practice, its desirability, the way it is done, and who and what profits from it to whose expense. And maybe even opens up thinking about and imagining alternatives.

In this chapter, I have proposed thinking about containment not only as ‘having in it’, but also as ‘holding together’. In this sense, The Code is an instrument that connects flows and trajectories in a certain way. It gives form to those, at the same time discursively and materially. Containment involves enacting and trying to keep hanging together a certain constellation of relationships, trajectories and possibilities in the world (cf. Massey, 2005), while at the same time also changing those and other relationships, trajectories and possibilities. This includes the introduction of a certain strain of salmonids, the possible distribution of salmon in Newfoundland waters, the making of industrial aquaculture and the prevention of criticism. Adding containment as holding together to our analytical toolkit helps to shift the focus from only looking at what is or is not held inside the net-pens or other containers, to what kinds of worlds containment practices hold together. Even though containment practices do not act alone, they contain more than a cursory look might capture.

Chapter Three

Making the Net Work: Spatial Biopolitics in and Around the Salmon Cage

3.1 Introduction

In the previous chapter, I argued for an understanding of containment as holding together and not only as holding inside. I articulated containment through the Code of Containment and its practices. This led me to understanding containment and the practices of The Code as a political device that helps to hold together the salmonid aquaculture industry in Newfoundland. In this chapter, I articulate containment through a different set of practices, namely the biopolitical ways in which space, life, and death are enacted and valued through the creation and maintenance of the 'rearing environment' of the salmon.

3.1.1 Shifting 'rearing environment': from the hatchery to the open net-pen

The so-called 'production' cycle of conventional open net-pen salmon farming can be divided into two parts on the basis of the character of the respective rearing environments. The first year of the production happens in the relatively closed and highly controlled space of the hatchery, while the last two years take place in the more open net-pens in a much less controllable marine environment. It takes approximately three years for salmon farmers to turn fertilized salmon eggs into 4-5 kg salmon that can be killed, processed, and sold on the salmon market. In short, the process of farming salmon comes down to the following (Purser & Forteath, 2012). First, male and female broodstock fish are 'stripped' of milt (the seminal fluid of fish) and eggs. The eggs are mixed with the milt to produce fertilized eggs which are placed in trays. After the fertilized eggs hatch, the small fish (alevins) are attached to a yolk sac that provides the small fish with feed. The alevins are kept in trays to which a certain substrate layer is added to make the trays resemble the gravel nests in rivers where wild salmon would normally lay their eggs in order to be fertilized. As soon as the alevins no longer have a yolk sac, they must be fed externally. The fish – now called fry – are transferred to land-based tanks, where they eventually turn into smolts, a process in which the fish undergo a complex physiological transformation and turn from a freshwater fish into a saltwater fish. When the fish are big enough, they are transferred to the so-called 'grow-out sites' that consist of net-pens hanging in the bays of places like the south coast of the island of Newfoundland. The fish remain in these marine net-pens for up to two years, until they weigh 4-5 kg and are killed, processed, and sold.

Physically separated from the environment outside, the hatchery comprises a world of its own that is relatively controlled and closed, making it harder for pathogens and other things from the outside world to make their way into the 'rearing environment' of the fish. The water that is used to grow the fish is brought to the right temperature, the right salinity, and the right oxygen levels. These and other parameters that influence the growth and development of the fish, are monitored and – if necessary – adapted per tank through computerized systems: decreasing the water temperature, increasing the salinity, adding more oxygen. The water used in most of the hatcheries is almost fully recirculated and is treated before it is reused, filtering out undesired solids and gasses.

In contrast, the net-pens in which the salmon are fattened during the last one or two years are more openly connected to the less controllable marine environment. In *Aquaculture operations in floating HDPE cages: A field handbook,* Cardia and Lovatelli (2015) describe this openness and lack of control: "[C]age culture refers to an open aquaculture system where the rearing environment is the environment itself. As such, there are interactions between cages and the environment in both directions – cages affect the environment, and vice versa" (p. 3) (also, see Figure 10). The fact that the net-pens use the environment itself as the production site, means that the way in which the space of the 'rearing environment' is created and maintained is significantly different than in the hatchery-part of the production cycle, not only in terms environmental impact and control, but also in terms of how spaces are made, and how life and death are valued and otherwise done in relation to those spaces. In this chapter, I focus on the net-pens as spaces for life and death making.

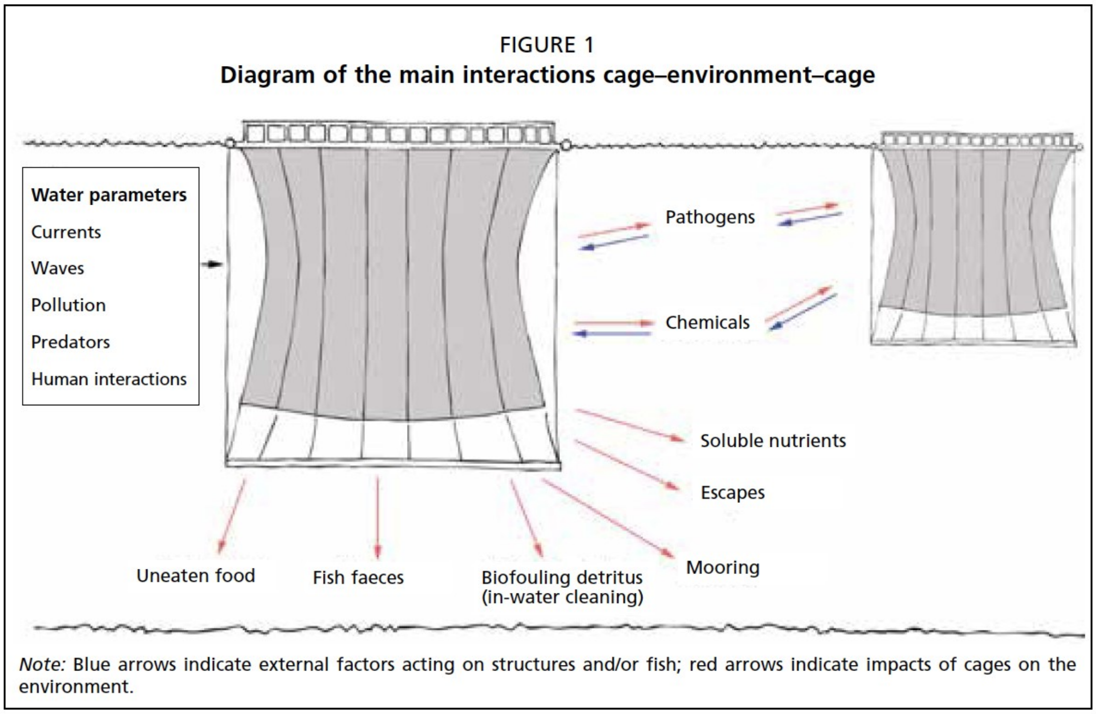


Figure 10: "the rearing environment is the environment itself" (Cardia & Lovatelli, 2015, p. 3)

3.2 Towards a spatial biopolitics of animal life and death

3.2.1 Space-, life-, and death-making in the salmon cage

In order to explore the relation between space-making and life-and-death-making in the context of the net-pens, I will describe the making of the 'rearing environment' as consisting of three parts. Firstly, making the space of the net-pen depends on not only the net, but a network of humans, nonhumans, and things that both create and transgress boundaries between the 'rearing environment' and the 'environment itself'. Secondly, some of the actors in the network want to solidify or keep together a certain version of the 'rearing environment'. These actors do net-work to monitor, and otherwise try and ensure that the 'rearing environment' keeps hanging together and separate enough from the ‘environment itself’. Thirdly, the ‘environment itself’ keeps challenging and surprising the network of the ‘rearing environment’, which means that this network has to keep adding new technologies and practices to the net to keep the ‘rearing environment’ hanging together and maintain it as a distinct space.[9]

The making of the cage space in salmon aquaculture has implications on how the lives and deaths of animals are done, both inside and outside the cage. I use the three-part description of network and net-work to explore these implications. As the rearing environment shifts and changes, what animals are allowed to live and what animals are made killable and allowed to die? And, how are animals and their lives and deaths governed and valued within these shifts and changes? In this article, I argue that the biopolitics at production sites like the net-pens are intertwined with the making of space. Animal lives and deaths are part of the creation and maintenance of the ‘rearing environment’. Therefore, the practices of ordering, governing, and valuing animal lives and deaths largely focus on those lives and deaths in relation to the cage space and eventually the profitable production of salmon bodies. Describing the process of creating and maintaining the ‘rearing environment’ helps to articulate the biopolitical differentiation and valuation of animal lives and deaths at production and other sites as a multispecies and spatial affair.

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[9] I thank Mariya Shcheglovitova for suggesting the articulation of these three parts.

3.2.2 Literature review

Practices of ordering, governing, and valuing animal life and death are at the center of scholarship within animal geography. In this chapter I am in conversation with scholarship within animal geography that uses the Foucauldian idea of biopolitics to describe and analyze the governing of non-human life and death, and multispecies relations.

Scholars have used the concept of biopolitics to think through the ways in which forms of animal life and death are made and governed. The concept is derived from Foucault, who described these processes as 'biopower', a form of power that "brought life and its mechanisms into the realm of explicit calculations and made knowledge-power an agent of the transformation of human life" (Foucault in Biermann & Anderson, 2017, p. 2). Foucault-scholar Gordon described biopolitics succinctly as "the conduct of living and the living" (Gordon in Rutherford & Rutherford, 2013, p. 414) and Braverman focuses on biopolitics as the governing of life (Braverman, 2015b). Braverman quotes Dreyfus and Rabinow to describe how this Foucauldian use of governing or "government" should be understood:

> This word ["government"] must be allowed the very broad meaning which it had in the sixteenth century. "Government" did not refer only to political structures or the management of states; rather it designates the way in which the conduct of individuals or states might be directed: the government of children, of souls, of communities, of families, of the sick. It did not cover only the legitimately constituted forms of political or economic subjection, but also modes of action, more or less considered, which were designed to act upon the possibilities of action of other people. To govern, in this sense, is to structure the possible field of action of others. (Dreyfus and Rabinow in Braverman 2015b, 221)

In other words, biopolitics refers to the ways in which the possible field of life and death is structured, or how certain forms of life and death are conducted, enacted, and made (im)possible.

A growing body of literature in humanities and social sciences attempts to extend Foucault's thinking on power and biopolitics to animals and other non-humans (see for example Asdal, Druglitrø, & Hinchliffe, 2017; Biermann & Anderson, 2017; Braverman, 2015a; Lorimer & Driessen, 2013; Shukin, 2009; Srinivasan, 2013; Wolfe, 2013). Asdal and colleagues (2017) describe different versions of deriving a non-human biopolitics from Foucauldian thinking, and ascribe to a version that is "less concerned with biopolitics as a philosophical position, and more with biopolitics as a (…) sensitivity regarding how words and things, or practices and things, shape and produce objects or allow for liveliness" (p. 17).

Using biopolitics as the sensitivity described by Asdal and colleagues enables describing the ways in which animal lives and deaths are valuated and hierarchized. In this context, Braverman (2017) introduces the idea of "zoometrics" as "the explicit or tacit deployment of a valorizing biopolitical metric, which positions instances of death and suffering as more or less worthy of concern by drawing on cultural and racial resonances of the human-animal divide" and as "a biopolitical ranking technology (Foucault 1990; 2003) that operates through demarcation within, and association or differentiation between, the human and the animal" (p. 192). She sees a broad potential for this concept, "encompassing a variety of institutions (e.g., prisons, hospitals, homes), spatial arrangements (e.g., nature reserves, cities, bodies), and events (war, peace, the Anthropocene, the dinner table)" (ibid., p. 193). Animal geographers show a range of different forms that this biopolitical technology can take and different logics, means, and criteria by which lives and deaths are valued and ranked. These include the genetic (im)purity of species (Biermann & Mansfield, 2014; Fredriksen, 2016); productivity and profits (Gillespie, 2014; Novek, 2005); preservation of 'wildlife' (Biermann & Anderson, 2017; Braverman, 2017); companionship (Haraway, 2008; Redmalm, 2019); hygiene and security (Buller, 2008; Hinchliffe & Bingham, 2008; Nagy & Johnson (II), 2013); biodiversity (Biermann & Mansfield, 2014; Dutkiewicz, 2015; Lorimer & Driessen, 2013).[10] Even though spatial concerns are often present in these accounts, space-making is rarely seen as the biopolitical ranking technology itself. In this article, I focus more explicitly on the role of space-making in biopolitical formations.

A lot of research in animal geography has focused more on the *conceptual* rather than *material* construction of space. From the onset of the current 'third wave' of animal geography, space has been a central concern (e.g. Philo, 1995; Philo & Wilbert, 2004; Philo & Wolch, 1998). Much scholarship couples the way that animals are given a conceptual place, to how they are placed materially. In reference to the early scholarship of the third wave, Bolla and Hovorka (2012) write that the conceptual "placements dictate where animals belong, where they should go, how long they should stay, how they should

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[10] I take these categories/logics largely from Lorimer and Driessen's categorization of different forms of biopolitics (Lorimer & Driessen, 2013).

behave, what use they have (to humans), and how humans interact with them" (p. 56). In this work, space as the material placement of animals seems to be mostly an effect of conceptual classification. Bolla and Hovorka (2012), for example, write that

> [m]any human discourses contain within them a definite imaginative geography, which serves to position 'them' (animals) relative to 'us' (humans) in a way that links the conceptual 'othering' (setting them apart in terms of character traits) to a geographical 'othering' (fixing them in world places and spaces different from those that humans tend to occupy) (Philo and Wilbert 10-11). (p. 57)

Even though, Philo and Wilbert (2000) state that one of the emphases of animal geography is "showing how the spaces and places involved make a difference to the very constitution of the relations in play" (p. 5), and Bolla and Hovorka (2012) note that "space, while appearing initially unproblematic, takes on an active role in the production and reproduction of human and animal positionality" (p. 57), the conceptual work of categorization seems to take a leading role, while material spaces are merely expressions of these categories.

Scholars that explicitly think through a 'more-than-human biopolitics' approach space differently. For example, Holloway and colleagues (2009) think through a case of livestock breeding and explore "how all entities are enmeshed in complex and heterogeneous webs of connection and co-constitution, and that action and subjectivity are relational achievements" (p. 395). Space can be seen as part and as effect of these webs, while not privileging conceptual categorization over material categorization, but seeing categorization as both conceptual and material at the same time. Explicitly, Holloway and colleagues (2009) write that

> [t]hese [heterogeneous biosocial] collectivities [that include humans and livestock animals] are, too, co-produced within particular biogeographies, incorporating animal and human bodies along with sites such as farmyards, agricultural showgrounds, breed society offices and herd/flock books. (p. 405)

In reference to Donna Haraway's *When Species Meet*, they note that livestock breeding can be seen as a series of moments and spaces in which species meet (ibid., p. 404). In a response to Haraway's book, Hinchliffe (2010) emphasizes the active role of material spaces more explicitly, when reflecting on the importance of the *where(s)* of species meeting: "Haraway's book also makes me think about spatial matters – as mundane as where things happen and as complex as how spaces are made as species meet, and as tricky as trying to think about more than one meeting and more than one companion species" (p. 34).

Collard (2012) takes on these mundane, complex, and tricky spatial matters. In order to do so, she combines biopolitical and spatial theory and thinks through the making, maintaining, and unmaking of 'safe-spaces' on Vancouver Island which is inhabited by both cougars and humans. Drawing on scholars in actor-network theory, feminist science studies, and so-called 'more-than-human' geography, she traces biopolitics' spatial expressions. Central to the spatial thinking of these scholars "is an idea by now familiar to most geographers: space is not a preexisting, static box that entities move through or not. Rather, spaces are produced within dynamic, heterogeneous, and often precarious assemblages of entities that are not all human" (Collard, 2012, p. 25; see also Gibbs, 2018).

Massey (2005) is representative of the kind of processual thinking about space that Collard draws on. She describes places as “temporary constellations of trajectories” (p. 153). As I described in the introductory chapter, Massey argues that (1) spaces should be understood as “the product of interrelations; as constituted through interactions”; (2) and as “the sphere of the possibility of the existence of multiplicity” and “as the sphere in which distinct trajectories coexist” in heterogeneity; and (3) because space is the product of a heterogeneous multiplicity of relations, and as these “relations … are necessarily embedded material practices which have to be carried out”, space is “always in the process of being made”, “always under construction” and “never finished; never closed” (p. 9). Spaces can productively be understood as “events” that “require negotiation” (ibid., p. 153). I will take this approach which will allow me to focus on the biopolitics of *material* space-making and its consequent valuations of animal lives and deaths.

In this chapter, I approach biopolitical spaces not just as an expression of conceptual categorizations or as ‘locations’ in which species meet, but as something that is constantly in the process of being made and unmade and plays an active role in biopolitics, as suggested by Hinchliffe (2010) and Collard (2012). I approach space as constitutive of and constituted by forms of life-and-death-making. In doing so, I formulate space-making as a mediator (Latour, 2005) through which animal lives and deaths are enacted, differentiated, valuated, and hierarchized. This chapter elaborates on Braverman’s (2017) suggestion of the role of “spatial arrangements” in zoometrics, and explores how space-making works as a “biopolitical ranking technology”.

Work on biopolitical space-making has tended to focus on primarily one other (non-human) species at a time (e.g. Braverman, 2015b; Collard, 2012; Lorimer & Driessen, 2013), and thus has largely overlooked the fact that spaces-making often involve *multispecies* interactions.[11] Hovorka (2019) notes that animal geographers "rarely talk about more than one animal (in relation to humans)…we can push further in terms of exploring animal lives within multispecies hierarchical networks and the implications for animals or animal groups" (p. 755). Doing so is important as, at least when humans are involved in this space-making, it points to the ways in which spaces are constructed through hierarchies of what is *good or bad* in the making of spaces. I explore this process through an explicit focus on space-making. Taking this space-making (rather than a certain animal-human relation) as analytical focal point enables the exploration of emerging "multispecies hierarchical networks" (ibid.).

Animal geographers have explored "co-presence and mutual becoming" (Buller, 2015, p. 379) at the terrestrial and aquatic farm through focusing on the "intermediating role of technological and scientific dispositifs in the nature-techno-culture assemblies that characterize the modern farm (see for example Higgin et al., 2011; Holloway and Morris, 2012; Holloway et al., 2013; Law and Lien, 2013)" (ibid.). For example, using fieldwork conducted on a Norwegian salmon farm, Lien and Law focus on what they call the "salmon domus", the big net-pens that 'house' the farmed salmon (Lien, 2015; Lien &

[11] An important exception is the work on biosecurity, that focusses on humans, farm animals, and wild animals, in the emergence of diseases (e.g. Hinchliffe, Allen, Lavau, Bingham, & Carter, 2013; Hinchliffe & Bingham, 2008).

Law, 2016). Using a relational approach focused on the description of practices, they move from an understanding of the net-pen as a semi-permeable boundary that is installed somewhere and subsequently acts on its environment, towards a more complex understanding of the "salmon domus" as a "heterogeneous assemblage consisting of matter and materials both dead and alive, both human and nonhuman" (Lien, 2015, p. 59) which is "dynamic" and "continuously in the making" (Lien & Law, 2016, p. 23). Lien (2015) describes the 'salmon domus' as "a complex material interface, a set of textures and affordances that serves to negotiate insides and outsides, defining, situating, and/or mediating across various boundaries" (p. 57). This "domus may be described as an assemblage that gets enacted through *fiddling, experimenting, and tinkering with the materials at hand*", which is a "complex relational practice" between more than only humans and salmon (Lien & Law, 2016, p. 24). They summarize "their version of the salmon domus" as "[a]n interface at the edge, dynamic, heterogeneous and multispecies" (ibid.). While building on their approach and understanding of the 'salmon domus', I will articulate more explicitly the combination of space-making and biopolitical valuation.

Through this case study I "attend to more-than-human biopolitics" (Asdal et al., 2017, p. 19) by formulating the central role of space-making in the biopolitical enactment and valuation of animal lives and deaths. In other words, I articulate the ways in which space-making and life-and-death making are intertwined in the stories that I collected through fieldwork around the cages and interviews about the cages. Moreover, by focusing on aquatic animals, I join the push beyond the dominant "empirical focus on terrestrial mammals" (Gibbs, 2019, p. 5) and open up ways of thinking about biopolitical space-making within animal geography scholarship on aquatic animals (see ibid. for examples).

3.3 Network/net-work: making the 'rearing environment'

> *It is my first day visiting one of the 'grow-out sites'. I am wearing a hard hat and steel-toed boots. In my pocket I have ear plugs to wear when blowing the feed pellets into the cage, as the feeder makes a lot of noise. I step aboard the boat with Darrell and John[12], the two workers who I will join today, and disinfect my boots in a tub full of orange-coloured disinfectant. About five minutes later we arrive at twelve large circular net-pens hanging in the water.*
>
> *One of the first things that the two men do, is measure the temperature and oxygen of the water. The sensor of the meter is connected to a cord attached to a black box on which numbers can be read. This sensor is lowered into the water by John at different depths (indicated by a piece of tape on the cord). At every depth, he reads three numbers out loud: the temperature and two types of measurement for oxygen. Darrell writes down the different numbers, to document the conditions in the cage and to decide whether the fish can actually be fed. If you feed when the top layer of the water is too warm or too cold, the hungry fish can end up in a water layer of which the temperature is dangerous for them.*
>
> *I am also allowed to feed the salmon today. Before I start feeding, a camera needs to be taken out of its tub with disinfectant and let down the cage. Then, with one hand and the support of one leg I move the hose of the feeder back and forth. The feeder blows the feed pellets in the net-pen. I have to be mindful of the direction of the wind and the sea currents to make sure that the pellets end up in and not next to the cage. At the same time, I look at the screen, from inside the cage up to the water surface. I see the blue color of the sky and the squirming shadows of salmon to be fed. I have to stop feeding when the pellets – not to be confused with specks of dirt, often fish feces – become visible on the camera. Most of the times the feed pellets are clearly recognizable by their rectangular shape and the steady speed with which they approach the camera. If they are visible on the screen, I need to stop feeding for some minutes and try again a little later. After doing this three times, you stop the machine, take the camera out of the water, return it to the tub with disinfectant, and write down how much feed you sprayed into the cage – at the end of today sometimes as much as 500 kg per cage.*

[12] All names of informants in this chapter are pseudonyms.

3.3.1 Network: connecting and separating humans, non-humans, and things

The 'rearing environment' of the cage is not just made by the big net-pen that hangs in the water, but depends on a network of humans, nonhumans, and things that both create and transgress boundaries between inside and outside.

First, there are certain biophysical requirements for the location of the net-pens; the landscape and environment in which the net-pens are placed, are part of the network that the 'rearing environment' depends on. As argued in the introduction, these requirements include the salinity of the water, water depth, current flow, oxygen concentration, substrate of the ocean floor, and the location in relation to for example seal colonies, which I illustrated with a recent DFO research project that aims to better understand "the physical oceanography of [the Coast of Bays]" (Donnet et al., 2017, p. ix).

Another part of the network are the material infrastructures that keep the net-pen in place in its marine environment. On satellite images you can see the net-pens hanging in the coastal waters on the south coast of Newfoundland (Figure 11). They are visible in the dark blue of the ocean as small light-colored circles, arranged in two rows of three or more. Around these cages, some light dots are visible at the intersections of the gridlines that are submerged underwater. These dots are buoys that connect to the grid-like cage structure underwater. Some of the buoys mark the corners of the farm perimeter, other ones are connected to anchors, grounded on the ocean floor, that prevent the whole structure from moving with the ocean currents, and a third type of buoy keeps the grid system afloat on which the actual cages are hanging. So-called corner plates are hanging in the water from this last type of buoy. Polysteel rope connects these corner plates not only to each other, but also to the grounding anchors and the circular high-density polyethylene pipes that are visible in the satellite images. The whole structure is both grounded and floating. The ropes and chains that make up the mooring and grid system need to be under constant tension to distribute the forces that the sea exerts on them in an even way so that the cage structure will not fall apart.

Figure 11: Part of a screenshot of Google Maps with the net-pens clearly visible.

There are anchors and buoys, ropes and chains, shackles, corner plates, and floating circular pipes. These all need to be in place before another crucial part can be added: the nets. These nets are attached to the floating circular pipes – the ‘cage collar’ – and are kept in shape by attaching a circular pipe filled with cement at the bottom of the net or by hanging so-called weight balls in the net. These weight balls are buoys filled with cement that are attached with rope to the cage collar, so that they can be hauled up in case any work needs to be done on the nets. Extra pipes around the ‘cage collar’ form a sort of walkway and fence around the surface of the net-pen. The result is something that looks a bit like an upside-down bell jar, which is closed off by the water surface. An important difference is that the net bordering the cage space is much less watertight and more permeable than the glass of the bell jar. Even though some things should not be able to pass the border (the fish should stay in the net-pen; predators should stay out), for other things it is crucial that they can flow in and out as easily as possible (water, oxygen, fish feces, uneaten feed pellets).

Even though they are not the only space-maker, the big nets of the net-pens are important elements of the network that makes up the ‘rearing environment’, especially in the creation of a boundary that encloses the salmon and is at the same time transgressed by other things. Making the ‘rearing environment’ is about both separating and keeping separate insides and outsides and about connecting them and keeping them connected. One the one hand, the net is a technology that separates spaces. The net holds together a ‘rearing environment’, a comprised space holding the fish, in order to feed, monitor, and fatten them efficiently. The net keeps them in the same place, so that they are easily locatable every morning. Having salmon in the same space also means that they can be fed efficiently: with one feed-blower, 500 kg of feed pellets, and two to three daily sessions of half an hour, a group of over 40,000 salmon can be fed at once. And, when the 'grow-out cycle' is over and the salmon have reached 'market size', they can easily be taken out of the water or 'harvested'. The net separates two spaces and closes off one of them. The net holds inside the salmon, while at the same time keeping 'predators' outside. Central in this is the ropework and the size of the meshes that make up the net; there needs to be enough ropework and small enough meshes to keep things on the right side. On the other hand, the net is also a technology that connects spaces. It is crucial that enough oxygen-containing water can flow into the cage. A relatively unobstructed flow of water through the net also prevents the water from exerting too much of a dragging force on the cage that would make the structure fall apart. At the same time, the water flowing through the meshes cleans out the net-pen – and pollutes what is outside the cage – by flushing out fish feces, uneaten feed pellets, and other waste products. This cleaning work is cheap. Besides the cage itself, no extra infrastructure is needed to bring in water and oxygen and dump flows of waste in the environment. In this way, the net is a technology that makes possible openings and connections between the 'rearing environment' and the 'environment itself'. Central in this are the empty spaces of the meshes that need to be big enough to let water and waste through.

In order to be able to grow salmon *at all*, a suitable space has to be made, called 'the rearing environment'. This should not be seen as just a closed-off space, bordered by the net-pen, holding the salmon within 'the environment itself', but rather as depending on a network that creates boundaries and also transgresses them. The space 'outside' the net-pen is crucial for the success of growing fish, as the outside supplies oxygenated water and is a site for for feed pellets, feces and other 'waste' to be dumped with serious environmental consequences. The outside is also the environment: the deep coastal waters, the water temperatures, oxygen levels, salinity, absence of icebergs, and the flow of water are part of what makes it possible to 'grow' Atlantic salmon in the open net-pens on the south coast of the island. Other elements that make up the network are the salmon themselves, the feed pellets, tubs of disinfectant, ropes, boats, knowledge about feeding, making knots, marine navigation, and the labor of the site workers. The presence of the labor of the site workers to the network leads to the second part of the creation of the 'rearing environment': the net-work that needs to be done to solidify a certain version of the 'rearing environment' and keep it together.

3.3.2 Net-work: solidifying 'the rearing environment' and keeping it together

The 'rearing environment' depends on the network described above, but this network alone is not enough to maintain this environment or cage space. Some of the actors in the network are after a certain version of the 'rearing environment' and need to put work in to keep this version together and solidify it. This work of spatial maintenance should be seen as a constant making and remaking of space. The maintained space is a space that is constantly becoming. Work is done to (re)make space and to keep the network making up the "rearing environment" more or less stable. I call this work *net-work*, to signify the character of the network as constantly under construction and to foreground the construction work that is constantly going on. Importantly for the overall argument in this chapter, animal lives and deaths are intertwined with this net-work.

3.3.2.1 Monitoring qualities

The salmon growers are after a 'rearing environment' that is good for growing salmon, and that has particular qualities. In the relatively uncontrollable 'environment itself' some of these qualities are hard to manipulate, but still need to be monitored and acted upon. In the fieldnotes at the beginning of the previous section, I learned that site workers measure the temperature and oxygen levels twice a day, and write them down for potential future reference. And, with the camera, which is taken out of a tub with disinfectant to make sure no undesirable parts of 'the outside' would enter the net-pen, the site workers extend their vision to the underwater world of the cage and see when to stop feeding and whether or not the salmon are eating well. Also, regularly, one of the site managers takes ten fish out of each cage and counts the number of parasitical sea lice they can find on the slimy salmon bodies. If monitoring the cage shows undesirable circumstances, measurements might need to be taken: no feeding today, stop blowing feed pellets in the cage for this round of feeding, planning a lice treatment or adding medication to the feed.

The temperature and oxygen levels of the water in the net-pen are measured and monitored in order to know whether or not to feed the fish, and to know how the circumstances in the net-pen are potentially changing over time; and the fact that some objects (e.g. boots and cameras) need to be disinfected before they are allowed on the production site or in the cage, points toward a qualitative difference between inside and outside that is attempted to be kept up. Moreover, there are devices and objects (environmental assessments, tubs with disinfectant, thermometers) in order to bring these qualities into the world, measure, and maintain them, and act upon: e.g. in order to decide whether we should we stop or start feeding. Importantly, these spatial qualities that are enacted and through which a certain version of the 'rearing environment' is attempted to be maintained, are grouped around growing the population of salmon in the cage as profitably and efficiently as possible.

3.3.2.2 Treating sea lice and disentangling spaces

The biopolitical networks of the salmon farm do not only produce the spatial possibilities for farmed salmon to live, but also for sea lice. Sea lice are parasites that fit easily through the meshes of the net. They thrive and reproduce on the bodies of the farmed salmon, feeding on the mucus, skin, and muscle of the fish. They threaten the lives of salmon through causing damaged fins and skin lesions, leading to "physiological stress, problems with salt regulation, increased susceptibility to other infections and reduced disease resistance in individual fish" (Thorstad & Finstad, 2018, p. 3). Sea lice can also cause "reduced swimming performance, feeding and growth and altered behaviour of the fish" (ibid.). Nets cannot keep sea lice out of the cages, and the sea lice thrive in the same spaces as and because of the dense population of farmed fish. The spaces of different forms of life become entangled when and where – in this case – sea lice and salmon meet. However, the two forms of life cannot 'flourish' together in the same space of the cage. During a sea lice count – in which ten fish are removed from the net-pen with a dip net and the amount of sea lice on their bodies is counted – and during feeding shifts, I see the bodies of salmon full of the parasitical sea lice, and workers point me at the 'whiteheads' and 'redheads', salmon that have been damaged by parasitical sea lice. The issue of sea lice is a big problem for salmon growers and creates challenges in terms of how to disentangle these spaces and forms of life, in such a way that the salmon stay alive, and growing. In other words, how to keep together and solidify a particular version of the 'rearing environment', i.e. one without high numbers of sea lice? The routes chosen could be described as net-work, and as biopolitical and spatial practices focusing on decreasing the likeliness for sea lice life to *take place*. One way of dealing with sea lice in a net-pen is adding medication to the feed, which makes the salmon bodies slimier and hopefully less attractive to sea lice. At other sites than the one I visited, so-called 'cleaner fish' are added to the cages that eat the sea lice off of the salmon bodies. During my fieldwork I witnessed a third method: the 'treatment' of sea lice by adding chemicals to the net-pen.

> *Yesterday there was a storm. Some places in the region received almost 200 mm of rain last night. The rain has colored the sea brown. The sediments in it make it hard to see through and branches and small trees are floating by our boat. Today, I joined the site workers that do what they term 'lice treatments', to try and get under control the infestations of sea lice that have never been as bad as this year, and during this time of the year specifically. They couldn't treat the cage when they tried earlier today: too little ocean current, the water was too brown, and it was hard to see the fish, which is important, I am told, because*

otherwise they could get in, stay trapped and even die in so-called 'bags', closed-off parts of the net that are created through hauling up the net.

I am on a boat with Nelson and Ben, men in their late-fifties, early-sixties. Nelson was a fisherman for 27 years before he joined the aquaculture work. Ben was a diver from the early days of aquaculture (the 1980s) onwards, but cannot do that work anymore because of complications caused by his COPD. We are on a longliner, a former fishing vessel. Onboard, are, among other things: tanks of oxygen, an oxygen measuring device, packages of powdered pesticides, a big barrel to mix the powder with water, a device to spray the pesticides in the cage, a gas mask for Nelson to wear while doing the spraying and mixing of the pesticides, a big crane to do heavy lifting. We are approaching the net that will be treated as the first of three today. There are already other people on site: some smaller boats, other longliners and a big barge that also is carrying oxygen supplies and a giant role with a tarp that will be put around and under the net.

Eight people hang over the outer rails of the net-pen to haul up the net. It is a 60-feet deep net and it will be hauled up 15 feet. Weight balls that keep the net in shape underwater have been removed, some ropes that keep the separate bird net attached to the railing of the cage have been untied. The ropes that are attached to the different tubes of the oxygen tank are brought to the opposite side of the net. Then the tubes are unrolled and now hang spread out through the cage, to keep the oxygen level high enough in the cage, and keep the fish alive.

Then, the tarp is slowly unrolled from the big roller on the barge. Two boats – one at both sides of the tarp - take the ropes attached to the tarp and quickly move over the water to help spread the tarp under the water. The ropes are taken by the guys on the walkway surrounding the net pen and hauled up until the tarp is visible, after which they attach the rope to the cage structure. This process is repeated until the tarp is applied around the whole underwater part of the cage and forms an extra border between 'the farm' and 'the world'.

After the net is lifted up with the crane on the longliner, Nelson takes a big sprayer and sprays about a thousand liters of pesticides in the cage. He wears the same gas mask as he was wearing when he prepared the mixture, by emptying white envelopes with powder sealed in water-solvable material to the barrel with sea-water. After it is sprayed in the cage, we have to wait for an hour. Other workers are preparing the second cage, while I wait with the two older workers, that aren't allowed anymore to do the physically 'heavy' labour of lifting weight balls, nets, and tarps. In the meantime, the two now and then check the oxygen levels. If it is increasing too much, the oxygen supply is decreased a bit. If it is getting lower, the supply is increased a bit. "Five more minutes", Nelson communicates to his colleagues at the barge at the opposite end of the cage. Then the crew that has been preparing the second cage is back and helps untying the tarp, taking out the oxygen supply tubes, putting the weight balls back in, and *tying all the small ropes back, such as the ones attaching the bird net to the railing of the cage.*

This is a successful treatment of sea lice, or a 'lice bath' as it is also called. Nelson and Ben tell me that at this time of the year, this year, at this location, this crew does on average five lice treatments a day, five cages containing ten-thousands of salmon each. It's like a big city, a worker told me earlier, where disease easily spreads. On each salmon there can be tens of sea lice. Looking in the cage I see the salmon that are affected by them: the 'grey heads', 'white heads', and 'red heads', as they are called, depending on the amount of damage the sea lice have done to the salmon. The redheads will probably not make it to the end, Nelson tells me. If a treatment is done, it will have to be done again in about two to five weeks – the treatments only affect the mature lice, and sea lice can come back from other cages on the same site, from other sites or other places in the sea, until the water is 5 degrees or lower, because then the sea lice won't breed anymore.

The third treatment of today is an unsuccessful one. For some reason an air bubble has gotten under the tarp, which makes it hard to correctly attach the tarp around the cage. It lifts up the net more, which creates less space for the fish in the net. It also has created a 'bag', the net is hauled up and a part of the top half flipped over a lower part and caught a group of salmon. A worker points me at the different bubbles that are visible at the surface. That's from the salmon and we have to get them out of that bag as soon as possible, or they will die, he tells me. The workers work as hard as they can to haul up the net further, remove the bag and free the fish. They succeed, but don't proceed and stop this treatment for the day, "before we make a mess", Nelson says. Two days later I learn that at some times in the past 800 (3 filled tubs), and even once 3000 (15 tubs) fish died during the treatments to be collected by divers the next day as 'morts' at the bottom of the cage.

'Sea lice treatments' are attempts to disentangle the farmed fish's and the sea lice's spaces of life. Because of the entanglement of the parasites with the individual salmon bodies within a high density of salmon bodies, disentangling the salmon and sea lice and their spaces is a challenge and requires work. Through the description of this example of net-work, its life-and-death-making aspects become visible, and the lives and deaths of animals become part of the making and maintaining of a particular space – in this case the 'rearing environment'. Spaces can support multiple forms of life. In this case, the trajectories of farmed salmon and sea lice coexist in the same space, although not peacefully and not independently. This coexistence is a problem, for the salmon, and for the salmon growers who see their salmon being damaged and their profits threatened. The killing of the sea lice and the (primarily) negative effects of the chemicals on the environment, are part of the work of maintaining and solidifying a particular version of the 'rearing environment'. The valuation of the lives and deaths of the sea lice is done spatially and in relation to the maintenance of the 'rearing environment' and the production of salmon bodies. The sea lice have to be removed, killed, expulsed from the net-pen, in order for the space for and lives of the salmon to be 'defended' and enabled. The maintenance of particular forms of life (in this case the space for salmon) is done through spatial interventions involving unmaking and remaking (deadly) spaces.

The goal of the sea lice treatments is to get rid of the sea lice 'infestations', while harming the fish in the cages as little as possible, by temporarily closing off the net-pen with a tarp, supplying the fish with oxygen, and adding pesticides to the water. In other words, the goal of this practice is to simultaneously change the inside of the net-pen in such a way that it becomes a deadly place for the sea lice (and potentially other forms of life in the cage that I do not know about), while the inside stays as much the same as possible for the salmon swimming around. This net-work is a process of unmaking and remaking different versions of the 'rearing environment' to eventually kill as many sea lice as possible, and solidify the most efficient and profitable 'rearing environment' for the salmon growers.

This work is demanding and consists of hauling up the net and weight balls, tying and untying knots, moving over the water to spread the tarp under the net, bringing in oxygen supplies and putting the tubes into the cage, mixing toxic powder with water and spraying it into the cage. This space-making work is not just done by the men at the site, but is done through a constellation that depends on humans, nonhumans, things, and the relations between them. The 'success' of a lice treatment depends on the salmon life-sustaining oxygen gas, the lifting powers of the crane, the protection of the gas mask, the biology of the sea lice and salmon, the less permeable character of the tarp compared to the net, and the flow of seawater which cleans out the pesticides from the cage when the treatment is done. The success of the sea lice treatment is also dependent on a certain 'outside': an outside from where flows are added during the treatment, such as the gas and the pesticides, an outside where the workers are coming from, eat, live, and recover from the hard and dangerous work, but also an outside for the pesticides and the dead sea lice to flow to after the treatment is over and the tarp is taken away. The backgrounded construction of the marine environment as a dump for (in this case) pesticides and sea lice (but in other parts of the aquaculture process also fish feces, leftover pellets, and other pollutants) is central to the relatively cheap making of aquaculture space. This construction and the flow of waste out of the net-pens has potentially serious effects on the surrounding marine environment.

Net-work can also go wrong. There are potential dangers involved for the organisms in the sea and the marine ecology, and for the workers doing the work. The 'inside' of the net-pen can potentially extend in dangerous ways out of the permeable nets that make up the pen and even the perimeters of the farm sites. However, an accidental and undesired creation of an inside within the net, can also pose a danger, in this case for the lives of fish. A net flipped over itself can trap a group of fish and lead to a lack of space and oxygen and ultimately the death of these fish. This shows that net-work can be a precarious balancing act.

3.3.2.3 'Mort dives': multiple spaces and maintaining space

In order to solidify the particular version of the 'rearing environment' that salmon growers are after, sometimes humans need to go into the cages. However, inasmuch as the net-pen is a space of life for commercially farmed salmon, it is not for the farmers itself (see also Lien, 2015; Lien & Law, 2016). On my shifts with site-workers we all wore a life jacket in case we would accidentally fall in the water. One man told me that he once fell in the water, but even though his clothes became heavy of the soaked-up water, luckily the man in question wore a life jacket, could swim well, and survived. However, sometimes humans do need to go down into the cage to check the state of the net-pen, to repair holes, or pick up dead fish at the bottom of the cage, all forms of the net-work of maintaining a particular 'rearing environment' as a distinct space. Therefore, the cage needs to be made into a space in which a human can survive for a certain period of time and do the necessary maintenance work.

> *While I help feeding the fish, diver Phil is brought to our boat by the site manager's boat. He will dive into the cages to pick up the dead salmon – the*

'morts' – at the bottom of the cage. He steps onto the walkway around the cage and is showered by a site worker with an orange mixture of water and some iodine-based disinfectant. After the shower, he dives into the cage while holding a big purse made out of netting material. He will clip this open in the cage, put the dead salmon in it, and pull the chord that connects the purse and the worker on the longliner. Then, the purse is hauled in as the diver swims back to the surface, after which Darrell classifies the 'morts': fish that have hit the cage structure while jumping out of the net ('mechanical deaths'), salmon that don't really eat the feed pellets and have stayed very small ('slinks'), ones that are already rotting a bit, ones with scale damage, fish that are killed by a predator.

Diving is not simple. You need your diving ticket. And, there are safety procedures, to keep pathogens out (the disinfectant) and to ensure the diver's safety; one pull at the diving chord connecting the diver and the worker at the vessel means 'I'm coming up'; three times indicates an emergency. Being in the water can be rough. One diver tells me about a friend who once was bitten by a blue shark in a cage. Another tells me about the young trout in a full cage which surface is covered in ice; they attack you and make your cheeks bleed. In order to dive, you also need equipment: tanks full of gas, a mixture of nitrogen and oxygen. These tanks need to be opened by someone and the flow of gas needs to be continuous, or you might drown. You can only be in a cage at certain depths for so long, as there are limits set and enforced for the maximum 'bottom time', based on the amount of nitrogen that is allowed to enter a body. For future, potentially deeper, nets a different gas mixture might be necessary.

Whereas in the case of the sea lice and salmon a space of death (for the sea lice) was attempted to be coordinated and overlapped with a space of life (for the salmon), in the example of diving an attempt is made to make two spaces of life coexist, i.e. that of humans and of salmon. As Lien and Law (2016) argue, fish and humans require different mediums to live in (pp. 17–18), which makes it hard to overlap and not just connect the spaces of the two. The net-work of maintaining the ‘rearing environment’ therefore depends on the possibility of creating a space for human life (i.e. a particular human: the diver) within the ‘rearing environment’.

In order to maintain the rearing environment of the fish, dead fish need to be removed from the cage space as forms of collateral damage. The work of keeping the salmon alive apparently also consists of spitting out dead fish bodies in the process, normalized sacrifices in the production of salmon commodities. The ‘mort dives’ by divers such as Phil occur once or more times per week, and the dead salmon bodies are collected in mundane black tubs, removed from the space of the net-pen, about to be knotted into a new spatial constellation of disposal. They are classified to monitor how the fish are doing and keep track of the changes in the amount of fish in the cage: are there any weird developments, are the fish healthy and doing okay?

It is not only dead bodies of salmon that are taken from the bottom of the nets. During one of my shifts, a site worker tells me that during some times of the year, herring swim through the meshes of the net-pens when they are small enough and eat from the small food pellets that are fed to the young salmon. At some point the food pellets get too big for them, and the herring themselves have gotten too big to exit the net. As a consequence, they die in the net-pen, and are collected by divers at the bottom of the cage. There have been times that workers took out multiple tubs of dead herring per cage, a site worker mentioned. The story of this site worker tells us something about the removal of dead fish bodies as part of the net-work, but also how the solidified (‘successful’ for salmon farmers) version of the ‘rearing environment’ also functions as a particular way of dividing forms of life and death, e.g. as a trap for herring. What is a space of life for some fish (most of the farmed salmon until they are slaughtered), is simultaneously a space of death for other fish (the salmonid ‘morts’, but also the ‘bycatch’ that gets trapped in the net-pen).

3.3.2.4 Net-work

From the examples in this section, I learn that making constellations of life and death is done through the (net-)work of making, unmaking, and remaking spaces (cf. Collard, 2012). Salmon production space is not a given, and is not only inhabited by salmon. A (‘safe’ or ‘productive’) space for growing salmon needs to be made, can be unmade, and needs to be made again, just as the sea lice treatments need to be repeated until the temperatures start decreasing. Biopolitics is not only concerned with making and maintaining spaces, but also with the coordination of spaces: the entanglement and disentanglement of spaces that different species inhabit, but also the setting up of an outside that helps to both constitute the different insides, and enables the spatial work that makes up many biopolitical interventions. The fact that space-making is entangled with (multispecies) forms of life-making, means it is also entangled with forms of death-making, sometimes very intentional, sometimes more-or-less ‘collateral’; salmon are taken out of the cages and put in black plastic tubs as ‘bycatch’ or during ‘mort removal’. The net-work of keeping together the ‘rearing environment’ can be analyzed as a biopolitical practice; forms of life and death are governed, i.e. the field of possibilities for different forms of life and death is structured, even if it is in ways that might often be seen as insignificant, unavoidable, or normal. It is this life-and-death mediating character of the work of maintaining the ‘rearing environment’ that makes up the spatial biopolitics of the everyday practices of salmon aquaculture.

3.3.3 Supplements: dealing with challenges and surprises of the ‘environment itself’

Even with the network in place and the net-work being done, the ‘environment itself’ stays full of challenges and surprises with regards to the maintenance of particular versions of the ‘rearing environment’. Therefore, the network needs to keep adding supplements – things, extra work, killing – to the net to keep the particular version of the ‘rearing environment’ together and maintain it as a distinct space.

One example of a surprise or at least a challenge from the ‘environment itself’[13] recently resulted in the death of about 2.6 million farmed fish on the south coast of the island, according to the aquaculture company MOWI (Maher, 2019), and led to the provincial government “yanking” some of the licenses (CBC News, 2019c). According to the company itself, the large amount of fish dying had to do with high water temperatures

[13] Importantly, I am not blaming ‘the environment’ here, but focusing on the challenges that emerge through the industrial production of salmon within ‘the environment’.

for a too-high number of days, a spokesperson said to the CBC: “Salmon, they prefer waters between 15 and five degrees (C), and we were experiencing 18 to 21 and we experienced that for 11 to 13 days when you normally only see temperature spike for two to three days" (CBC News, 2019b, para. 21). Even though workers of a local fish processing plant speculated that the large numbers of sea lice that they noted on some fish could also have played a role in the massive die-off (Maher, 2019), the spokesperson rejects these explanations:

> No viruses. No threat to human health. Sea lice aren't to blame, said Card [the spokesperson], with the dead fish to be rendered into pet food instead of being served in restaurants and at dinner tables — no different than a farmer whose crops are damaged by frost or drought, he said. (Roberts, 2019a)

The tragic death of these fish due to challenges posed by the ‘environment itself’ – in this case rising water temperatures – is approached with a technological solution, a supplement or change to the net:

> “With respect to adapting to the reality of more extreme temperatures, Northern Harvest is currently exploring increasing the depth of our cages and nets to allow our fish the opportunity to swim at lower and cooler temperatures, and is also exploring adding aeration systems,” Card said. (CBC News, 2019a)

The challenges from the ‘environment itself’ proved fatal to millions of salmon, and severely impact the livelihoods of plant workers, as the dead salmon will be made into pet food at other places, leaving the fish plant inactive for perhaps even a year, as the CBC reports a plant worker saying (CBC News, 2019b). In the context of this section, it is important to note the suggestion of increasing the depth of the nets as a supplement or change to the nets that is necessitated by a challenge from the relatively uncontrollable 'environment itself'.

Animals that live outside the net-pen and make their way into the net-pen are another case of surprises contained in the 'environment itself'. Over the course of my fieldwork, informants told me about many examples of animals (besides the herring and sea lice mentioned earlier) that get in and (sometimes) out of the cage. For example, one man told me about a case in which a family of minks visited a cage that is closest to the shore on a site and climbed over the handrails of through the hole between the handrail and a bird net – the same kind of hole that is opened for divers to get into the pen. A diver told me that they can kill up to 30 or 40 salmon to only eat the part of the intestines that they like the most. In a 1990 newspaper article I read about these animals as well (Figure 12):

> Last year, young trout in the cooperative's [FCB Fisheries Limited's] holding pens kept suffering mysterious deaths. Farmers had only one clue to the cause of the fish deaths - the tail of each steelhead corpse was slightly mangled.
>
> Divers eventually unraveled the mystery.
>
> Periodically, they discovered, a mink would swim out to one of the aquaculture cages and chew a small hole through a mesh wall. Once inside, the mink would not attempt to eat the baby trout. Instead, the animal would sink its teeth into a steelhead's tail and go joy riding around the cage at the end of a frightened fish.
>
> "In total, we lost a couple of hundred fish that way," said Mr. Collier, who later employed his family pet to win the battle against the killer minks. Allowed to run free on the shore of Bay d'Espoir, Mr. Collier's golden retriever now happily sniffs out local minks and deters the animals from wandering anywhere near the trout farm. (Strowbridge, 1990)

In this quote, the minks are described as "killer minks" that are "deter[red]" by a "golden retriever happily sniff[ing them] out". Centered around the quest of the maintenance of a solidified "rearing environment" and of the lives of the farmed salmon, the minks are transformed into villains, while Mr. Collier and his brave dog are the heroes of the story, defending the lives of the salmon. I want to note here, that the invasion of the minks, makes these animals into space-makers themselves – maybe even doing a non-human biopolitics – structuring the field of possibilities for themselves, the salmon, the salmon grower, and the golden retriever, and unmaking the solidified 'rearing environment' and remaking it into a space that better suits their needs, and maybe even pleasures, as they went "joy riding". Moreover, in response to the challenge of the minks, the net is extended here by the work of divers and – importantly – Mr. Collier and his dog, all performing net-work to solidify the salmon grower's preferred 'rearing environment'.

Shifting ice, joyriding mink confound managers of Bay d'Espoir trout farm

By LINDA STROWBRIDGE
Sunday Express Reporter

Bay d'Espoir trouters hooked a bonanza this season after local fish farmers lost a $10,000 bout with Mother Nature.

All winter, members of the area's fish farming cooperative attempted to protect pens of baby steelhead trout from the bay's heavy ice covering by pointing the head of the pens into the prevailing wind.

But one day early this summer, the wind shifted unexpectedly and the last slabs of ice lingering near the farm sheered off one side of a holding net. Suddenly, 5,062 steelhead trout cut free into the bay.

"All the locals are tickled pink," said Clyde Collier, the manager of FCB Fisheries Limited. "We've got more than 5,000 fish swimming past here. So now they can catch

Figure 12: "Shifting ice, joyriding mink confound managers of Bay d' Espoir trout farm" (Strowbridge, 1990)

Blue sharks often come to the net-pens and nibble on the dead salmon at the bottom of the cage and sometimes accidentally enter the net and cause a hole. Keeping the blue sharks away is – according to many informants quite successfully – achieved by doing regular ‘mort removals’, so that there are not so many dead salmon bodies at the bottom of the cage. When blue sharks do get into a cage, they do not know how to get out again. These sharks have to be taken out of the cage. In the stories that I heard, the sharks more often end up dead than alive. One diver told me about spearing these sharks underwater, videotaping it and looking back at the video at home, and seeing that it didn’t look as heroic as it had felt while doing it. Two other workers told me about a recent visit of two sharks in a cage: they used gaffs to try and get a hold of the sharks. They took one of them out of the water. One worker held the shark at its tail, while the other held its head. It was dangerous, I am told, as this 8-ft long animal was strong and could have gotten loose from the grip and bitten one of the workers. The other shark was too wounded from the wounds left by the several attempts of getting hold of it with the gaffs. It died, and sank to the bottom of the cage. During these conversations, I felt as if the killing of the sharks was the obvious thing to do in these contexts. However, the mixed feelings of the diver while looking back at the videos at home, show that this is not necessarily the case, or at least that that the division of the roles of hero and villain is not cast in stone.

How to deal with challenges and surprises is not just made up on the spot; how and when ‘invaders’ can be killed or otherwise dealt with and what to do with their bodies, is situated within not only a capitalist logic of centering the salmon-as-capital-and-commodity-to-be, but also within a landscape of policies, thresholds, the imagination and judgement of government officials, traditions of eating fish and seafood, trade agreements, and laws and legislation. For example, a former DFO aquaculture manager, told me about “pockets of high densities of river otters” at the location of a proposed new aquaculture project:

> *DFO official*: [R]iver otters will also slink around… climb, swim up to the site… You’re not gonna keep them out. There is authorized trapping for sea, or river otters here… So maybe that problem can be, would be mitigated by…
>
> *Me*: What does that mean, authorized trapping?
>
> *DFO official*: You can trap… There are fur trappers that catch otters… So, there is an authorized trapping hunt, or whatever you call it. So, there are fur trappers in the province. And this might… If this problem might be managed to that activity. A trapper… has never set traps on an aquaculture site before. But maybe that’s a place to set traps. So that would be done within the auspices of the trapping management, the trapping management plan. Who knows. I am just guessing…

The DFO official speculates on the enrolment of an existing legal and regulated trapping hunt for the purpose of keeping river otters out of the salmon net-pens. Through dealing with the potential challenge of otters the maintenance of the ‘rearing environment’ is – at least imaginatively – tied in with other forms of governing animal life and death, in this case the “authorized trapping hunt”. Spatial biopolitics is not done in isolation, but is instead situated within ways of doing animal life and death elsewhere.

The same official also told me about a similar strategy of catching animals before they reach the cage, that was experimentally attempted for sharks during one season. Gill nets and line gear were set outside farms to catch blue sharks. This strategy was abandoned after 60 to 70 blue sharks were caught in the nets, which was too much according to DFO.

When a ‘predator’ like a blue shark enters the cage, killing is often the only possible solution, structured by the central importance of maintenance of the ‘rearing environment' and the salmon in the cage. For blue sharks and tuna, entering a cage often means their death sentence. The former federal aquaculture manager told me:

> When a tuna or a shark is inside a cage, there are no options other than the application of lethal management measures. Industry has tried to roll them up using a seine, roll the predators outside the net… There is so much stress involved… The tuna goes mental, as an example, often drowns, gets entangled… There is no way of releasing it. It is dangerous to the staff. So, if a tuna goes into a cage, it's going to die, whether it drowns, or gets shot, or speared.

Divers and other workers told me about the increasing amount of tuna around the cages, as the water has gotten warmer over the past years. They sometimes swim through the netting and end up in the cages. Some of my informants told me that this happens when they chase a school of fish that swim through a salmon cage and enter the net-pen. The high speed of the tuna allows them to break the net. However, they don't seem to remember where they entered the net and are not able to speed up enough to swim through the net-pen again, which is problematic as they have to keep moving to stay alive – I was told. Tuna are taken out of the net pens, more often dead than alive, brought up by divers, killed with harpoons or seine nets, or by divers with sticks with an explosive at the end of it. One diver told me how he once was looking for a tuna in a cage, but could not find it, even though he could read from the behavior of the fish that it must have been within the sea cage.

However, how to kill tuna and what to do with the dead tuna afterwards is not straightforward. It is complicated by practical considerations and by laws and legislation. I have heard different instances of tuna in and around cages. In one, local fishermen that owned 'tags' to catch tuna – the capture of which is restricted by a quota system – were asked to catch some of the tuna that were swimming around the cage and jumping out of the water. In another, a dead tuna was brought up out of the net by a diver, and then distributed amongst the community, as it couldn't be slaughtered in the correct way anymore to send it to Japan, an important importer of tuna. DFO-officials noted this through a photo posted on Facebook and came by to check what was going on, as this was against the rules of DFO. After an explanation of what was going on, the DFO-official tolerated it and left again. A third instance involved the enrollment of a nearby Indigenous community that was allowed to catch tuna. A manager of an aquaculture company told me that

> The first tuna we ever had, we called [the First Nation community] and they came down and they harpooned it out of the net. And they sent it to Japan. It was really interesting, because I have never seen a tuna slaughtered the correct way, before, you know… I can't remember the name of the Japanese method now. But they basically drove a close line down to the spine, after they cut the head off, in order to prepare the fish, and they packed it in ice, in a box and drove it to Gander and sent it to Tokyo. And it was, 8 feet, 7 feet long.

Through the encounter with the net-pens, the tuna are enrolled within political economies and the food system of local communities.

Perhaps not surprisingly, the way the trajectories of the dead animals are done, is of concern of industry and government, according to the former federal aquaculture manager:

> So, if a tuna goes into a cage, it's going to die, whether it drowns, or gets shot, or speared. Industry says, if the animal has to die, we should be able to… If it is fit for human consumption, we should be able to do something with it. Otherwise it's just going into an incinerator and is being wasted… Same with sharks… If the animal has to die, is there a way… The industry says we don't wanna draw value from it, but can we give it to someone? So therefore, a number of years, when a tuna was caught, folks from the nearby

> First Nation would come and take the tuna and they would distribute it within the community.

In dealing with the surprises and challenges of animals making their ways into the cages, these animals are simultaneously valued in particular ways, both with respect to their lives as undesirable in relation to the maintenance of the 'rearing environment' – they can be rendered 'killable' (cf. Despret, 2016, pp. 81-88) – and with respect to their deaths, as being connected to proper ways of disposing, using, or otherwise treating the dead animal bodies. These processes of dealing with challenges from the 'environment itself' and the valuation of animal life and death, intertwine the making of the 'rearing environment' with other spaces and concerns. Which spaces, is an empirical question and a concern for different actors. Some of these connecting spaces seem to legitimize the killing of some animals more than others.

The case of seals further illustrates these processes of dealing with surprises and the valuation of animal lives and deaths. Seals are sometimes attracted by the large amounts of salmon in the cages. Seals are able to make a hole, go in to eat some salmon, leave the cage again, and use the same hole another time, I was told by a former diver. In the past, some of the site managers of the locations I visited had a license to shoot seals, but with a new company that has taken over the sites, shooting is not allowed anymore. A person working for a big European company that builds materials for aquaculture operations told me that new legislation in the United States might ban the importation of salmon from farms where a gun was used to 'solve' the 'problem' of seals. The company he worked for sells acoustic deterrent devices (ADDs) to keep seals away from farms. In Scotland, a life-size fake orca was manufactured and put into the water to scare away seals, through its appearance and the recorded orca sounds that it emits (Editors, 2019). Another company markets an “electric fish” “to deter seals which have become hard of hearing and are not put off by ADDs. The fish, which looks like a mort and is placed at the bottom of a salmon-pen, is covered with electrodes which give a shock when it touches them” (ibid.) Killing, making the environment unpleasant through sound and fake predators, and attempting to teach behavior through electrical shocks, are some examples of the ‘tools’ that salmon farmers use to carve out a seal-free space.

The space-making through life-and-death making is not only about killing animals in or close to the cage, but also about tuning in to the sensory worlds of predators in order to govern their behavior (cf. Lorimer, Hodgetts, & Barua, 2019). Dead salmon bodies are taken away from the bottom of the cage to not attract blue sharks; traps are set for sharks and otters; a Golden Retriever sniffs out minks; seals are deterred in various ways; and, the company that operated the sites where I conducted my fieldwork, had recently ordered some fake birds of prey that look like kites and are attached to sticks. They move around in the wind and are supposed to scare away sea gulls.

Sometimes the trajectories of life that is killed, lead to the plates of the site workers. On the nets, pipes, lines, ropes, and other parts of the cage structure also grow organisms: kelp, sea weeds, mussels, scallops. These have to be removed for different reasons, to not have too much drag on the net, to not block the oxygen and water flow through the nets, to keep the cage structure clean and undamaged. Mussel spat is scraped off of the pipes that make up the walkway; nets are cleaned after each 18-month grow-out cycle; at the cleaning facility the nets are dipped in an anti-foulant that mainly consists of copper which should prevent life from growing on the nets; and the anchors, bridals, and grid plates are also cleaned after each grow-out period. Some workers told me about frying up the scallops that came from one of the corner plates, on their working barge and sharing them with their coworkers after their maintenance shift was done. Other workers take home tubs of the mussels that come off the grid lines at these cleanings. I received a jar of mussels from one of the site workers.

The 'environment itself' is full of surprises that challenge the maintenance of particular versions of the 'rearing environment'. Changing water temperatures, sea lice and other animals swimming or flying into the net-pens necessitate additions to the network that the 'rearing environment' depends on; the network is extended with a manifold of supplements – both in terms of elements of the network and forms of net-work – that might be successful for shorter or longer periods of time at keeping the 'environment itself' at bay. Throughout this process, animal lives and deaths are valued and otherwise done – killed, expelled, kept at bay – in various ways.

These ways are embedded in capitalist practices of salmon production, but are also influenced by policies, legislation, imaginations, acceptable ways of treating animals, socialities and trade agreements. The constant making and remaking of space entails a constant implicit and explicit process of enacting what are good and allowable forms of life – jellyfish and small fish swimming in and out the cages do not seem to present a problem – and what are good and allowable forms of death. Therefore, the making of the 'rearing environment' plays an important role in non-human biopolitics, the ways in which humans relate to and govern animals, and other non-humans and their environments.

3.4 Conclusion: space-making and the valorization of life and death

The net-pen is placed within already existing worlds. For example, it is situated within an ecosystem full of relations between predators and preys, and organisms and their potential habitat. The net-pen and this ecosystem influence each other. Prompted by my question about the multiple forms of life in and around the cage, an aquaculture manager told me that:

> - you have to think about the other bioaccumulation of stuff… of the biofouling that's on there - the mussels, clams, you know, the other things, the plankton, that is a good settlement place. And it sticks there. You got a whole bunch of biodiversity going on within that cage, as well as the dynamics between inside, outside… And you know… I have always thought that in a place where our – I guess, the amount of primary productivity in and around our coastal zone, is probably fairly low, compared to – It is fairly low, compared to BC [British Columbia], for example, or even Nova Scotia. That we are actually enriching the environment a fair bit. The key is, is not to over-enrich it in a concentrated spot, so much that we throw everything else just totally out balance. But when you think about it, if you provide an extra habitat and protection for other species, then is that not a good thing? If you are living in a place that's sort of… everybody's on the edge anyway?

In some sense this manager turns around often-convincing and well-supported critique of open net-pen farming that focus on the detrimental effects of net-pens on the environment outside of the cage. I do not evaluate the response here. However, it does bring attention to the fact that the spatial net-work and its effects create new biopolitical collectives in relation to the environment they are placed in and part of, both in- and outside the net-pens. These new collectives do life and death in particular ways and raise new questions about what is and what is not valuable life and death, and how these should be valued.

This leads to the focus of this chapter, the formulation of a spatial biopolitics. What can be learnt about the relation between space-making and life-and-death-making at open and relatively uncontrollable production sites of the net-pen, through the case of the creation and maintenance of the 'rearing environment'?

Firstly, life and death are done as part of the making of spaces. By describing the network/net-work in this article, I took seriously Massey's (2005) notion of spaces as "temporary constellations of trajectories" (p. 153). I understand the 'rearing environment' as such a constellation and the network/net-work of holding together as a series of "events" that constantly "require negotiation" (ibid.). The practices of holding – or containing – farmed fish within a 'rearing environment' involve an open-ended network of humans, non-humans, things, and flows that both create and transgress boundaries. Particular versions of this network are attempted to be held together and solidified through techniques and other forms of work. In this way, the 'rearing environment' as a space is constantly in the process of becoming, being made, remade, and made again. Life and death are part of the constellation of trajectories being negotiated. In other words, space, and life and death are done simultaneously. Or understood through Massey's thinking life and death are part of space. Therefore, I argue that the space-making and life-and-death-making are fundamentally intertwined and should be understood together.

Secondly, and leading from the previous lesson, the ordering and valuing of animal lives and deaths is mediated by the creation and maintenance of 'the rearing environment'. It is partly through the network/net-work described in this chapter that life and death are enacted, governed, and valued - hierarchically and otherwise. Biopolitical valuation or zoometrics (Braverman, 2017) and human-animal relations are largely done through the animals' relation to the process of creating and maintaining a space for the production of salmon life, even though they are also situated and textured by other spaces and practices, such as laws about the killing of seals, authorized otter trapping, technologies to keep predators at bay, the labor of site workers during a sea lice treatment, the parasitical relation between sea lice and salmon, and the possibility of human divers in a cage. The idea of spatially mediated biopolitics is an important contribution to the scholarship on biopolitical renderings of animals' lives and deaths that has focused primarily on other elements such as the conservation of (sub-)species, landscapes, and their purity; animals' potential for capitalist extraction and production; the prevention of diseases; and animal welfare.

Third, a focus on spatial biopolitics allows the articulation of the multispecies character of human-animal relations and biopolitical collectives. This adds to calls for more scholarship on multispecies affairs in animal geography, adding to the large scholarship focusing primarily on the relations between human and one other species at a time. In particular, in the context of the biopolitics of production sites – such as agriculture and aquaculture – attention to the spatial aspects of biopolitics can help to broaden attention to not only include the productive relation between humans and one other farmed species, but also the other forms of life and death that exist in and around these sites and are rendered killable, valuable, or go unnoticed. This becomes especially visible at sites such as the cage, that are relatively open and less controllable, and in which "the rearing environment is the environment itself" (Cardia & Lovatelli, 2015, p. 3). The lives and deaths of multiple animals are part of network/net-work, and are acted upon and enacted through it. In the case of challenges by predators and parasites, the space of the net-pens has to be carved out by people working for the aquaculture companies, sometimes quite literally with spears and gaffs. The boundary between the corporate life zone of the cage space and outsiders coming in, is done through monitoring, manipulating, scaring away, dividing, catching, killing, and removing life, often with detrimental environmental consequences in cases of large-scale and mono-species 'production'. This way of approaching production sites can also be applied to more closed and controllable sites, such as salmon hatcheries or land-based industrial livestock production facilities, as animal lives and deaths and other elements from the 'environment itself' are in these sites also folded into the 'rearing environment' (see also Lien, 2015, p. 72), albeit in different ways than in the case of the cage. Even with regards to the cage, there are many more stories that can be told about the spatial biopolitics of the 'rearing environment', for example about the food pellets and where they come from (Changing

Markets Foundation and Compassion in World Farming, 2019), and about salmon that swim out or 'escape' the net-pen (e.g. Lien, 2015, pp. 148–163). Even though, I have not come close at all to describing all forms of animal life and death, and other parts of different environments that are folded into and out of the 'rearing environment' of the net-pen, I did show the potential for the simultaneous study of processes of space-making and life-and-death-making and -valuation. In the context of the net-pen, it enabled me to show that biopolitics in the cage is a multispecies and spatial affair primarily done in relation to the maintenance of a particular version of 'the rearing environment'.

Chapter Four

Conclusion

4.1 Summary

Poststructuralist geographers have argued that space should not be thought of as a closed-off container, and from the work of STS-scholars I have learned that we should not see containment as a hermetic and permanent closing off of a definite space. In my thesis, I set out to further explore what containment then is and what it means to try to contain something. I chose to do so in the context of the salmonid aquaculture sector on the south coast of the island of Newfoundland with my overarching question asking what the production of spaces through containment practices in salmonid aquaculture in Newfoundland teaches us about containment. To answer this, I looked at how containment is done and to what effects in two cases, i.e. 'The Code' and 'the cage'.

In order to do so, I collected a wide range of materials pertaining to different containment practices in salmonid aquaculture. I gathered documents, interviewed informants, and conducted participant observation at the south coast of Newfoundland and at an aquaculture industry conference. Early on it became clear that, the Code of Containment plays an important role in the governance of the risk of escapes in the industry. Newspaper articles from the time of the emergence of The Code, government documents around The Code, its evaluation, and its committee, and stories from interviews and fieldwork helped me to understand what The Code is, how it works, and what it does. Stories about containment in and around the cage emerged primarily through conversations during my fieldwork, interviews with informants, and documents such as newspaper articles and other publications. Based on the different documents, interviews, and field notes I started distinguishing between different ways in which containment was *done* in my materials, while primarily focussing my attention on the practices of 'The Code' and 'the cage'.

In chapter 2, I proposed thinking about containment not only as 'having in it', but also as 'holding together'. I did this through answering the question as to how containment is enacted through the *Code of Containment for the Culture of Salmonids in Newfoundland and Labrador*. I distinguished between and described three modes of doing containment: framing, monitoring, and improving. Effectively monitoring containment turned out to be a fiction, and achieving full containment to be impossible. With the impossibility of these two situations, the improvement of containment became The Code's key goal. This logic of improvement is enacted as a proof of The Code's effectiveness, it is the main mode of engaging with escapes that happen, and it is a way of containing dissent and making The Code immune to actually-occurring escapes. I showed how the three modes bring containment into existence as something that can be thought about, talked about, observed, and governed. At the same time, this enacted containment in its turn brings particular possibilities and impossibilities in the world. For example, I argued that it helps to sustain aquaculture as a multinational, industrial practice in the province. So, The

Code's version of containment not only holds inside salmon, but also helps holding together the world of industrial aquaculture in Newfoundland.

In chapter 3, I formulated a spatial biopolitics in and around the net-pen. Through the case of the creation and maintenance of the 'rearing environment' of farmed fish, I answered the question as to what can be learnt about the relation between space-making and life-and-death-making in open and relatively uncontrollable production sites such as the net-pen. Making the 'rearing environment' consists of an open-ended *network* of humans, non-humans, things, and flows that both create and transgress boundaries. Through *net-work* particular versions of this network are attempted to be solidified by some of the actors. The 'environment itself', however, keeps challenging these solidifications which means that *supplements* need to be constantly added to keep the 'rearing environment' together. Life and death are part of these network and practices of solidification and holding-together, as I showed through the examples of the farmed fish, sea lice, predators, and flows of chemicals leaving the net-pen. Space-making and life-and-death-making are fundamentally intertwined and should be understood together. I argued that the ordering and valuing of animal lives and deaths is mediated by the process of making and maintaining the 'rearing environment', but is also situated within a wider landscape of laws, policies, technologies, and practices. I concluded that the idea of biopolitics as mediated through the creation and maintenance of spaces is an important addition to scholarship on non-human biopolitics that has largely focussed on other aspects mediating biopolitical intervention that center more on the characteristics of the animals in question (but see for example Collard, 2012).

4.2 Lessons

Writing the two chapters enabled me to think through containment in two ways, i.e. as done through a document and as done through net-pens. Reflecting on what the two cases teach me about containment, I formulate three different lessons.

Firstly, the two cases foreground the significant amount of work that goes into bringing about containment. Callon (1998) writes about the conditions required for the existence of economic markets, and describes how particular overflows need to be framed (i.e.: measured and contained) in order for markets and transactions to be possible. He argues that in constructivist sociology – akin to the poststructuralist geography and ANT-approaches I draw from – "the view [is] that overflowing is the rule; that framing – when present at all – is a rare and expensive outcome; in short, is very costly to set up" (p. 252). He also emphasizes "the size of the investments required to frame interactions and contain overflows" (p. 248), and finally argues that

> [b]y focusing on the omnipresence of overflows, on their usefulness, but also on the cost of actions intended (partially) to contain them, constructivist sociology highlights the importance of the operations required to identify and measure these overflows. It also encourages us to question the mechanisms used to create frames by suggesting ways in which the social sciences might help to develop or to confine such spaces of calculability. (p. 256)

The cases in my thesis are full of examples of the costly and laborious operations that go into containing overflows that are identified and deemed relevant. In opening up some of these operations, I contribute to Callon's call for questioning framing (or containment) mechanisms (e.g. The Code and the life-and-death-making). Furthermore, this questioning involves thinking about for whom or what these mechanisms are costly, what the consequences and effect are, and who and what reaps the benefits and who bears the harms and disadvantages. In order to answer such questions, it is helpful to look at the ways in which containment is enacted and what kinds of realities are generated along the way.

The second lesson relates to the ways of existence of containment. The two chapters show different ways in which containment is made to exist. Even though in both cases the existences of containment are both material and discursive and full of meaning, contrasting The Code and the cage does show us some interesting differences. In the case of The Code the way containment exists, seems close to what Felt (2016) describes as the imaginations that are attached to spatial practices that were used after Fukushima Daiichi nuclear disaster in Japan (p. 55). She investigates "how diverse actors began to design and implement a range of techno-social interventions to re-envision and sustain a continued imagination of control and containment" (p. 52). In the case of The Code, certain interventions – both technical and social – also created a certain imagined containment which in turn helps keeping the aquaculture industry hang together. In contrast, the way containment exists as articulated in chapter 3, is less about imagination, but makes itself felt in the flesh of animals and the way animal lives and deaths, and other parts of the environment are valuated. Furthermore, in the case of The Code the goal is to bring into the world a sense of 'this-is-contained-enough', whereas in the case of the net-pen the goal is primarily focused on the ongoing production of salmon-as-commodities. So, whereas containment seems to be a goal in the case of The Code, it seems to be more of a means in the case of the cage. The nuances of the ways in which containment is made to be, are important in understanding what it is to do containment.

The last lesson I learned through my research project is that containment is a "particular and complex reality generating practice" (Hawkins & Paxton, 2019, p. 1012). Describing a certain fence used in a conservation project in Australia, Hawkins and Paxton (2019) argue that "[t]he act of containing doesn't simply enclose a space, it triggers and simulates something new" (p. 1026). In other words, containment practices generate realities. These realities are not neutral. Similar to my argument about life and death in and around the net-pen, Hawkins and Paxton show that "the fence is not simply a neutral reality generating device, but it is also a biopolitical intervention that is securing some life and not others" (p. 1026). The stakes are high in containment practices: they can involve animal lives and deaths, industrial development, or for example the livelihoods of people (cf. Bavington, 2010, p. 105). Through The Code, government and industry sanction a certain version of containment, but with that also contribute to sanctioning and strengthening the assumption that industrial aquaculture is something good that has to be developed on the south coast of Newfoundland in a particular way. And, through the making of the 'rearing environment', certain kinds of desired and undesired forms of life and death are realized and valuated. In other words, containment practices do not just neutrally enclose things, but participate in the making and breaking of worlds. Through seeing containment as holding together (chapter 2) and as a location of the valuation of life and death (chapter 3), I contribute to formulating some of the non-neutral ways in which containment practices play a role in this process of generating realities.

4.3 Concluding thoughts

Over the course of this research project a number of other concerns and potentially productive venues of research came up. I will share three of them. Firstly, concerns around containment often seem to be connected to thinking about improvement. Governments, industries, and other organizations – including some of the opponents of open net-pen aquaculture – often seem to present the good of containment to the 'public' as closure. Good containment is closed containment. With Caitlynn Beckett and Alex Zahara, I have argued that this can lead to a situation of "technological comfort, an easing of controversies around the system that the containment practices are part of" (Schoot, Beckett, & Zahara, 2019). The closed comfort of containment goes hand in hand with a logic of improvement, and a seemingly self-evident direction of development. Many enactments of containment seem to embody a continuing movement of closing and containing, which should be constantly attempted to be improved, such as in The Code. This fantastical gesture of spatial closure as an unquestioned good and something that should be improved, opens up certain trajectories while closing off others. The movement of improving containment often seems to 'cool down' controversies. This couplet of containment and improvement is worthy of further research within geography and STS.

Secondly, through approaching animal 'production' sites as sites of containment and spatial production (chapter 3), I suggested possible ways for more research on the multispecies character of these sites. Paying more attention to the production of space at these sites through containment and other practices, can help animal geography to go beyond the focus on the productive relation between humans and one other farmed species at a time, and include the many other forms of life and death that exist in and around these sites. This would contribute to exploring what kinds of "new natures" are "provoked" (Hawkins & Paxton, 2019) on farms, how they are provoked, and what kinds of relations come into play in this. Furthermore, it would enable animal geographers to approach space-making as playing a more active role in the making and unmaking of animal relations and valuations.

Thirdly, at various places throughout my thesis I have implicitly hinted at the existence of the 'other spaces' of containment. Spaces that the enacted containment – leaking or not – depends upon, connects to, is separated from, or otherwise has effects on. For example, in chapter 3 I talked about the backgrounded construction of the sea as a dump for pesticides and sea lice. Also, the workers, oxygen, feed pellets, salmon eggs need to come from somewhere. And, the particular way of doing containment has implications for the kind of space that the marine and coastal environment is for both human and non-human animals. Further research could productively focus on the material-semiotic production of these ‘other spaces’ of containment: how do policies, legislation, and technologies enact the ocean as a dump; how do the enacted enclosures connect to other places and marine livelihoods; what role do those enclosures play within the political economy of producing salmon fillets; and how is ‘closed containment’ aquaculture positioned as the ultimate good versus open net-pens as the ultimate bad? More widely speaking, this research could draw from research in political ecology and various other areas of critical scholarship, to answer questions that ask how ‘contained’ spaces are connected to and disconnected from other spaces; how those spaces are opened up and closed off from their others; and, how they depend on and affect their others? This would lead to even more situated descriptions of containment-in-practice.

In this thesis, I have shown two contrasting ways of doing containment in salmonid aquaculture in Newfoundland. Through The Code I learned how containment is brought into existence through different modes, which in turn helped to hold together the aquaculture industry. Through the cage I explored a spatial biopolitics connected to making contained spaces such as ‘the rearing’ environment, and I learned how life, death, and space are done together. In both cases the stakes are high for some actors: the maintenance and expansion of industrial aquaculture, the profitable production of farmed fish, people’s livelihoods, and the lives and deaths of animals in and around the net-pen. The effects of particular ways of containment can be big, they are reality-generating and have uneven effects. Furthermore, containment does not just exist out there, but needs to be brought into existence – materially and discursively – and is done, undone, and done again in different practices. By opening up containment in this way – as something that is always being done, but never a done deal – I contribute to starting to imagine how these practices can be done differently, to make spaces that are better and practices that are more democratic and less harmful. In the end, the ultimate question might be: what kinds of worlds do we want containment practices to hold together?

Bibliography

Anderson, B. (2008). For Space (2005): Doreen Massey. In P. Hubbard, R. Kitchin, & G. Valentine (Eds.), *Key Texts in Human Geography* (pp. 227–235). Thousand Oaks, CA: SAGE Publications.

Anderson, J. M. (2007). *The Salmon Connection: The Development of Atlantic Salmon Aquaculture in Canada*. Glen Margaret, NS: Glen Margaret Publishing.

Asche, F., & Bjorndal, T. (2011). *The Economics of Salmon Aquaculture*. Hoboken, NJ: John Wiley & Sons.

Asdal, K. (2015). What is the issue? The transformative capacity of documents. *Distinktion: Journal of Social Theory*, *16*(1), 74–90.

Asdal, K., Druglitrø, T., & Hinchliffe, S. (Eds.). (2017). *Humans, Animals and Biopolitics: The More-than-human Condition*. London and New York, NY: Routledge.

Atlantic Salmon Federation. (n.d.a). ASF and Land-based Closed-containment Aquaculture. Retrieved October 23, 2019, from Atlantic Salmon Federation website: http://oldsalmon3.ca/asf-and-land-based-closed-containment-aquaculture.html.

Atlantic Salmon Federation. (n.d.b). Atlantic Salmon Federation. Retrieved October 19, 2019, from Atlantic Salmon Federation website: https://www.asf.ca.

Barry, G. (2019, October 2). Pink liquid flows in Fortune Bay as cleanup of massive salmon die-off continues. *CBC News*. Retrieved from CBC News website: https://www.cbc.ca/news/canada/newfoundland-labrador/fortune-bay-cleanup-1.5305994.

Barry, T. K., & VanderZwaag, D. L. (2007). Preventing Salmon Escapes from Aquaculture in Canada and the USA: Limited International Coordinates, Divergent Regulatory Currents and Possible Future Courses. *Review of European Community & International Environmental Law*, *16*(1), 58–75.

Bavington, D. (2010). *Managed Annihilation: An Unnatural History of the Newfoundland Cod Collapse*. Vancouver, BC: UBC press.

Beckett, C., & Keeling, A. (2019). Rethinking remediation: Mine reclamation, environmental justice, and relations of care. *Local Environment*, *24*(3), 216–230.

Biermann, C., & Anderson, R. M. (2017). Conservation, biopolitics, and the governance of life and death. *Geography Compass*, *11*(10), online.

Biermann, C., & Mansfield, B. (2014). Biodiversity, Purity, and Death: Conservation Biology as Biopolitics. *Environment and Planning D: Society and Space*, *32*(2), 257–273.

BioMar. (n.d.). Tri-X: Special feed for triploid salmon. Retrieved October 23, 2019, from BioMar website: https://www.biomar.com/en/uk/articles/products/choose-right-species/tri-x--special-feed-for-triploid-salmon/.

Bolla, A. K., & Hovorka, A. J. (2012). Placing Wild Animals in Botswana: Engaging Geography's Transspecies Spatial Theory. *HUMaNIMALIA*, *3*(2), 56–82.

Braverman, I. (2015a). *Animals, Biopolitics, Law: Lively Legalities*. London and New York, NY: Routledge.

Braverman, I. (2015b). *Wild Life: The Institution of Nature*. Palo Alto, CA: Stanford University Press.

Braverman, I. (2017). Captive: Zoometric Operations in Gaza. *Public Culture*, *29*(1 (81)), 191–215.

Britten, L. (2018, March 2). Washington state senate bans Atlantic salmon farming in state waters. *CBC News*. Retrieved from CBC News website: https://www.cbc.ca/news/canada/british-columbia/washington-state-fish-farms-salmon-farming-1.4560888.

Brown, W. (2010). *Walled States, Waning Sovereignty*. New York, NY: Zone Books.

Bryman, A. (2012). *Social Research Methods* (4th ed). Oxford: Oxford University Press.

Buller, H. (2008). Safe from the Wolf: Biosecurity, Biodiversity, and Competing Philosophies of Nature. *Environment and Planning A: Economy and Space*, *40*(7), 1583–1597.

Buller, H. (2015). Animal geographies II: Methods. *Progress in Human Geography*, *39*(3), 374–384.

Callon, M. (1998). An essay on framing and overflowing: Economic externalities revisited by sociology. *The Sociological Review*, *46*(S1), 244–269.

Cameron, S. D., & Beckett, C. (2012). *Salmon Wars: Aquaculture, Wild Fish and the Future of Communities*. Retrieved from Youtube: https://www.youtube.com/watch?v=NIPcgfJocRo.

Cardia, F., & Lovatelli, A. (2015). *Aquaculture Operations in Floating HDPE Cages: A Field Handbook* (No. 593; p. 176). Rome: Food and Agriculture Organization of the United Nations and Ministry of Agriculture of the Kingdom of Saudi Arabia.

CBC News. (2013a, May 16). Escaped farmed salmon could cause problems, council warns. *CBC News*. Retrieved from CBC News website: https://www.cbc.ca/news/canada/newfoundland-labrador/escaped-farmed-salmon-could-cause-problems-council-warns-1.1317724.

CBC News. (2013b, September 25). Thousands of salmon escape fish farm on south coast. *CBC News*. Retrieved from CBC News website: http://www.cbc.ca/news/canada/newfoundland-labrador/thousands-of-salmon-escape-fish-farm-on-south-coast-1.1868312.

CBC News. (2019a, September 24). Northern Harvest's failure to report die-off in salmon pens hurts public trust: Byrne. *CBC News*. Retrieved from CBC News website: https://www.cbc.ca/news/canada/newfoundland-labrador/salmon-aquaculture-environment-climate-change-death-1.5295014.

CBC News. (2019b, September 26). Harbour Breton fish plant workers concerned for the future after Northern Harvest fish die-off. *CBC News*. Retrieved from CBC News website: https://www.cbc.ca/news/canada/newfoundland-labrador/plant-workers-without-work-harbour-breton-1.5297255.

CBC News. (2019c, October 10). Licences yanked for troubled N.L. salmon farm amid revelation of 2.6M dead fish. *CBC News*. Retrieved from CBC News website: https://www.cbc.ca/news/canada/newfoundland-labrador/government-aquaculture-act-changes-1.5316940.

Changing Market Foundation and Compassion in World Farming. (2019). *Until the Seas Run Dry: How industrial aquaculture is plundering the oceans.* Retrieved from Changing Markets website: http://changingmarkets.org/wp-content/uploads/2019/04/REPORT-WEB-UNTILL-THE-SEAS-DRY.pdf.

Collard, R.-C. (2012). Cougar-Human Entanglements and the Biopolitical Un/Making of Safe Space. *Environment and Planning D: Society and Space*, *30*(1), 23–42.

Couturier, C., & Rideout, K. (2018). Sustainable Aquaculture Production. In C. Keske (Ed.), *Food Futures: Growing a Sustainable Food System in Newfoundland and Labrador* (pp. 303–346). St. John's, NL: ISER Books.

De Sousa, A. (2018, October 8). Salmon farmers are scanning fish faces to fight killer lice. *Bloomberg Businessweek*. Retrieved from Bloomberg website: https://www.bloomberg.com/news/features/2018-10-08/salmon-farmers-are-scanning-fish-faces-to-fight-killer-lice.

Despret, V. (2016). *What Would Animals Say If We Asked the Right Questions?* Minneapolis, MN: University of Minnesota Press.

Donnet, S., Ratsimandresy, A. W., Goulet, P., Doody, C., Burke, S., & Cross, S. (2017). *Coast of Bays Metrics: Geography, Hydrology and Physical Oceanography of an Aquaculture Area of the South Coast of Newfoundland*. St. John's, NL: Fisheries and Oceans Canada, Science Branch.

Douny, L. (2011). The role of earth shrines in the socio-symbolic construction of the Dogon territory: Towards a philosophy of containment. *Anthropology & Medicine*, *18*(2), 167–179.

Dutkiewicz, J. (2015). Important Cows and Possum Pests: New Zealand's Biodiversity Strategy and (Bio)Political Taxonomies of Introduced Species. *Society & Animals*, *23*(4), 379–399.

Editors. (2018, November 2). Marine Harvest charged over massive escape in Chile. Retrieved March 15, 2019, from FishFarmingExpert website: https://www.fishfarmingexpert.com/article/marine-harvest-charged-over-massive-escape-in-chile/.

Editors. (2019, June 3). Shock and orca: Mowi uses fake whale to scare seals. Retrieved October 23, 2019, from FishFarmingExpert website: https://www.fishfarmingexpert.com/article/shock-and-orca-mowi-uses-fake-whale-to-scare-seals/.

Edwards, P. N. (1996). *The Closed World: Computers and the Politics of Discourse in Cold War America*. Cambridge, MA: The MIT Press.

Evans, O. (2018a, July 9). “Significant” escape from Marine Harvest Chile site after fierce storm. *Salmon Business*. Retrieved from Salmon Business website: http://salmonbusiness.com/significant-escape-from-marine-harvest-chile-site-after-fierce-storm/.

Evans, O. (2018b, July 13). Marine Harvest Chile given 30 days to recover escaped fish. *SalmonBusiness*. Retrieved from Salmon Business website: http://salmonbusiness.com/marine-harvest-chile-given-30-days-to-recover-escaped-fish/.

Felt, U. (2017). Living a Real-World Experiment: Post-Fukushima Imaginaries and Spatial Practices of “Containing the Nuclear”. In I. van de Poel, L. Asveld, & D. Mehos (Eds.), *New Perspectives on Technology in Society: Experimentation Beyond the Laboratory: New Perspectives on Technology in Society* (pp. 49-78). London: Routledge.

Few, R. (2001). Containment and Counter-Containment: Planner/Community Relations in Conservation Planning. *The Geographical Journal*, *167*(2), 111–124.

Fisheries and Oceans Canada. (2014, September 9). Closed containment. Retrieved October 23, 2019, from Fisheries and Oceans Canada website: https://www.dfo-mpo.gc.ca/aquaculture/programs-programmes/containment-eng.htm.

Fisheries and Oceans Canada. (2016, July 6). Aquaculture in the Coast of Bays region, Newfoundland and Labrador. Retrieved October 19, 2019, from Fisheries and

Oceans Canada website: http://www.dfo-mpo.gc.ca/aquaculture/ref/coast/coast-cote-eng.htm.

Fisheries and Oceans Canada (2019, November 22). Fisheries and Oceans Canada. Retrieved November 24, 2019, from Fisheries and Oceans Canada website: http://www.dfo-mpo.gc.ca/index-eng.htm.

Flatt, C., & Ryan, J. (2017, August 24). “Environmental Nightmare” After Thousands Of Atlantic Salmon Escape Fish Farm. *NPR*. Retrieved from NPR website: https://www.npr.org/sections/thesalt/2017/08/24/545619525/environmental-nightmare-after-thousands-of-atlantic-salmon-escape-fish-farm.

Fredriksen, A. (2016). Of wildcats and wild cats: Troubling species-based conservation in the Anthropocene. *Environment and Planning D: Society and Space*, *34*(4), 689–705.

Gibbs, L. (2018). Shores: Sharks, Nets and More-Than-Human Territory in Eastern Australia. In K. Peters, P. Steinberg, & E. Stratford (Eds.), *Territory Beyond Terra* (pp. 203–219). London: Rowan & Littlefield International.

Gibbs, L. (2019). Animal geographies I: Hearing the cry and extending beyond. *Progress in Human Geography*, *online*.

Gillespie, K. A. (2014). *Reproducing Dairy: Embodied Animals and the Institution of Animal Agriculture*. (PhD Dissertation, University of Washington, Seattle, WA).

Ginn, F. (2008). Extension, subversion, containment: Eco-nationalism and (post)colonial nature in Aotearoa New Zealand. *Transactions of the Institute of British Geographers*, *33*(3), 335–353.

Glover, K. A., Solberg, M. F., McGinnity, P., Hindar, K., Verspoor, E., Coulson, M. W., … Svåsand, T. (2017). Half a century of genetic interaction between farmed and wild Atlantic salmon: Status of knowledge and unanswered questions. *Fish and Fisheries*, *18*(5), 890–927.

Gray-Cosgrove, C., Liboiron, M., & Lepawsky, J. (2015). The Challenges of Temporality to Depollution & Remediation. *SAPI EN. S. Surveys and Perspectives Integrating Environment and Society*, *8*(1).

Hansen, L. P., & Windsor, M. (2006). *Interactions between aquaculture and wild stocks of atlantic salmon and other diadromous fish species: Science and management, challenges and solutions* (No. 34). Trondheim: Norwegian Institute for Nature Research.

Haraway, D. (2008). *When species meet*. Minneapolis, MN: University of Minnesota Press.

Hawkins, G., & Paxton, G. (2019). Infrastructures of conservation: Provoking new natures with predator fencing. *Environment and Planning E: Nature and Space*, *2*(4), 1009–1028.

Haya, K., Burridge, L. E., & Chang, B. D. (2001). Environmental impact of chemical wastes produced by the salmon aquaculture industry. *ICES Journal of Marine Science*, *58*(2), 492–496.

Hinchliffe, S. (2010). Where Species Meet. *Environment and Planning D: Society and Space*, *28*(1), 34–35.

Hinchliffe, S. (2015). More than one world, more than one health: Re-configuring interspecies health. *Social Science & Medicine*, *129*, 28–35.

Hinchliffe, S., Allen, J., Lavau, S., Bingham, N., & Carter, S. (2013). Biosecurity and the topologies of infected life: From borderlines to borderlands. *Transactions of the Institute of British Geographers*, *38*(4), 531–543.

Hinchliffe, S., & Bingham, N. (2008). Securing Life: The Emerging Practices of Biosecurity. *Environment and Planning A: Economy and Space*, *40*(7), 1534–1551.

Hird, M. J., & Zahara, A. (2017). The Arctic Wastes. In R. A. Grusin (Ed.), *Anthropocene feminism* (pp. 121–145). Minneapolis, MN: University of Minnesota Press.

Ho, M.-S., & Su, F.-S. (2008). Control by Containment: The Politics of Institutionalizing Pollution Disputes in Taiwan. *Environment and Planning A: Economy and Space*, *40*(10), 2402–2418.

Holloway, L., Morris, C., Gilna, B., & Gibbs, D. (2009). Biopower, genetics and livestock breeding: (Re)constituting animal populations and heterogeneous biosocial collectivities. *Transactions of the Institute of British Geographers*, *34*(3), 394–407.

Hovorka, A. J. (2019). Animal geographies III: Species relations of power. *Progress in Human Geography*, *43*(4), 749–757.

Hunt, C. (2006, June 18). Minister predicts region will be “aquaculture capital”. Awareness session brings together industry stakeholders, communities. *The Coaster*, p. 1.

Jasanoff, S., & Kim, S.-H. (2009). Containing the Atom: Sociotechnical Imaginaries and Nuclear Power in the United States and South Korea. *Minerva*, *47*(2), 119–146.

Jones, M. (2018, August 21). Grieg to use ‘escape-proof’ net cages for Newfoundland project. Retrieved October 23, 2019, from Aquaculture North America website: https://www.aquaculturenorthamerica.com/grieg-to-use-escape-proof-net-cages-for-newfoundland-project-2024/.

Kemper, C. M., Pemberton, D., Cawthorn, M., Heinrich, S., Mann, J., Würsig, B., … Gales, R. (2003). Aquaculture and Marine Mammals: Co-existence or Conflict? In N. Gales, M. Hindell, & R. Kirkwood (Eds.), *Marine Mammals: Fisheries, Tourism and Management Issues* (pp. 208–225). Melbourne: CSIRO.

Kinsella, W. J. (2001). Nuclear Boundaries: Material and Discursive Containment at the Hanford Nuclear Reservation. *Science as Culture*, *10*(2), 163–194.

Latour, B. (2005). *Reassembling the social: An introduction to actor-network-theory*. Oxford and New York, NY: Oxford University Press.

Law, J. (2017). STS as Method. In U. Felt, R. Fouché, C. A. Miller, & L. Smith-Doerr (Eds.), *The Handbook of Science and Technology Studies* (pp. 31-58). Cambridge, MA: MIT Press.

Lezaun, J., Muniesa, F., & Vikkelsø, S. (2013). Provocative Containment and the Drift of Social-scientific Realism. *Journal of Cultural Economy*, *6*(3), 278–293.

Li, T. M. (2007). *The Will to Improve*. Durham, NC and London: Duke University Press.

Liboiron, M., Tironi, M., & Calvillo, N. (2018). Toxic politics: Acting in a permanently polluted world. *Social Studies of Science*, *48*(3), 331–349.

Lien, M. E. (2015). *Becoming Salmon: Aquaculture and the Domestication of a Fish*. Berkeley, CA: University of California Press.

Lien, M. E., & Law, J. (2016). The Salmon Domus as a Site of Mediation. In K. Bjørkdahl & T. Druglitrø (Eds.), *Animal Housing and Human–Animal Relations: Politics, Practices and Infrastructures* (pp. 15–28). London and New York, NY: Routledge.

Lorimer, J., & Driessen, C. (2013). Bovine biopolitics and the promise of monsters in the rewilding of Heck cattle. *Geoforum*, *48*, 249–259.

Lorimer, J., Hodgetts, T., & Barua, M. (2019). Animals' atmospheres. *Progress in Human Geography*, *43*(1), 26–45.

Maher, D. (2019, October 11). 2.6 million farmed salmon dead on south coast of Newfoundland, company says. *The Telegram*. Retrieved from Telegram website:

https://www.thetelegram.com/news/local/26-million-farmed-salmon-dead-on-south-coast-of-newfoundland-company-says-363123/.

Mapes, L. V. (2018, January 30). Fish farm caused Atlantic salmon spill near San Juans, then tried to hide how bad it was, state says. *The Seattle Times*. Retrieved from Seattle Times website: https://www.seattletimes.com/seattle-news/fish-farm-caused-atlantic-salmon-spill-state-says-then-tried-to-hide-how-bad-it-was/.

Massey, D. (2005). *For Space*. Thousand Oaks, CA: SAGE.

Mayblin, M. (2017). Containment and Contagion: The Gender of Sin in Contemporary Catholicism. In K. Norget, V. Napolitano, & M. Mayblin (Eds.), *Anthropology of Catholicism* (pp. 139–154). Berkeley, CA: University of California Press.

McPhail, C. (2018, January 17). Salmon escape leads Cooke into legal fight with Washington state. *CBC News*. Retrieved from CBC News website: https://www.cbc.ca/news/canada/new-brunswick/cooke-aquaculture-washington-salmon-escape-1.4490171.

McTague, C., & Wright, B. (2010). Day labor halls as spaces of containment and control. *Dialectical Anthropology*, *34*(4), 539–544.

Milewski, I. (2001). *Impacts of Salmon Aquaculture on the Coastal Environment: A Review*. Retrieved from Conservation Council of New Brunswick website: https://www.iatp.org/sites/default/files/Impacts_of_Salmon_Aquaculture_on_the_Coastal_E.pdf.

Morton, A. (2015). *Salmon Confidential: The ugly truth about Canada's open-net salmon farms*. Retrieved from Alexandra Morton website: http://www.alexandramorton.ca/salmon-confidential-booklet/.

Mountz, A., Coddington, K., Catania, R. T., & Loyd, J. M. (2013). Conceptualizing detention: Mobility, containment, bordering, and exclusion. *Progress in Human Geography*, *37*(4), 522–541.

Nading, A. M. (2017). Local Biologies, Leaky Things, and the Chemical Infrastructure of Global Health. *Medical Anthropology*, *36*(2), 141–156.

Nagy, K., & Johnson (II), P. D. (2013). *Trash Animals: How We Live with Nature's Filthy, Feral, Invasive, and Unwanted Species*. Minneapolis, MN: University of Minnesota Press.

Navarro, L. (2018, July 31). Here are the largest recorded farmed Atlantic salmon escapes in history. *IntraFish*. Retrieved from IntraFish website: http://www.intrafish.com/aquaculture/1543294/here-are-the-largest-recorded-farmed-atlantic-salmon-escapes-in-history.

Newfoundland and Labrador. (1996). *Initiatives announced to develop and expand aquaculture in province* [News Release]. Retrieved from Department of Fisheries and Aquaculture, Aquaculture Division website: https://www.releases.gov.nl.ca/releases/1996/exec/0205n02.htm.

Newfoundland and Labrador. (1998). *The 1997 Newfoundland & Labrador Seafood Industry—Year in Review*. St. Johns, NL: Department of Fisheries and Aquaculture.

Newfoundland and Labrador. (2014). *Economic Impacts of the Newfoundland and Labrador Aquaculture Industry*. Retrieved from Department of Fisheries and Aquaculture, Aquaculture Division website: https://www.fishaq.gov.nl.ca/publications/pdf/Aquaculture_Macro_FINAL.pdf.

Newfoundland and Labrador. (2017). *Achieving a More Efficient Public Sector*. Retrieved from Newfoundland and Labrador Government website: https://www.releases.gov.nl.ca/releases/2017/exec/0222n03.aspx

Newfoundland and Labrador. (2018). *Seafood Industry Year in Review 2017*. St. John's, NL: Department of Fisheries and Land Resources.

Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch. (n.d.). *Code of Containment Aquaculture Liaison Committee (CoCALC): Terms of Reference. DOC-01563*. Department of Fisheries and Aquaculture, Aquaculture Division.

Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch. (2012). *Annual Compliance Report—2011 on the Code of Containment for the Culture of Salmonids in Newfoundland and Labrador*. St. John's, NL: Department of Fisheries and Aquaculture, Aquaculture Division.

Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch. (2014a). *Annual Compliance Report—2013 on the Code of Containment for the Culture of Salmonids in Newfoundland and Labrador*. St. John's, NL: Department of Fisheries and Aquaculture, Aquaculture Division.

Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch. (2014b, March). *Code of Containment for the Culture of Salmonids in Newfoundland and Labrador*. Retrieved from Department of Fisheries and Aquaculture website: http://www.fishaq.gov.nl.ca/aquaculture/public_reporting/pdf/Salmonid%20Code%20of%20Containment%202014.pdf.

Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch. (2016a). *Annual Compliance Report—2015 on the Code of Containment for the Culture of Salmonids in Newfoundland and Labrador*. St. John's, NL: Department of Fisheries and Aquaculture, Aquaculture Division.

Newfoundland and Labrador, Department of Fisheries and Aquaculture, Aquaculture Branch. (2016b). *Code of Containment Liaison Committee Meeting Minutes. April 26/16. DFA Boardroom. St. Albans's.*

Newfoundland and Labrador, & Newfoundland Aquaculture Industry Association. (2017). *The Way Forward on Aquaculture: Sector Work Plan*. Retrieved from Department of Fisheries and Land Resources website: http://www.flr.gov.nl.ca/aquaculturesummit/

Novek, J. (2005). Pigs and People: Sociological Perspectives on the Discipline of Nonhuman Animals in Intensive Confinement. *Society & Animals*, *13*(3), 221–244.

OED Online. (2019). Contain, v. In *OED Online*. Retrieved from OED website: https://www-oed-com.qe2a-proxy.mun.ca/view/Entry/40041?redirectedFrom=contain#eid.

Parsons, L. (2019, August 29). Beyond Containment: Toxic Justice and Space-Time Violence in the Ruhr. Retrieved October 22, 2019, from Toxic News website: https://toxicnews.org/2019/08/29/beyond-containment-toxic-justice-and-space-time-violence-in-the-ruhr/.

Philo, C. (1995). Animals, Geography, and the City: Notes on Inclusions and Exclusions. *Environment and Planning D: Society and Space*, *13*(6), 655–681.

Philo, C., & Wilbert, C. (2000). *Animal Spaces, Beastly Places: New Geographies of Human-Animal Relations.* London and New York, NY: Routledge.

Philo, C., & Wolch, J. (1998). Through the Geographical Looking Glass: Space, Place, and Society-Animal Relations. *Society & Animals*, *6*(2), 103–118.

Pieper, M. A. (2012). Containment and the Cold War: Reexaming the Doctrine of Containment as a Grand Strategy Driving US Cold War Interventions. *Inquiries Journal/Student Pulse*, *4*(8).

Pinfold, G. (2013). *Socio-Economic Impact of Aquaculture in Canada 2013 Edition*. Halifax, NS; Sackville, NB; Sechelt, BC: Gardner Pinfold Consultants Inc.

Pinfold, G. (2016). *An International Regulatory Review to Support Consistent and Improved Management of the Impacts of Sea Cage Salmon Aquaculture*. Halifax, NS; Sackville, NB; Sechelt, BC: Gardner Pinfold Consultants Inc.

Purser, J., & Forteath, N. (2012). Salmonids. In J. S. Lucas & P. C. Southgate (Eds.), *Aquaculture: Farming aquatic animals and plants* (pp. 313–337). Oxford: Wiley-Blackwell.

Quinn, M. (2016, September 21). DFO study confirms "widespread" mating of farmed, wild salmon in N.L. *CBC News*. Retrieved from CBC News website: http://www.cbc.ca/news/canada/newfoundland-labrador/farmed-salmon-mating-with-wild-in-nl-dfo-study-1.3770864.

Quinn, M. (2018, June 15). Interview with Bendik Slyngstad. In *The Broadcast*. CBC.

Redmalm, D. (2019). To Make Pets Live, and To Let Them Die: The Biopolitics of Pet Keeping. In T. Holmberg, A. Jonsson, & F. Palm (Eds.), *Death Matters: Cultural Sociology of Mortal Life* (pp. 241–263). Cham: Springer International Publishing.

Reuters. (2018, August 7). Chile accuses fishery of damaging environment after 600,000 salmon injected with antibiotics escape. *The Straits Times*. Retrieved from Strait Times website: https://www.straitstimes.com/world/americas/chile-accuses-fishery-of-damaging-environment-after-600000-salmon-injected-with.

Rideout, K. (2006). *The ecological and genetic impacts of escaped farmed salmon on wild salmon with recommended management measures for southern*

Newfoundland (Masters, Memorial University of Newfoundland). Retrieved from http://research.library.mun.ca/11341/.

Rigby, B., Davis, R., Bavington, D., & Baird, C. (2017). Industrial aquaculture and the politics of resignation. *Marine Policy*, *80*, 19–27.

Riise, O. J. S. (2019, August 29). Massive bluefin tuna found in Norwegian salmon farm. *IntraFish*. Retrieved from IntraFish website: https://www.intrafish.com/aquaculture/1843526/massive-bluefin-tuna-found-in-norwegian-salmon-farm.

Roberts, T. (2019a, September 25). Aquaculture conference overshadowed by fish die-off, bickering. *CBC News*. Retrieved from CBC News website: https://www.cbc.ca/news/canada/newfoundland-labrador/aquaculture-bickering-salmon-1.5296822.

Roberts, T. (2019b, October 17). Northern Harvest aquaculture expansion needs more scrutiny, says salmon federation. *CBC News*. Retrieved from CBC News website https://www.cbc.ca/news/canada/newfoundland-labrador/salmon-expansion-mowi-1.5324187.

Rogers, A., Castree, N., & Kitchin, R. (2013a). Animal geographies. In *A Dictionary of Human Geography*. Retrieved from Oxford Reference website: https://www.oxfordreference.com/view/10.1093/acref/9780199599868.001.0001/acref-9780199599868-e-59?rskey=MnKBKv&result=1.

Rogers, A., Castree, N., & Kitchin, R. (2013b). Participant observation. In *A Dictionary of Human Geography*. Retrieved from Oxford Reference website: https://www.oxfordreference.com/view/10.1093/acref/9780199599868.001.0001/acref-9780199599868-e-1364?rskey=MtcnmV&result=1.

Rutherford, P., & Rutherford, S. (2013). The Confusions and Exuberances of Biopolitics: Confusions and Exuberances. *Geography Compass*, *7*(6), 412–422.

Schoot, I., Beckett, C., & Zahara, A. (2019, September). Containment as the Material-Discursive Organization of Flows: Three Cases of Environmental Management in Canada. In I. Schoot, C. Beckett, & A. Zahara (Chairs), *4S*. Conference conducted at the meeting of the Society for the Social Studies of Science, New Orleans.

Shildrick, M. (1997). *Leaky Bodies and Boundaries: Feminism, Postmodernism and (Bio)ethics*. Boca Reton, FL: CRC Press.

Shukin, N. (2009). *Animal capital: Rendering life in biopolitical times*. Minneapolis, MN: University of Minnesota Press.

Silver, J. J. (2013). Neoliberalizing coastal space and subjects: On shellfish aquaculture projections, interventions and outcomes in British Columbia, Canada. *Journal of Rural Studies*, *32*, 430–438.

Simms, G. (2017, August 17). Interview with Mark Lane. In *The Broadcast*. CBC.

Sofia, Z. (2000). Container Technologies. *Hypatia*, *15*(2), 181–201.

SouthCoaster. (2018, July 11). Greenpeace calls escape of 900,000 farmed salmon in Chile a “serious environmental disaster". Retrieved August 22, 2018, from

Responsible Aquaculture website: https://responsibleaquaculture.wordpress.com/2018/07/11/greenpeace-and-escape-of-800000-farmed-salmon-loaded-with-antibiotics-it-is-a-serious-environmental-disaster/.

Srinivasan, K. (2013). The biopolitics of animal being and welfare: Dog control and care in the UK and India. *Transactions of the Institute of British Geographers*, *38*(1), 106–119.

Statistics Canada. (2017, February 8). *Census Profile, 2016 Census*. Retrieved from Statistics Canada website: https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E.

Strowbridge, L. (1990, July 8). Shifting ice, joyriding mink confound managers of Bay d'Espoir trout farm. *Evening Telegram*.

The Associated Press. (2018, February 4). Washington State cancels lease at site of salmon net-pen collapse. *CBC News*. Retrieved from CBC News website: http://www.cbc.ca/news/canada/british-columbia/washington-state-cancels-lease-cooke-aquaculture-pacific-1.4519717.

The Canadian Press. (2017, August 27). Washington state puts moratorium on new fish farms after salmon escape. *CBC News*. Retrieved from CBC News website: http://www.cbc.ca/news/canada/british-columbia/washington-state-puts-moratorium-on-new-fish-farms-after-salmon-escape-1.4264342.

Thorstad, E. B., & Finstad, B. (2018). *Impacts of salmon lice emanating from salmon farms on wild Atlantic salmon and sea trout* (No. 1449). Trondheim: Norwegian Institute for Nature Research.

Tironi, M., & Farías, I. (2015). Building a park, immunising life: Environmental management and radical asymmetry. *Geoforum*, *66*, 167–175.

Tobin, S. (2018, August 7). Salmon escaped from Cooke Aquaculture farm, company confirms. *CBC News*. Retrieved from CBC News website: https://www.cbc.ca/news/canada/newfoundland-labrador/salmon-escape-cooke-1.4776073.

Treviño, J. (2018, March 28). Why Washington State Is Phasing Out Atlantic Salmon Farming. *Smithsonian*. Retrieved from Smithsonian website: https://www.smithsonianmag.com/smart-news/washington-state-bans-atlantic-salmon-farming-180968600/.

Turner, J. (2013). Disciplinary Engagements with Prisons, Prisoners and the Penal System. *Geography Compass*, *7*(1), 35–45.

Tveiten, H. (2017). Sterilisation breakthrough for farmed salmon. Retrieved October 23, 2019, from Nofima website: https://nofima.no/en/forskning/naringsnytte/sterilisation-breakthrough-for-farmed-salmon/.

Undercurrent News. (2016, July 28). Grieg still ‘very far’ away from production in Newfoundland. *Undercurrent News*. Retrieved from Undercurrent News website:

https://www.undercurrentnews.com/2016/07/28/grieg-still-very-far-away-from-production-in-newfoundland/.

Volpe, J., & Shaw, K. (2008). Fish Farms and Neoliberalism: Salmon Aquaculture in British Columbia. In *Environmental Challenges and Opportunities: Local-Global Perspectives on Canadian Issues* (pp. 131–158). Toronto, ON: Emond Montgomery Publications.

Wangersky, R. (1999, June 19). Province tightens safety net: Beefed up "code of containment" to be instituted. *The Telegram*, p. 4.

Warnier, J.-P. (2007). *The pot-king: The body and technologies of power*. Leiden and Boston, MA: Brill.

Warnier, J.-P. (2010). Inside and Outside: Surfaces and Containers. In C. Y. Tilley (Ed.), *Handbook of material culture* (pp. 186–195). Los Angeles, CA: SAGE.

Whiffen, G. (1998a, December 11). Province gets into aquaculture: Efford says government took over SCB Fisheries Ltd. To save 200 jobs. *The Telegram*, pp. 1–2.

Whiffen, G. (1998b, December 12). Monitor investments: Failure to check out struggling aquaculture company led to province having to jump in to save industry, says Byrne. *The Telegram*, p. 3.

Whiffen, G. (1999, April 27). Bay d'Espoir operation back in the swim. *The Telegram*, p. 4.

White, L. (2019, March 8). Letter: Open-net pen aquaculture is a failed technology. *The Telegram*. Retrieved from The Telegram website: https://www.thetelegram.com/opinion/local-perspectives/letter-open-net-pen-aquaculture-is-a-failed-technology-338876/.

Wolfe, C. (2013). *Before the Law: Humans and Other Animals in a Biopolitical Frame*. Chicago,MI: University of Chicago Press.

Wringe, B. F., Jeffery, N. W., Stanley, R. R. E., Hamilton, L. C., Anderson, E. C., Fleming, I. A., … Bradbury, I. R. (2018). Extensive hybridization following a large escape of domesticated Atlantic salmon in the Northwest Atlantic. *Communications Biology*, *1*(1).

Young, N., & Matthews, R. (2010). *The aquaculture controversy in Canada: Activism, policy, and contested science*. Vancouver, BC: UBC Press.

Appendices

Appendix I: Information document interviews

Dear [name potential participant],

My name is Ignace Schoot and I am a Dutch MA-student in the Department of Geography at Memorial University of Newfoundland. I am conducting a research project called "Net-Pen Technologies in Salmon Aquaculture" for my master's degree. My supervisors are Dr. Mario Blaser and Dr. Charles Mather. I send you this email in the context of this research.

I specialize in the subdiscipline that is called 'Science, Technology and Society' (STS). This field consists of social scientists that study sciences and technologies in place and in context. The focus of people working in this field is on understanding how technologies work in particular places and times. Methods that are used involve interviews with different people involved in the particular technologies, but also reading relevant documents, and conducting so-called "participant observation", or extensive visits to relevant places.

In my research project, I focus on technologies that have to do with the net-pens in salmon aquaculture. The questions that I try to answer are:

- When and how do net-pens work?
- When and how can net-pens fail?
- What work is required to keep net-pens working and holding together?
- How have net-pens been developed, designed, made, and repaired over time?

In order to answer these questions, I will visit relevant places and interview people engaged with salmon aquaculture in a variety of ways (e.g. people working at salmon aquaculture facilities, technicians, divers, maintenance workers, ecologists, DFO scientists, government officials, engineers, and designers).

In the context of this research, I would like to speak with someone who has experiences with [specific sentence, depending on potential participant]. [sentence on how I ended up emailing this person/who gave me their contact details]. Would you be willing to participate in an interview in which you will be asked about your experiences and knowledge regarding current and historical practices around net-pen technologies in salmon aquaculture? Such an interview will take approximately one hour, and can be conducted at a place and time that suits you best. [potentially: details when I will be in a certain town etc.].

[In case of request for participant observation:] Furthermore, I wonder if it is possible to visit and watch the activities at your farm [or other relevant place]. I am also willing to lend a hand if requested, as to not only be observing, but also participating and helping out.

Participation in this study is totally voluntary and in no way required or expected. It is not a job or government requirement. Responses and notes will be kept confidential and not shared with peers, superiors or community members.

If you are interested in participating in this study, please contact me and we can arrange a meeting time and place.

In case of any questions or concerns about me or my project, please contact me by email at ijgschoot@mun.ca, or by phone at (709) 689-7333.

If you know anyone who may be interested in participating in this study, you are welcome to give them a copy of this information.

Thank-you in advance for considering my request,

Ignace Schoot

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as your rights as a participant, you may contact the Chairperson of the ICEHR at icehr.chair@mun.ca or by telephone at 709-864-2861.

Appendix II: Consent form interviews

MEMORIAL
UNIVERSITY

Informed Consent Form for Research
Net-Pen Technologies in Salmon Aquaculture

Researcher: Ignace Schoot, MA-student in Geography, Memorial University of Newfoundland, St. John's, Newfoundland, Canada, A1C 5S7, ijgschoot@mun.ca, (709) 689-7333

Supervisors: Dr. Mario Blaser, Memorial University of Newfoundland, mblaser@mun.ca, (709) 864-6116

Dr. Charles Mather, Memorial University of Newfoundland, cmather@mun.ca, (709) 864-8193

You are invited to take part in a research project entitled "Net-Pen Technologies in Salmon Aquaculture."

This form is part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. It also describes your right to withdraw from the study. In order to decide whether you wish to participate in this research study, you should understand enough about its risks and benefits to be able to make an informed decision. This is the informed consent process. Take time to read this carefully and to understand the information given to you. Please contact the researcher, Ignace Schoot, if you have any questions about the study or would like more information before you consent.

It is entirely up to you to decide whether to take part in this research. If you choose not to take part in this research or if you decide to withdraw from the research once it has started, there will be no negative consequences for you, now or in the future.

Introduction:

My name is Ignace Schoot and I am a MA-student in the Department of Geography at Memorial University of Newfoundland. As part of my Masters thesis, I am conducting research under the supervision of Dr. Mario Blaser and Dr. Charles Mather. This research is funded through the Ocean Frontier Institute (OFI).

Purpose of Study:

This research project is part of a subdiscpline of Geography, called 'Science, Technology and Society' (STS). This field consists of social scientists that study sciences and technologies in place and in context. The focus of people working in this field is on understanding how technologies work in particular places and times. Methods that are used involve interviews with different people involved in the particular technologies, but also reading relevant documents, and conducting so-called "participant observation", or extensive visits to relevant places.

In my research project, I focus on technologies that have to do with the net-pens in salmon aquaculture. The purpose of the research is to try and understand how net-pen technologies in the salmon aquaculture sector work, by answering these questions:

- When and how do net-pens work?
- When and how can net-pens fail?
- What work is required to keep net-pens working and holding together?
- How have net-pens been developed, designed, made, and repaired over time?

This research will, on the one hand, contribute to nuancing and deepening public debates around salmon aquaculture, while on the other hand to debates within the field of Science and Technology Studies, concerning the role of technology in aquaculture and other practices.

What You Will Do in this Study:

You are being asked to participate voluntarily as an interview participant as part of the research project outlined above.

Length of Time:

The estimated time for interviews is about an hour. Interview times may vary between participants. You may choose to end the interview or withdraw your participation at any time.

Withdrawal from the Study:

You may withdraw from the study at anytime before, after, or during the interview process without consequence. You have the right to ask that recorders be turned off during an interview and that sections or the entirety of a recording be deleted. Data may be altered or destroyed, or the conditions of its use altered (for instance, made anonymous) until March 1st, 2019, according to the wishes expressed by the participant, regardless of previous representations of consent and with no consequences for the individual participant. To express these wishes, you are asked to send an email to the PI, Ignace Schoot. After this, writing and analyzing will have started, and withdrawing is impossible or impracticable. However, when the deadline has past, you are still able to send an email and make your wishes clear, after which the PI will seriously try in good conscience to meet your requirements. In all cases, withdrawal or participation is a confidential matter and will not be shared with other participants or organizations.

Possible Benefits:

You will have the opportunity to share your experience, knowledge and understanding of practices around net-pen technologies in salmon aquaculture. By participating in the project, you will contribute to efforts to bring extra nuance and depth to debates around salmon aquaculture. The project will add to knowledge and debates in the field of Science and Technology Studies, about for example the role of technologies and aquaculture practices. Results will be shared in both public and scholarly forums.

Possible Risks:

The topic of net-pen technologies in salmon aquaculture has recently been the subject matter of heated debates. Indeed, some people may consider net-pen technologies in sea-based salmon aquaculture to be a controversial issue. As such, participation in the study may present some emotional and social risks, including: feeling uneasy or nervous to speak about the topic; being concerned about harm caused to employment or social relations by participating in the study; feeling your work or concerns are misunderstood by the research project. While these risks may not be avoided entirely, this study actively seeks to mitigate these risks by:

(1) making clear that this project aims to learn to the actual technologies and practices that net-pens consists of;
(2) stressing that the research project is not in the service of either side in debates about salmon aquaculture;

(3) emphasizing that participation in the study is entirely voluntary, and not required by your place of employment, or role in any community;
(4) making clear that you can skip or decline any questions that you do not wish to answer;
(5) allowing you to participate anonymously and to redact potentially identifiable information as you see fit;
(6) allowing you to suggest interview locations so that these may occur in places you feel most comfortable;
(7) allowing withdrawal from participating in the research project.

Confidentiality:

The ethical duty of confidentiality includes safeguarding participants' identities, personal information, and data from unauthorized access, use, or disclosure.

If you agree to participate, you may decide whether you want your name published with your responses or to be left anonymous. If you do not provide a name, we will refer to participants using generic terms or using a pseudonym. Some identifying information may come up in conversation (e.g. place of work, job title, communities lived in) and therefore may be included in our results unless you tell us not to. Based on this information, it is possible that people may identify you even if you do not give your name.

The student researcher will be responsible for transcribing the interviews, which will be stored on a locked computer. No further use or distribution of these interviews or transcripts is contemplated without obtaining further written consent from individual participants themselves. You will be provided with a final approved version of your interview transcript for your personal records.

Anonymity:

Anonymity refers to protecting participants' identifying characteristics, such as name or description of physical appearance. All research participants will be given the opportunity to participate anonymously or with their given names. Identifying characteristics (e.g. birthdate, age, description of physical appearances) will not be recorded.

Our purpose is not to collect private information on the interviewees. However, given there is a relatively small number of people involved in salmon aquaculture in Newfoundland, certain topics that come up in our conversation could indirectly identify you. This includes your type of involvement related to salmon aquaculture (e.g. scientist, diver, or manager of a salmon aquaculture facility), or an occupation that is easily traceable to a certain institution (e.g. DFO or Memorial University). You will be given the opportunity to read and redact transcripts, including indirectly identifiable information after being interviewed. While a small number of questions may address personal involvement or knowledge (i.e., what is your involvement in salmon aquaculture?), in all cases the emphasis will be on the issue of net-pen technologies in salmon aquaculture and not your personal and private life.

No directly identifiable information will appear in any publication unless indicated otherwise by participants (e.g. if they indicate they would like their names attributed to quotes). Publication may include indirectly identifiable information as they come up in conversation, such as stakeholder affiliation, or institution working for.

Every reasonable effort will be made to ensure your anonymity. You will not be identified in publications without your explicit permission.

Recording of Data:

Interviews will be recorded using an audio recorder unless otherwise indicated by the participant.

Storage of Data:

Only Ignace Schoot and his supervisors will have access to interview responses. The primary researcher and his supervisors will securely store interviews and transcripts on password-protected computers during and after the project. Only the researcher and his supervisors will have access to these computers. Data will be kept for a minimum of five years, as required by Memorial University's policy on Integrity in Scholarly Research.

Reporting of Results:

The information collected during the interview will be used for the above project only. These uses will include a written thesis, academic publications, conferences, and public communication of results (e.g. in blog posts or newsletters). Upon completion, my thesis will be available at Memorial University's Queen Elizabeth II library, and can be accessed online at: http://collections.mun.ca/cdm/search/collection/theses.

Sharing of Results with Participants:

You will be sent a copy of the transcript. Moreover, you will be provided notice and copies of publications (where relevant) and will be provided with a copy of the thesis that will be a result of this project. Results will also be communicated through non-academic presentations, and reports. Results will also be shared via a project website to be created in the near future.

Questions:
You are welcome to ask questions at any time before, during, or after your participation in this research. If you would like more information about this study, please contact:

- Ignace Schoot, MA-student, Memorial University, ijgschoot@mun.ca, (709) 689-7333
- Dr. Mario Blaser, Memorial University, mblaser@mun.ca, (709) 864-6116
- Dr. Charles Mather, Memorial University, cmather@mun.ca, (709) 864-8193

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861.

Consent:
Your signature on this form means that:

- You have read the information about the research.
- You have been able to ask questions about this study.
- You are satisfied with the answers to all your questions.
- You understand what the study is about and what you will be doing.
- You understand that you are free to withdraw participation in the study without having to give a reason, and that doing so will not affect you now or in the future.
- You understand that if you choose to end participation **during** data collection, any data collected from you up to that **point will be destroyed**.
- You understand that if you choose to withdraw **after** data collection has ended, your data can be removed from the study up to March 1st, 2019.

I agree to be audio-recorded ☐ Yes ☐ No

I agree to the use of direct quotations ☐ Yes ☐ No

I allow my name to be identified in any publications resulting from this study ☐ Yes ☐ No

By signing this form, you do not give up your legal rights and do not release the researchers from their professional responsibilities.

Your Signature Confirms:

- ☐ I have read what this study is about and understood the risks and benefits. I have had adequate time to think about this and had the opportunity to ask questions and my questions have been answered.
- ☐ I agree to participate in the research project understanding the risks and contributions of my participation, that my participation is voluntary, and that I may end my participation.
- ☐ A copy of this Informed Consent Form has been given to me for my records.

______________________________ ______________________________

Signature of Participant Date

Researcher's Signature:

I have explained this study to the best of my ability. I invited questions and gave answers. I believe that the participant fully understands what is involved in being in the study, any potential risks of the study and that he or she has freely chosen to be in the study.

______________________________ ______________________________

Signature of Principal Investigator Date

Appendix III: Interview guide

In my research project, I interviewed, what I call, "salmon aquaculture containment experts", people involved or engaged with practices around containment in salmon aquaculture – in particular in Newfoundland -, e.g. technicians, divers, maintenance workers, ecologists, DFO scientists, government officials, engineers, designers and fish farmers.

As different participants have different roles and perspectives towards the containment practices, I did not ask all of my informants the same questions. I tailored the questions to the individual participant and their role and perspective. For this reason, I did not have a rigid interview script. However, questions mainly focused on the four questions that lead my research project:

- When and how do net-pens work?
- When and how can net-pens fail?
- What work is required to keep net-pens working and holding together?
- How have net-pens been developed, designed, made, and repaired over time?

Following are some examples of the kind of questions I asked:

- How are you involved in net-pen technologies in salmon aquaculture?
    - What does your role entail?
    - Can you describe the activities you engage in?
    - Where do these activities take place?

- Can you describe me how net-pens work?
    - How are net-pens built?
    - Where do the designs, rules, regulations, and technologies come from?
    - What are the things that need to be kept in and kept out?
    - What happens with the things that are not kept in the net-pen?
    - What does the maintenance of nets entail?
    - What are the challenges related to keeping/having net-pen technologies do their work?

- Can you describe possible ways in which net-pens can fail?
    - When is something perceived as a failure?
    - How are net-pens repaired?

- What kinds of tensions, if any, exist regarding net-pen technologies?
    - In your role, what concerns do you have, if any, about net-pen technologies?
    - How do you address these concerns?
    - What constraints exists to addressing these concerns?
    - How do you deal with those?

  - What kind of, if any, scientific/technical/political/practical controversies or discussions are happening regarding net-pen technologies?
  - What are these discussions about, and how have they developed?

- Have practices (maintenance, repair, design, usage, regulations) concerning net-pen technologies changed throughout your lifetime?
  - In what ways?
  - What are the effects of this?

Appendix IV: Information document participant observation

My name is Ignace Schoot and I am a Dutch MA-student in the Department of Geography at Memorial University of Newfoundland. I am conducting a research project called "Net-Pen Technologies in Salmon Aquaculture" for my master's degree. My supervisors are Dr. Mario Blaser and Dr. Charles Mather. In the context of this research I will be conducting so-called "participant observation" at [fill out name facility]. This means that I will be visiting and watching the activities at the farm [or other relevant place] and lending a hand if requested, as to not only be observing, but also participating and helping out.

I specialize in the subdiscipline that is called 'Science, Technology and Society' (STS). This field consists of social scientists that study sciences and technologies in place and in context. The focus of people working in this field is on understanding how technologies work in particular places and times. Methods that are used involve interviews with different people involved in the particular technologies, but also reading relevant documents, and conducting so-called "participant observation", or extensive visits to relevant places.

In my research project, I focus on technologies that have to do with the net-pens in salmon aquaculture. The questions that I try to answer are:

- When and how do net-pens work?
- When and how can net-pens fail?
- What work is required to keep net-pens working and holding together?
- How have net-pens been developed, designed, made, and repaired over time?

In order to answer these questions, I will visit relevant places and interview people engaged with salmon aquaculture in a variety of ways (e.g. people working at salmon aquaculture facilities, technicians, divers, maintenance workers, ecologists, DFO scientists, government officials, engineers, and designers).

It is in the context of this research that I will be visiting the farm for the next [period of time].

[Name of person/organisation] has given permission to conduct this participant observation. However, participation in this study is totally voluntary and in no way required or expected by your occupational or other position. Types of information recorded will only pertain to the purpose of answering my research questions, i.e. understanding how net-pens work and are made to work in place and in context. If there is specific information you do not want to be recorded or if you do not want to be documented for research purposes, please let me know. This can be done privately and confidentially in person, through telephone (709 689 7333) or through e-mail (ijgschoot@mun.ca). This will have no negative consequences.

I will hopefully see you all soon somewhere at the facility. I look forward talking to you and learning about net-pens and the ways in which salmon aquaculture works in practice.

Ignace Schoot